

IMPROVING CUSTOMER SATISFACTION THROUGH PERSONALIZATION

MASTER THESIS

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Business Information Technology
*Faculty of Electrical Engineering,
Mathematics and Computer Science*

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FOREWORD

Whatever you do, work at it with all your heart, as working for the Lord, not for men (Col. 3:23, NIV)

Dear reader,

You are currently reading the result of eight months of research work, which concludes my Master Business Information Technology. Unfortunately, this version of the thesis is not personalized. If it was, this thesis would suit exactly to your needs, whether you are an interested family member or friend, an employee of NS, one of my supervisors or somebody wanting to apply personalization in his or her company.

As is the case in the majority of graduation assignments, the first phase of the research described in this thesis was very foggy and cost a lot of effort. The field of personalization is very broad and a lot of research directions were possible. Also, it was challenging to determine a balance between scientific rigour and practical application. When that balance was found, the work progressed much faster and became more enjoyable as well. In the end, I can look back on a satisfying journey towards the result you are currently reading: my Master's thesis.

This would not have been possible without the support and feedback of my supervisors. Hans and Marten, thanks to you for being critical and challenging me to think a few steps ahead, even though sometimes it was hard to find a timeslot in which we could meet. Jos and Robin, thank you for showing and explaining me the ins and outs of the NS environment and helping me to apply my research at NS. I am grateful for the numerous colleagues at NS that helped me by giving feedback and using their expertise to validate my theories. Also, I greatly enjoyed the contact with my colleagues from VM. The daily lunch walks through Utrecht enabled a fresh start of the afternoon and the atmosphere was very positive!

Finally, I want to thank my family and friends, in particular my wife Annet, for supporting me.

Hopefully you will enjoy the reading!

A.W. van den Berg



EXECUTIVE SUMMARY

From the owner of the grocery shop around the corner to the search results of Google: personalization is found in all facets of society. In this thesis, personalization is applied on the online services of the Dutch Railways (NS), in order to improve the customer satisfaction regarding those services. More specifically, personalization is used to reduce customer effort, which is an indicator of customer satisfaction.

Using a literature study and real-world case studies, background information about personalization is retrieved and summarized. A design science approach is used to redesign two online services, in order to reduce customer effort. The redesign is demonstrated and validated to estimate its effects on customer effort, and analyzed to determine its impact on the IT landscape of NS. Finally, findings from both literature and the redesign analysis are synthesized to define generic impact factors of personalization on the IT of a company.

The literature study and case studies led to several conclusions about the effects and methods of personalization. Furthermore, literature regarding personalization was found in some ways to be subjective and biased, which leads to recommendations with respect to future scientific research.

The main conclusion is that NS should personalize its online services through layered authentication, by which services can be offered at three authentication levels. At each authentication level, the services have specific characteristics and the customer is encouraged to increase his authentication level. For users that are not logged in, services should be simple and accessible. For users that have created and are logged into their account, services should be fluent and personal by remembering personal customer information and previous behaviour. When customers have connected their OV-chipkaart to their account, services should be extensive and pro-active: customers that have fully authenticated themselves can receive the most personalized services.

Expert validation is used to conclude that the usage of layered authentication lowers the customer effort regarding the redesigned online services. Also, the redesign will cause customers to transfer from using offline channels to using online channels for the services of NS. Thirdly, the layered authentication approach will result in a higher percentage of customers being identified online, which positively affects the possibilities of NS to personalize customer interactions. Because experts were not able to precisely guess to which extent the redesign would improve the current situation, the conclusions cannot be quantified, which is a limitation of the redesign validation.

The impact on NS's IT of the changes caused by introducing layered personalization is analysed at two levels: an architectural and a processual level. A baseline and target architecture are designed and a gap analysis is done. The biggest change at the architectural level consists of introducing an Identity and Access Management (IAM) system, which identifies and authenticates customers across all online channels and provides channels with customer information so that they can authorize those customers. At a processual level, many small changes are identified to adapt business processes to the usage of layered authentication. Most changes are related to the front-end systems, which take care of the customer dialogue in multiple service variants.

The generic impact of personalization on the IT of a company is summarized by four factors. Firstly, when applying personalization, companies need data integration and analytics capabilities because customer data is the basis of personalization. Secondly, identity and access management is needed to consistently recognize customers in order to provide personalized services. Thirdly, the service architecture of a company needs to be adaptable to be able to handle changes in channels, services or available customer data. Fourthly, applying personalization increases the complexity of a company's IT landscape, which can be reduced using several techniques.

In the future, personalization, especially via smartphones, will be crucial to offer mobility as a service, which includes a personal journey for every traveller. To enable cross-channel and cross-functional personalization, NS should establish a personalization program, in which personalization scenarios are tested and implemented using pilot projects.

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1 INTRODUCTION

1 INTRODUCTION

In this chapter, the research is introduced. First, the concept of personalization and the situation of NS are introduced. Then, the research motivation and scope are stated. After this, the definition of personalization is given, related terms are clarified and the research questions are stated. Finally, an overview is given of the remainder of this thesis.

1.1 INTRODUCTION TO PERSONALIZATION

Personalization, the tailoring of products and services to make them more relevant for the customer, has received a lot of attention in the past few years. US marketing professionals identify personalization as the most important future area to their company's marketing moving forward (Marketing Charts, 2014). Consumers also appreciate personalization: "The majority of consumers want to be recognized and expect personalized experiences across channels and devices" (MyBuys, 2014). The popularity is rising because the possibilities of data collection, analysis and personalization are increasing rapidly. With Big Data technologies, companies suddenly have the possibility to analyze every customer contact and draw conclusions from it in a systematic way. Kurt Schlegel, research vice-president at Gartner, said that "offering customers a highly personalized level of service will be among the key trends of 2014 for many firms when it comes to determining their big data strategies" (Kognitio, 2014).

In the good old days of the local grocery shop around the corner, analog personalization was already present: when a regular customer would walk in, the shop owner would recognize him, greet him and, possibly, tell him about the new magazine he knew the customer would like. If the regular customer would then go to the bar next door, the bar keeper would pour a whisky on the rocks – his favorite drink, without him needing to ask for it. Later, manufacturers used mass customization to produce products at a large scale, while still offering varying products to account for differences between their customers (Gilmore & Pine II, 1997). While in the beginning of the 20th century, Henry Ford stated that "any customer can have a car painted any colour that he wants so long as it is black", currently, almost every detail of a car can be adapted to a customer's desires.

In the digital age, personalization is applied even more often. Google analyzes search history and the search data of similar customers to offer personalized search results to each customer (Hannak et al., 2013). AirBnB offers the searching customer the rooms and houses he will most likely accept. Recently, they have introduced a new feature which also takes into account the renter's preference in the sorting algorithm. If the customer is a 21-year old guy from Germany and the renter has often rejected those kinds of people before, the house of that renter will be placed lower in the search results because of that (Ifrach, 2015). At numerous other services, like LinkedIn, Bol.com, Facebook, Spotify and Amazon, recommendations are personalized so that your past preferences are taken into account when recommending things to buy or people to connect with.

1.2 NEDERLANDSE SPOORWEGEN

The Dutch Railways (Dutch: Nederlandse Spoorwegen, abbrev. NS) are responsible for a large part of the passenger train transport in the Netherlands: in 2013, the passengers of NS travelled more than 16 billion kilometers together (Nederlandse Spoorwegen, 2013). This is around 70 percent of the total Dutch public transport and almost 90 percent of the passenger transport by train (Kennisinstituut voor Mobiliteitsbeleid, 2015). All shares of NS are owned by the Dutch Government, but it is still a private company: NS was never nationalized. In the second half of the 20th century, NS received substantial subsidies from the Dutch Government because they were declared to be a company of national importance, especially in the years after the Second World War. However, more recently, the government decided there should be market competition in the rail sector and currently, the subsidies are not granted anymore.

This research is focused on the situation of Business Systemen, which is the IT-department of NS Commercie. NS Commercie (abbrev. as NSC) is the business department responsible for all activities related to customers. Among its responsibilities are marketing, sales, services related to season tickets, the information before, during and after

the train journey. There are many channels NSC can use to contact customers, such as the website, a smartphone application, customer service via telephone, post or the service shops and ticket machines at railway stations.

Business Systemen is divided into two sections: one section is responsible for the central services of NS, like the website, customer service via telephone or analog mail etc. Central services are services that are centrally deployed: the website is centrally hosted, the help desk is in one certain place. Another section is responsible for the decentral services, like the vending machines and service desks at the railway stations and the travel information at the stations and inside the trains.

This research is requested by the part of Business Systemen that is concerned with the central services of NS Commercie, and therefore, this research will focus on those central services.

An overview of the central services of NS can be found in Appendix C. More information about the different departments involved in this research can be found in section 2.5.

1.3 RESEARCH MOTIVATION

Customers are not very satisfied with the services NS is offering. For example, the website of NS is currently rated a 5.8 out of 10 by its visitors, compared to a rating of 7.6 out of 10 for Customer Service via telephone (MarketResponse, 2015). Also, when compared with a benchmark for American insurance and bank websites, the website of NS scores a lot lower than the average, which is 8.0 out of 10 (The American Customer Satisfaction Index, 2014). Results of research about personalization indicate that customers perceive personalized services as more useful (Liang, Chen, Du, Turban, & Li, 2012). Personalization could be a way to improve the customer satisfaction of the central services of NS, but research is needed to confirm this and identify best ways to do this.

Personalization offers a lot of opportunities to distinguish between (types of) customers and serve them in a way they would like to be served. It is especially relevant for NS, because NS has a heterogeneous group of customers, from all ages, with different travelling patterns and motivation, having different levels of digital literacy (van Hagen, 2009).

Within NS, the importance of personalization for the improvement of its services is recognized. At some points, personalization is already applied or being tested. For the actual train journey, a set of six personas was constructed that describe how people experience the train journey and how they want to be treated by personnel of NS, as can be seen in Figure 1. These personas are used to instruct train personnel as to how they should treat different kinds of passengers. Also, NS International is doing a number of pilots in which they test the effect of offering personalized content, based on e.g. previous behavior and the age of the customer. The central services of NS Commercie also have some personalized elements. For example, a customer relationship program is currently being tested, NS Extra, that gives small treats and discounts to regular customers. Also, service quality for those customers is improved by pro-actively giving them a refund when they have forgotten to check-out after a train journey. It is currently not clear which effects NS Extra has on customer satisfaction, revenue and cost efficiency. Recently, an external consultancy company formulated a vision on the future of NS customer service, in which personalization was one of the central terms. However, this was not made very concrete: NS knows that personalization would be very important and useful, but struggles to apply it in daily practice.

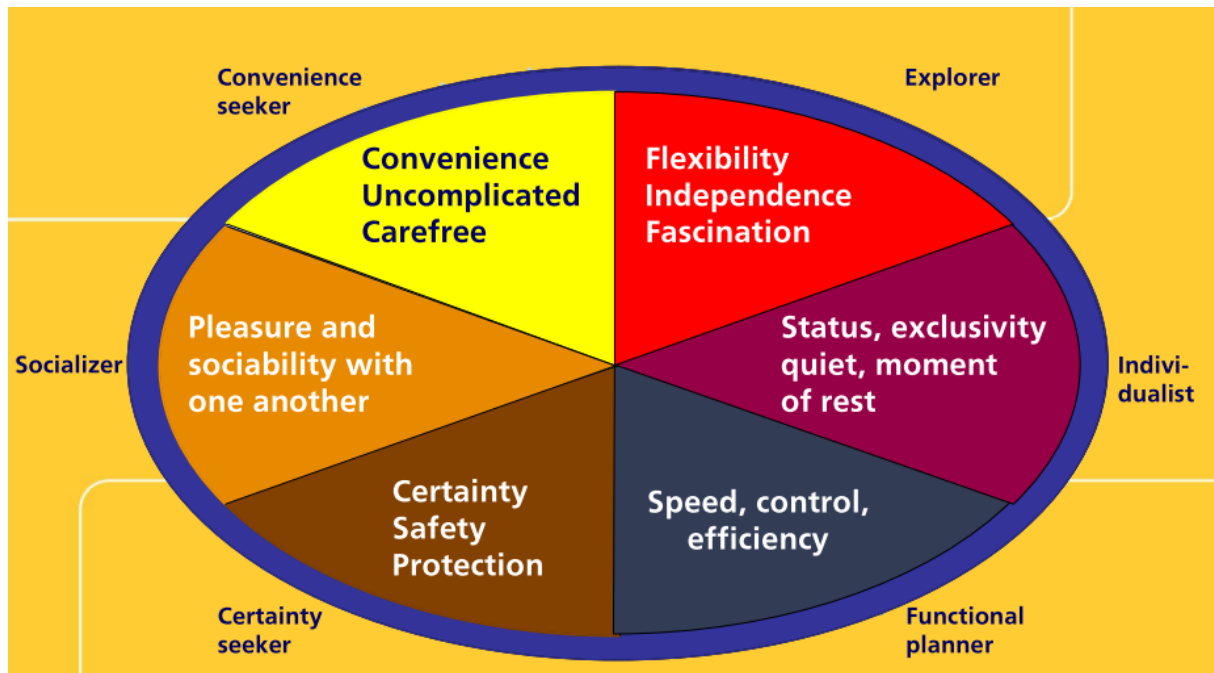


Figure 1 – Needscope personas (van Hagen, 2009)

However, the majority of personalization effort regarding the central services is incidental: there is no overarching vision on personalization. Also, there are a lot of ideas being brought up by NS employees, but there is not much insight into how those ideas would affect IT, nor is clear what the improvement effects of those ideas are on the goals NS has. There is a lot of buzz regarding personalization, but not much is currently done to actually implement it.

Therefore, research is needed into the application of personalization on the central services of NS. First, more knowledge is needed about how personalization can affect customer satisfaction and what other effects it has. Second, it is currently not clear how personalization can be applied and what can actually be personalized. Third, personalization can have a lot of impact on the IT of a company: those two subjects are thoroughly linked. McKinsey researchers state that IT makes personalization possible (Bughin, Chui, & Manyika, 2013). Research is needed into which changes into IT architecture and processes are needed to facilitate personalization.

1.4 SCOPE AND FOCUS

A well-defined research scope prevents the research becoming too broad in order to ensure enough depth. However, the research need not be too specific in order to ensure added research value: the research should be applicable to other situations as well.

The research scope is made more specific by choosing reduction of customer effort as an indicator for the increase of customer satisfaction, which is the final goal of applying personalization. Personalization is shown to reduce customer effort (Liang, Lai, & Ku, 2007). Customer effort is a reliable and accurate measure of customer satisfaction (Dixon, Freeman, & Toman, 2010).

The mentioned focus on central services of NS is still very broad: there are numerous channels via which central services are offered, such as email, physical mail, website and telephone. Therefore, the focus will be set to a more specific set of services, namely the publicly accessible online services: the services offered via the website and via a smartphone application. There are two reasons to choose this focus. First, the satisfaction with those services is lower compared to services on other channels (MarketResponse, 2015). Second, personalization is the most applicable and most widely applied on those channels: almost all literature about personalization is about personalization of the online channel (see chapter 5 for an overview of the relevant literature).

Knowledge will be gained on a theoretical, abstract, level by discussing the application of personalization on companies in general, as well as on more concrete, by showing how personalization can be applied in the situation of NS.

1.5 DEFINITION OF PERSONALIZATION

Personalization is used in a number of different research and applied fields, such as e-commerce, computer science, architecture, information science and social sciences (Fan & Poole, 2006; Vesanen, 2005). It has been an upcoming field in the past fifteen years. Definitions of personalization vary widely, dependent on the field and research goal of the authors defining personalization (Fan & Poole, 2006).

A general definition of personalization is given by the Personalization Consortium [document itself not available anymore, but cited by (Adolphs & Winkelmann, 2010; Fan & Poole, 2006; Koutsabasis et al., 2008; Liang et al., 2007; Vesanen, 2005)]: "Personalization is the combined use of technology and customer information to tailor electronic commerce interactions between a business and each individual customer." In this definition is spoken of interactions between a business and its customers, and not of a system. Also, the use of information about the customer and the technology is mentioned and personalization factors are not mentioned. However, electronic commerce is specifically mentioned as a field in which personalization is used. This is too narrow for this research, because buying and selling is not the only application field of personalization.

When the definition of the Personalization Consortium is made more general by removing the reference to electronic commerce, the definition is as follows:

Personalization is the combined use of technology and customer information to tailor interactions between a business and each individual customer.

This definition indicates the essence of personalization: the tailoring of interactions, without specifying how and why this happens, thus not limiting the execution of personalization to a specific way. Therefore, this is the definition that will be used in this research.

1.6 RELATED TERMS

The concept of personalization is often confused with **customization**. In this thesis, customization is seen as a way to achieve personalization. Personalization means making the product or service more relevant to the customer using information about that customer. Customization is a specific way to do that: using direct and explicit input from the customer, the product or service is tailored. In other words, customization is another term for explicit personalization (Fan & Poole, 2006; Piller, 2015).

Another term related to personalization, often used in the financial world, is **Know Your Customer** (KYC). KYC is used by banks and other financial institutions to determine the risk level of certain customers (Jones & Stahl, 2011). To do this, they gather and analyze all sorts of information about their (prospective) customers. This is similar to personalization, only the goal is not to provide relevant services or products, but to assess the risk related to certain customers.

Context-awareness is a frequently mentioned term used to indicate services using data from the context of the customer, such as time and location, to provide a personalized experience (Dey & Abowd, 1999). It is a subtype of personalization, because it specifically uses one type of data that is used as a basis for personalization.

1.7 RESEARCH QUESTIONS

The main research question is formulated as follows:

How can the online services of NS be personalized, so that customer effort is reduced, and how does that affect its IT?

The following sub-questions are identified:

RQ1. What is the effect of personalization on customer effort and what other effects does it have?

RQ2. What are the best ways to apply personalization?

RQ3. Which impact can personalization have on the IT of a company?

RQ4. How and to which extent does personalization affect the customer effort of the online services of NS?

RQ5. How can NS best personalize its online services in order to reduce customer effort?

RQ6. Which changes in IT architecture and processes are needed to apply personalization on the online services of NS?

The first two research questions will be answered via a literature study, questions three to five will be answered following a design science cycle and the last question will be answered via a generalization of the design science effort. More explanation about the research methodology will be given in chapter 3.

1.8 STRUCTURE THESIS

The structure of this thesis is based on the format defined by Gregor and Hevner (2013): Positioning and presenting design science research.

This chapter gives an introduction to the thesis, which consists of an introduction to personalization and the context of NS and the research motivation and questions.

In the second chapter, an extensive overview is given of NS, its goals and the services it provides to customers. From this context, a problem definition is derived, which will serve as the basis for the redesign, later in this thesis.

Chapter 3 describes the methodology with which the research is carried out. This research is primarily based on the Design Science Research Methodology defined by Peffers et al. (2008).

Chapters 4 and 5 consist of the results of a literature study done to gain more information about personalization. Chapter 4 focuses on the effects of personalization and the goals that companies can have to apply personalization. Chapter 5 focuses on how personalization can be applied and what categorizations can be made. Both chapters end with three case studies through which the theory found in literature can be validated against practice.

Chapters 6 and 7 are focused on the redesign that is central in this research. In chapter 6, the redesign process is described and the theory of initial and regular effort is defined. Chapter 7 describes the redesign, which applies layered authentication on the online services of NS. In more detail, two services are redesigned: refund in case of delay and travel history and card information.

In chapter 8, the redesign is demonstrated using HTML mockups and evaluated with experts from NS using semi-structured interviews and an online questionnaire.

The impact of personalization on IT is described in chapters 9 and 10. Chapter 9 does this for the redesign of NS's online services, described in chapter 7. In chapter 10, the general impact on IT is given for companies that want to apply personalization.

Chapter 11 contains a summary of the answers to the research questions and main conclusion. Furthermore, the research methodology is discussed, limitations and contributions of this research are stated and recommendations are given for science as well as for practice.

A close-up photograph of a middle-aged man with wavy, greyish-brown hair. He is wearing a dark navy blue suit jacket over a light blue pinstriped shirt and a red, white, and blue patterned tie. He is looking down and to his right with a slight smile. In his right hand, he holds a black mobile phone. The background is blurred, showing indistinct light and dark shapes. A solid blue banner with a thin yellow border at the bottom contains white text.

2 NEDERLANDSE SPOORWEGEN

2 NEDERLANDSE SPOORWEGEN

In this chapter, background information is provided about NS. This gives insight into the problem context of this research. First, the most important business goals of NS are listed. Then, an overview is given of the services NS currently offers and through which channels it offers them, after which some statistics are shown about NS's customers and their service usage. Finally, the most important problems are defined and an organization chart of NS is shown, containing the most relevant departments with respect to this research.

2.1 GOALS NS

To know if personalization is a suitable strategy for NS, knowledge is needed about the goals that NS has formulated. Therefore, documents of NS and of external parties about NS are reviewed to discover those goals.

2.1.1 STRATEGY NS

NS has formulated a strategy for 2014-2017 (Nederlandse Spoorwegen, 2014b). Core of this strategy is the customer focus: the customer is of utmost importance for NS. Average "ok" is not good enough and therefore, a specific focus is on the less performing services of NS: they should be improved first (Nederlandse Spoorwegen, 2014b). NS concretizes this strategy in their "Vervoerplan" (English: Transport plan) in which they state how they will operate in the next ten years and what the focus will be of future improvements. Key is that NS wants to treat its customers in an excellent way and provide outstanding service that corresponds with their needs, sometimes before they even know it themselves. According to the plan, NS will invest in online services so that customers can more easily use those services and the satisfaction will go up (Nederlandse Spoorwegen, 2015). NS creates the plan as a part of the concession for the use of the core rail network in the Netherlands and therefore, the Dutch Government can use the plan to review the performance of NS.

2.1.2 CUSTOMER SATISFACTION

Customer satisfaction is of utmost importance for NS. Not only because satisfied customers are often more loyal and will return more frequently to use the services of NS, but also because NS risks fines from the Ministry of Infrastructure and Environment when customer satisfaction is too low (Ministerie van Infrastructuur en Milieu, 2014). This fine could get up to €2.75 million per year and has recently been increased to a maximum of €6.5 million per year. In 2014, NS has had the maximum fine of €2.75 million (Nu.nl, 2015) because of the customer satisfaction regarding punctuality and the availability of seats during rush hour being too low. These fines are based on a number of performance indicators which have to be above a certain threshold. Among the performance indicators are: "general customer satisfaction", "analysis of customer insight research" and "analysis of customer service reports" (Ministerie van Infrastructuur en Milieu, 2014).

Customer satisfaction is also influenced by a number of services NS offers to customers, apart from the actual train journey. Examples of these services, which are offered by NS Commercie, are customer service by phone, email, regular mail and Twitter, refund with delays, refund when a customer forgets to check out, the website NS.nl and the personal portal Mijn NS.

Current customer satisfaction about online services is too low. This can be seen, for example, by looking at satisfaction and effort levels of the website of NS, coming from online customer satisfaction questionnaires by MarketResponse (2015). More information about satisfaction levels can be found in section 2.3. This low satisfaction level could be caused by the fact that the website is not tailored to the needs of specific groups of customers.

2.1.3 INTERNAL EFFICIENCY

Also, from the viewpoint of NS, the services are currently not as efficient as they could be. Customers should as often as possible choose for self-service, so that NS does not need to spend time on the delivery of that service. However currently, customers regularly choose a type of service in which NS-employees are actively involved. They need to spend time and effort on delivering the service to the customer, which costs NS money. In some cases, this face-to-face approach is desirable, for example with ticket inspectors in trains. However, in other cases,

like the processing of claims, employee involvement should be avoided as much as possible: automatically processing those claims will save costs. In the current situation, customer channels are often not connected and there is not one single view of the customer: it is dispersed across several information systems.

There is a need to improve the services of NS Commercie, so that the customer gets more satisfied and NS will work more efficiently, saving money in the process.

2.1.4 REVENUE

Like almost every other company, NS wants to increase its revenue, and eventually, its profit. Revenue is generated by selling train tickets, single as well as season tickets, to customers, but also by selling food, drinks and other items in shops at railway stations. NS Commercie, the primary stakeholder of this research, is involved with the train tickets. They are trying to find the optimal product portfolio so that customers can find products which suit them which causes as many as possible customers to travel by train and the revenue of NS to increase.

2.2 SERVICES AND CHANNELS NS

NS offers a number of central services via different channels. The services can be divided into three categories: Information, Sales and Service, all of which are related to different service goals. Informational services aim at providing information to customers, sales services are related to selling single and seasonal tickets and services from the Service-category aim at helping customers in different ways.

The channels NS communicates through can be divided into online and offline channels. Online channels use the internet to communicate. Examples of online channels of NS are the website, the smartphone application Reisplanner Xtra, social media like Twitter and email. Offline channels do not use the internet to communicate. Examples of offline channels of NS are analog mail, vending machines, paper forms and telephone.

Service examples for the three categories via the online and offline channels are displayed in Table 1.

	Information	Sales	Service
Online	Journey planner on smartphone application "Reisplanner Xtra"	E-ticket and season ticket sales via the web shop	Generating a travel history overview via Mijn NS
Offline	Travel information at a service desk in a railway station	Paper ticket sales at a vending machine	Paper form to claim refund in case of delay

Table 1 – Service examples at online and offline channels

NS currently applies personalization at some services and channels. Examples of personalization at NS in the current situation can be found in section 1.3. A full overview of the services, together with the channels they can be accessed through and the personas that use those services, can be found in Appendix C.

2.3 STATISTICS ABOUT SERVICE USAGE AND CUSTOMERS

To give an impression of the usage and satisfaction of the services and channels of NS, this section provides a graphical summary of statistics regarding those subjects.

2.3.1 TRAVELLER QUANTITIES

Figure 2 shows that there are almost 10 million travelers in the Netherlands, of which approximately 26 percent have a season ticket. Just 734.000 customers have a fully functioning Mijn NS account, to which an OV-chipkaart is connected. This is less than 30 percent of the people with a season ticket.

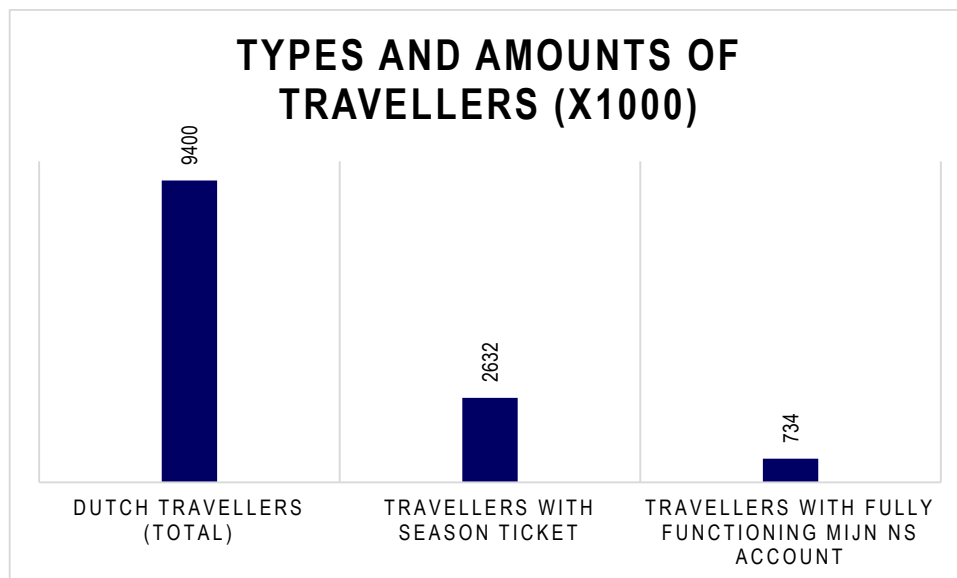


Figure 2 – Types and amounts of travellers

2.3.2 USAGE OF CHANNELS AND SERVICES

This section describes how and how often the channels and services of NS are being used. Figure 3 shows how often the contact channels are being used by customers. There are still a lot of calls to NS, but the digital channels like Twitter and Mijn NS are also used often.

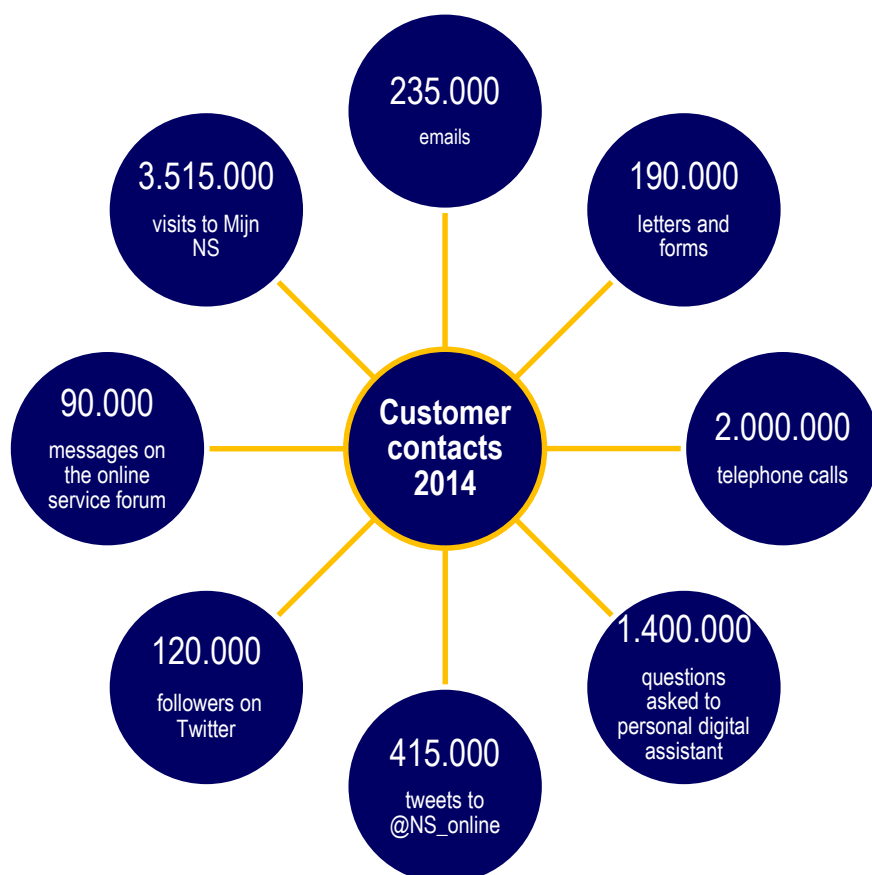


Figure 3 – Statistics regarding customer contacts in 2014 (Nederlandse Spoorwegen, 2014a)

In Figure 4 is shown how often the different elements of Mijn NS were visited in 2014. Personal travel history is by far the most visited part of Mijn NS, and the second most visited part is My Products, which contains information about season tickets and the OV-chipkaart. Customers rarely look at their claim history, probably because NS also communicates about the claim status via email.

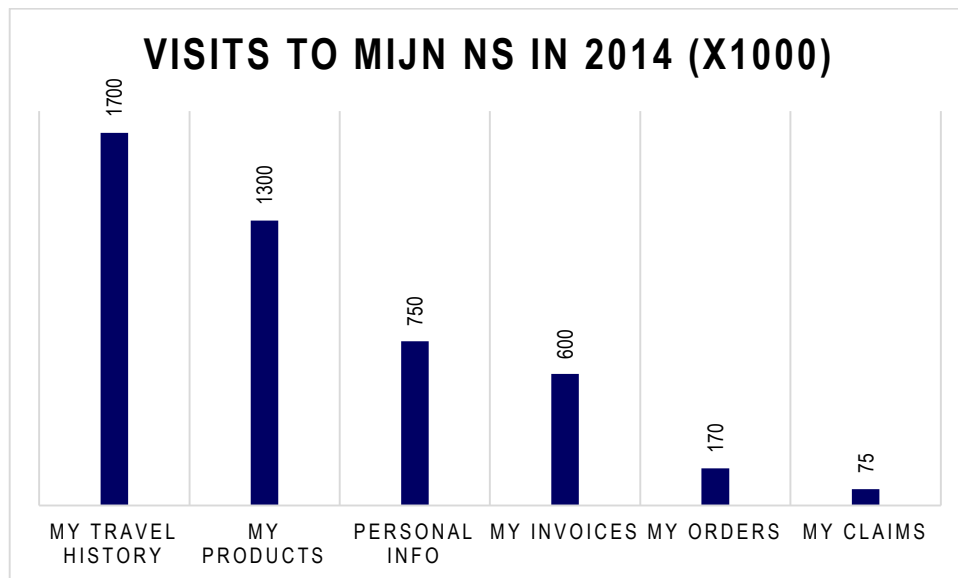


Figure 4 – Visits to Mijn NS in 2014 (Internal documents NS)

Every month, more than 160.000 customer calls are being made to Customer Service. As is shown in Figure 5, customers most regularly call to ask for information regarding e.g. journey planning. Also, a lot of telephone calls are being made about claims, when a customer experienced delay or in case of a forgotten check-in or check-out.

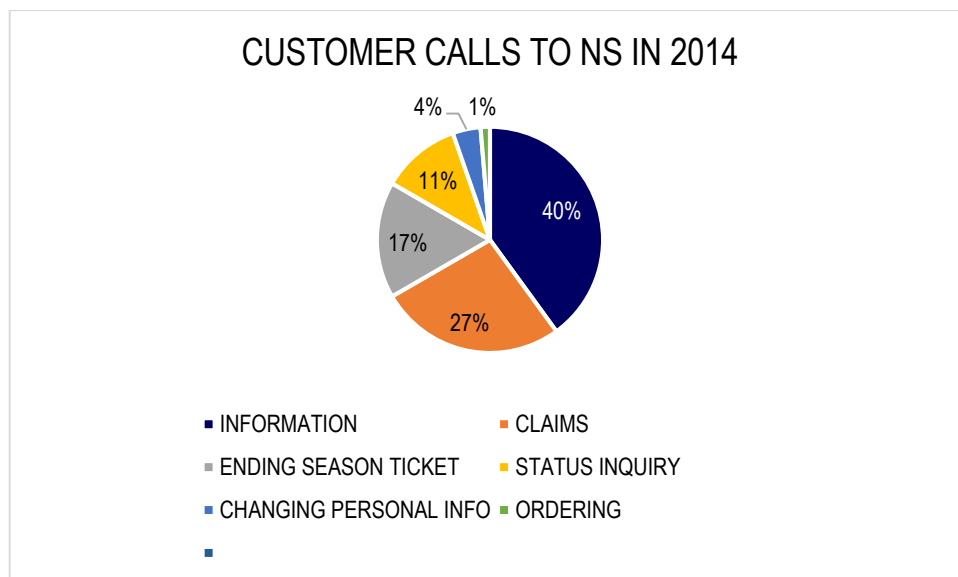


Figure 5 – Customer call statistics (Internal documents Customer Service)

In 2014, just over 335.000 claims were accepted that were filed by customers because of delay they had experienced. As can be seen in Figure 6, almost three-quarters of those claims was done online, via the travel history overview of Mijn NS. The offline option, via a paper form, was used almost 100.000 times.

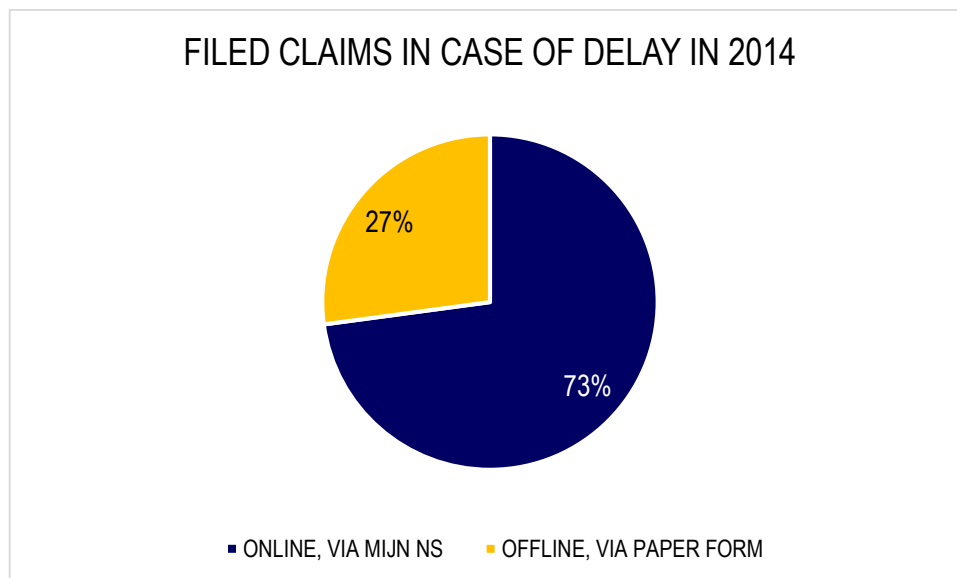


Figure 6 – Filed claims in case of delay in 2014 (Internal documents Customer Service)

2.3.3 SATISFACTION ABOUT CHANNELS AND SERVICES

In this section, statistics are presented with respect to the customer satisfaction regarding services of NS. Figure 7 shows how the customer satisfaction rate differs per contact channel, on a scale of 1 to 10. Overall, the customer satisfaction rate is 7.1. Personal channels like live chat and telephone are rated higher than average, and contact channels like email, website and service forum are only adequate. The website satisfaction rate is still acceptable because of high satisfaction regarding the online journey planner. Other parts of the website are rated lower. In Table 2, more extensive statistics are shown with respect to customer satisfaction and customer effort. Customer effort scores closely match the satisfaction scores.

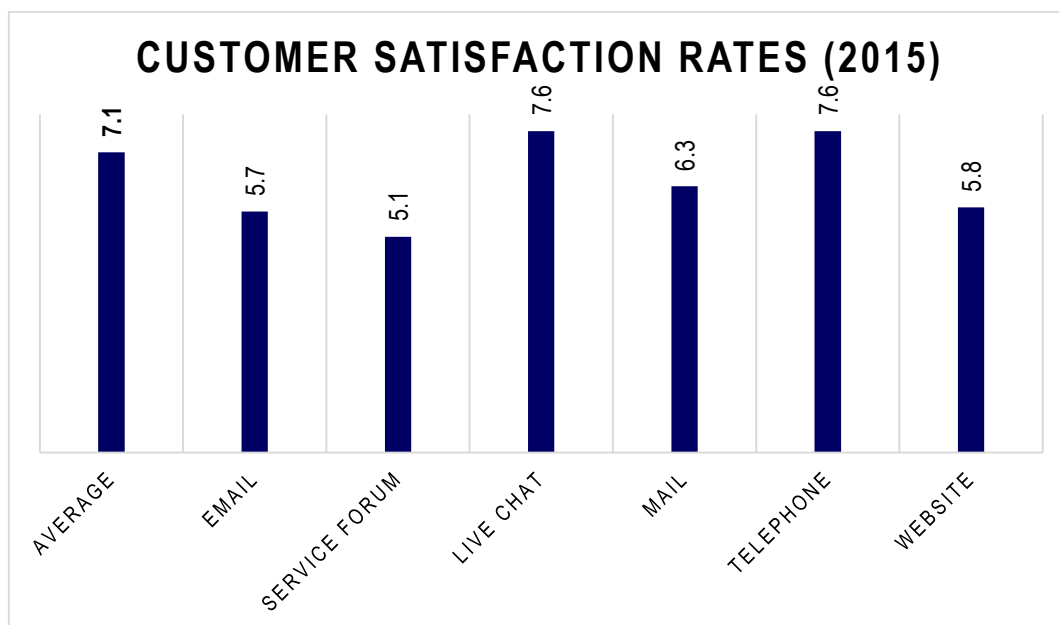


Figure 7 – Customer satisfaction rates per channel (MarketResponse, 2015)

	Satisfaction level				Effort score		
	Average	1-5 (low) (%)	6 (adeq.) (%)	7-10 (high) (%)	4-5 (high) (%)	3 (med) (%)	1-2 (low) (%)
All channels	7.1	21	6	73	28	18	54
Email	5.7	40	8	52	35	22	43
Service forum	5.1	49	10	40	51	18	31
Live chat	7.6	15	4	80	15	12	73
Mail	6.3	32	9	59	31	24	46
Telephone	7.6	14	5	80	24	18	58
Website	5.8	39	9	51	44	15	41

Table 2 – Statistics about customer satisfaction and effort per channel (MarketResponse, 2015)

The average customer satisfaction of bank and insurance websites of the United States was found to be 8.0 on a scale of 1 to 10 in 2014 (The American Customer Satisfaction Index, 2014), which is significantly higher than the satisfaction level of the website of NS, which is 5.8 on that scale.

2.4 PROBLEM DEFINITION

Analyzing previous statistics yields several observations. There is a relatively low customer satisfaction and a high customer effort score, especially the satisfaction and effort for online services is poor and should be improved. For the website, almost half of the customers indicate the service level is only adequate or below adequate.

This leads to a lower usage of the online channels and therefore, a higher usage of the offline channels, such as telephone, of which the satisfaction level is significantly higher. Offline channels are more expensive to maintain because employees need to invest more time into an offline service request: a call takes more time than approving a digital request. Therefore, the low customer satisfaction also leads to cost increase for NS. Unfortunately, due to data from other companies not being available, it is not possible to compare the ratio of online and offline contacts with other cases.

The principle of “Know Your Customer” is essential to every customer-oriented company (Jones & Stahl, 2011). NS also tries to do this. The online environment is suitable for this goal, when customers can be identified and their behavior tracked. However, of the total number of season tickets, only 24 percent is connected to a Mijn NS account and since Mijn NS is the only online place to use certain services, more than three-quarters of the season ticket holders do not have access to those services online and do not interact with NS in this way. NS customers are therefore not much engaged online. This is probably caused by the high customer effort score mentioned before.

Therefore, the problem in this research is defined as follows:

1. The customer effort score for online services of NS is too high, the customer satisfaction score is too low
2. Customers relatively use services much via offline channels compared to online channels
3. Only a small segment of users has an online account and is active with online services

2.5 ORGANIZATION CHART NS

There are several involved departments of NS that are influenced by this research. A graphical overview of those departments and their responsibilities is given in Figure 8. After that, the departments are explained more extensively.

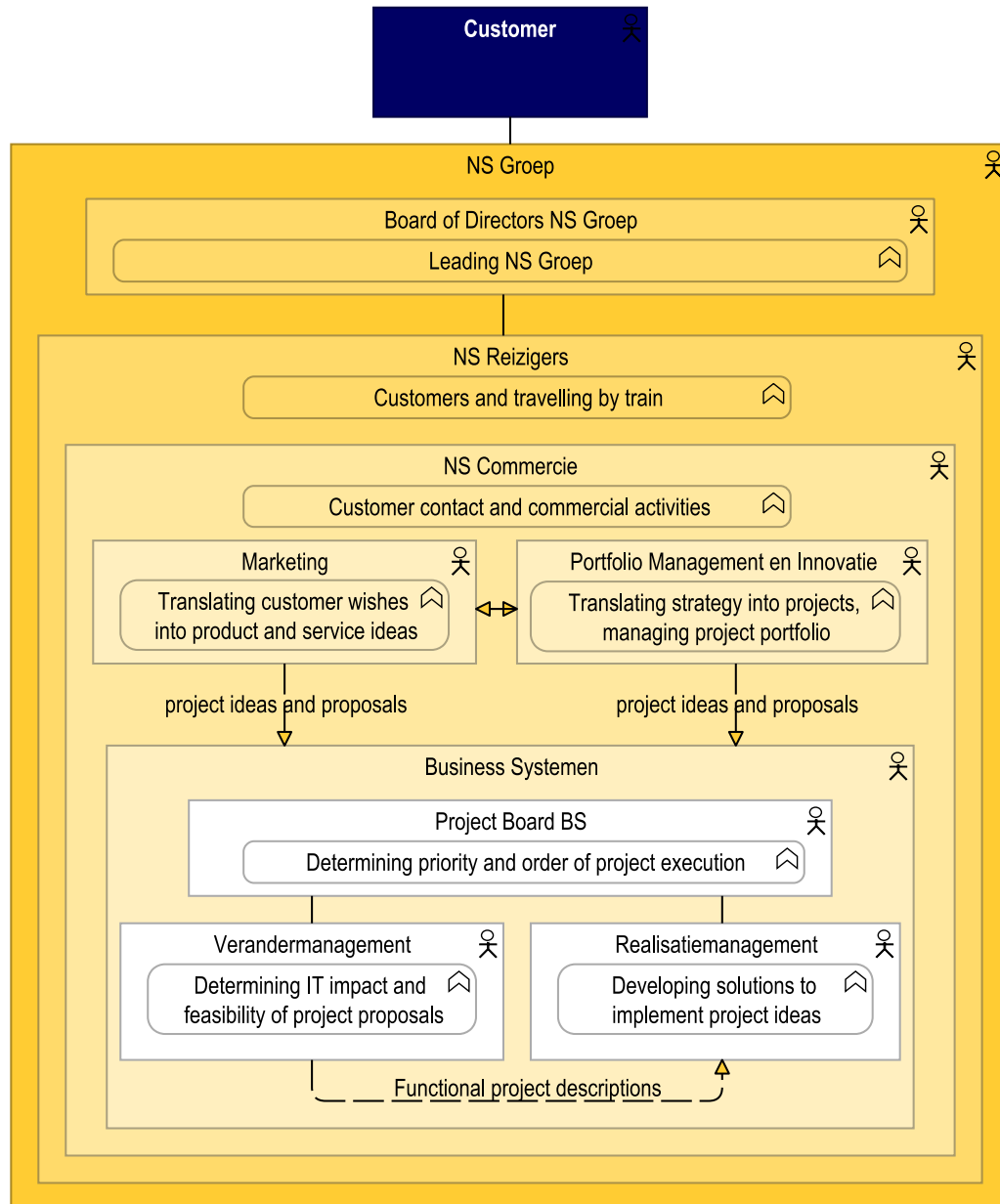


Figure 8 – Organization Chart of relevant stakeholders

Customers of NS (9.4 million in total) use the services NS provides. The group of NS customers is very diverse: characteristics like age and travel frequency vary widely.

The Board of Directors of NS oversees the activities of and is responsible for all departments of NS. Recently, a strategy was formulated in which the customer is given the highest priority and in which the Board of Directors states that less-than-average performing products and services should be improved (Nederlandse Spoorwegen, 2014b).

NS Reizigers (NSR, English: NS Travellers) is the department of NS concerned with travel and related subjects, like commerce, IT and finance.

NS Commercie (NSC, English: NS Commerce) is the department of NSR responsible for customer contact and commercial activities.

Portfolio Management & Innovatie (PMI), part of NSC, is responsible for generating new ideas that could improve services of NS, in line with strategy. They also check whether the idea is matching the goals of all stakeholders involved.

The **Marketing** department is also part of NSC and is concerned with selling products to customers: season tickets as well as non-recurring tickets.

Business Systemen (BS, English: Business Systems) is the IT department of NSC. It consists mainly of three sections: Verandermanagement (VM, English: change management), Realisatiemanagement (RM, English: realization management) and the Project Board. Their work can be described as follows:

VM is responsible for the translation of a concept or idea, which it receives from PMI and Marketing, into concrete impact analyses and fact sheets, which can then be developed by RM. It functions as the intermediary between business and IT. VM has commissioned this research and therefore it is marked in the organization chart of Figure 8.

RM translates deliverables from VM into concrete IT solutions. Those solutions are then developed, tested and launched.

The **project board** of BS reviews all proposed projects, decides with which initiatives to continue and how the initiatives are prioritized.



3 RESEARCH METHODOLOGY

3 RESEARCH METHODOLOGY

The following section describes which methodology is used to carry out the research. First, an order is given in which the research questions will be answered. Then, of every research question is specified how it is going to be answered using this research.

3.1 DESIGN PROBLEMS AND KNOWLEDGE QUESTIONS

The goal of this research is to find out how personalization can be applied to the situation of NS. Research problems can be classified into two categories, according to Wieringa (2010): design problems and knowledge questions. Design problems call for an actual change in the situation: a design of that change is the solution to the problem, but there can be many solutions that would fit. Knowledge questions are about the world as it is now, they ask for knowledge about it. When doing design science, one can iterate between knowledge questions and design problems: knowledge questions lead to design problems and the other way around.

The first three research questions are knowledge questions:

RQ1. What is the effect of personalization on customer effort and what other effects does it have?

RQ2. What are the best ways to apply personalization?

RQ3. Which impact can personalization have on the IT of a company?

All are asking questions about the world as it is and do not call for a change in that world.

The last three research questions are largely design problems, although parts of those questions consist of answering knowledge questions:

RQ4. How and to which extent does personalization affect the customer effort of the online services of NS?

RQ5. How can NS best personalize its online services in order to reduce customer effort?

RQ6. Which changes in IT architecture and processes are needed to apply personalization on the online services of NS?

Those questions are not about the world as it is, or about knowledge that is currently present. Answers to those questions can be provided by designing a way for NS to personalize its online services, and validating that design. Wieringa (2010) states that with design science research, one can iterate over the two different problem types. This research will also do this, by first answering the first two questions with use of literature, then answering the last three questions by doing design science research, then answering the third question by generalizing the outcomes from the IT impact-part of the design science research. This can be graphically displayed as shown in Figure 9.

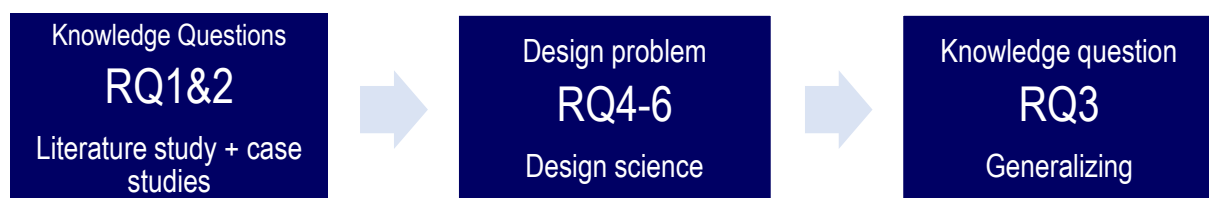


Figure 9 – High-level research methodology model

3.2 LITERATURE STUDY

The first two research questions will be answered by doing a literature study. This method is chosen because this research should build upon conclusions of previous researchers. Furthermore, reviewing literature is a very efficient method in comparison with interviewing experts about their opinions and conclusions, suitable for this research which has limited time available.

The literature study will be about two different subjects: the effects of personalization and the different ways in which personalization can be applied. The literature study is set up according to the five-stage grounded-theory method for reviewing literature by Wolfswinkel et al. (2013).

3.2.1 SOURCES

The study will be done using two search engines for the literature search: Scopus and Google Scholar. Both are widely used, general search engines with big databases. Scopus has indexed a broad range of scientific journals: over 19.000 can be searched via Scopus (Aghaei Chadegani et al., 2013). Google Scholar is even more broader than Scopus and is suitable for discovering academic and, sometimes, more popular literature (Howland, Wright, Rebecca, & Roberts, 2008). Using those two search engines complementarily is therefore a sound way of searching for literature in this research.

3.2.2 STEPS

Literature search is done in an iterative way, as is summarized in Figure 10. First, search terms are defined, as is shown in section 3.2.3. Then, the sources mentioned in section 3.2.1 will be searched. The studies found are read in different levels of depth. First, the search results are refined by title. If the title seems relevant, the abstract is read and the study is skimmed. If reading a paper shortly does not suffice and relevant detailed information seems to be available, the paper is read thoroughly. Found papers will be used to find more relevant papers in an iterative way. Using forward and backward citations, new search terms could be defined, after which the search process is repeated. Also, studying forward and backward citations could directly lead to new relevant papers, which are then refined based on the criteria mentioned before.

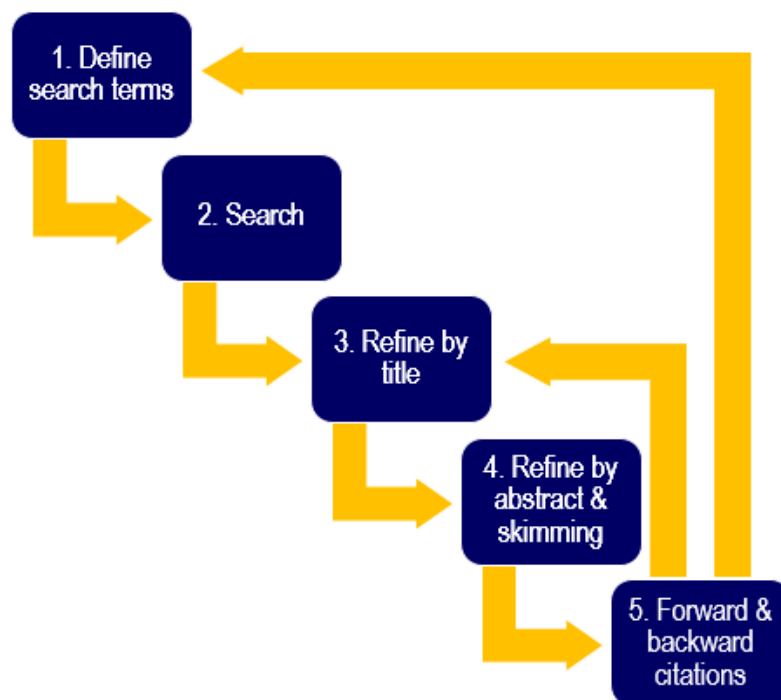


Figure 10 – Literature search method

3.2.3 SEARCH TERMS

A selection of search terms was used to find relevant literature. There are general keywords that were used with every search, and keywords specifically about one of the two subjects. The general keywords were often combined with words from a specific category. An overview of used keywords can be found in Table 3.

General	Effects (RQ1)	Aspects (RQ2)
Personaliz*	Effects	Framework
Customiz*	Customer effort	Levels
Personification	Effort	Characteriz*
Personal	Reasons	How to
Segmentation	Satisfaction	Taxonomy
Mass personalization	Usefulness	Technolog*
Know Your Customer	User	Classif*
KYC	Goals	Perspective
Context-aware*	Profit	Categori*
	Revenue	Application
	Marketing	In practice
	Increase	
	Behavior	
	Effectiveness	
	Potential	
	Customer	
	Efficiency	
	Loyalty	

Table 3 – Keywords used in literature search

3.3 CASE STUDIES

To give a complete answer to the first two research questions, the results from the literature study are validated by speaking to employees from companies that apply personalization. Also, sources from the internet are studied in addition to the interviews. Using the case studies, the results from literature can be validated, to see if the theory is actually applied in the real world.

For this research, three cases are studied: firstly, a company that uses personalization to increase revenues, secondly, a company that uses personalization to increase their revenue and provides personal services to increase customer satisfaction, and thirdly, a company that is purely focused at customer satisfaction, uses personalization for that purpose and has no profit motive. The three cases are chosen based on an exploratory internet search as to which companies suit those descriptions. The three chosen companies are online retailer Wehkamp, health insurer Zilveren Kruis and the Dutch Government. All three organizations are applying personalization or are having plans to do so, but for various reasons.

3.4 DESIGN SCIENCE STUDY

In order to answer the last three research questions, a design science study needs to be carried out. Meertens (2013) describes in his PhD-thesis the different models and papers about design science. Although authors have written about concepts, frameworks and guidelines regarding design science, the methodology described most extensively is the Design Science Research Methodology (DSRM) by Peffers et al. (2008). Therefore, the DSRM is chosen for this part of the research.

The research objective of the design science study is formulated as follows, according to the format proposed by Wieringa (2013):

Improve the online services of NS

By tailoring them to customers' personal needs

Such that the customer effort is reduced

In order to increase customer satisfaction regarding the usage of those services

The DSRM is built up out of six steps, which can be carried out iteratively. The research can begin at multiple points. An overview of the steps can be seen in Figure 11.

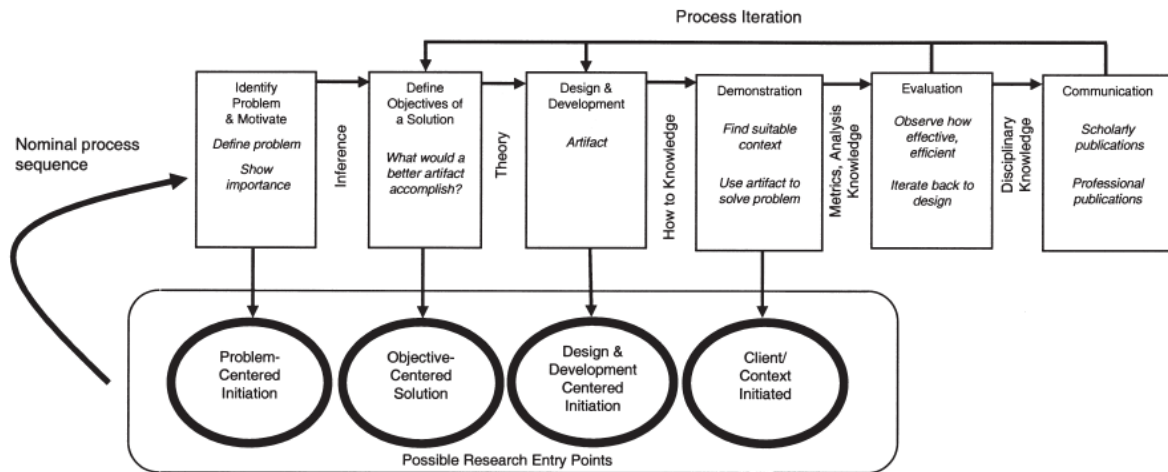


Figure 11 – Design Science Research Methodology process (Peppers et al., 2008)

The reason for this research is the recognition of certain problems with online services of NS. Therefore, this research enters the DSRM in the first phase: Identify Problem & Motivate. The following steps will be taken to carry out the Design Science research:

Identify Problem & Motivate: through studying internal and external documents about the situation of NS and through talking with employees, a problem definition is composed. This also shows the importance of the design of an artifact.

Define Objectives of a Solution: based on the problem identification, objectives of a redesign effort are defined before the redesign can be made. These objectives indicate exactly what the redesign should aim to improve and are used in the evaluation phase to check whether the redesign does indeed satisfy the goals.

Design & Development: this is done by defining personalized authentication levels and redesigning two online services according to those. The redesign process is described in chapter 6 and the results of the redesign are described in chapter 7. This step shows how personalization can be applied at NS and therefore provides an answer to RQ5.

Demonstration and evaluation: the redesigned services are demonstrated by creating HTML mockups. This illustrates and further clarifies the answer to RQ5. Evaluation is done by asking twelve experts from NS about their opinions regarding the mockups and the estimated customer effort of the redesigned services. The Expert Opinion method defined by Wieringa (2010) is used to carry out this step of the DSRM. Evaluation of the demonstration leads to insight into the effects of the redesign on the reduction of customer effort. Together with background information about the goals of NS, this gives an answer to RQ4.

This phase of the DSRM will not be carried out as the methodology suggests. The redesigned services are not placed in a real-world environment, but only demonstrated as mockups which imitate functionality. Evaluation is not

done by observation of the artifact's effects on the environment, but by asking experts to estimate those effects, based on their knowledge.

Analyzing impact on IT: the redesigned services are analyzed to see what impact the redesign has on IT. Two aspects of IT impact are analyzed: the IT architecture and processes needed to facilitate the redesigned services. Both aspects are validated by talking to two experts of NS and two experts from outside NS, to see if the analysis is valid. This answers RQ6.

3.5 GENERALIZATION OF PERSONALIZATION IMPACT ON IT

A generalized overview of the impact of personalization on IT is created by synthesizing and integrating conclusions from the literature study, case studies and impact analysis of the design science study. The impact factors resulting from that integration are then generalized by searching for semi-scientific literature about those factors. The answer is validated by interviewing two experts of NS and two experts from outside NS. This will provide an answer to RQ3.

3.6 SUMMARY

To summarize how and where the research questions are answered, Table 4 gives an explanation.

#	Question	Problem type	Answering method	Chapter
1	What is the effect of personalization on customer effort and what other effects does it have?	Knowledge question	Literature study, case studies	4
2	What are the best ways to apply personalization?	Knowledge question	Literature study, case studies	5
3	Which impact can personalization have on the IT of a company?	Knowledge question	Synthesizing, integrating and generalizing research conclusions	10
4	How and to which extent does personalization affect the customer effort of the online services of NS?	Design problem, Knowledge question	Background study, validation redesign	4, 8
5	How can NS best personalize its online services in order to reduce customer effort?	Design problem	Redesign online services, demonstration redesign	6, 7, 8
6	Which changes in IT architecture and processes are needed to apply personalization on the online services of NS?	Design problem, knowledge question	Impact analysis of redesign	9

Table 4 – Summary of answering research questions



4 EFFECTS OF PERSONALIZATION

4 EFFECTS OF PERSONALIZATION

This chapter explores the question why companies would want to personalize products and services. Using the results of a literature study, an overview of the effects of personalization is given. Then, each of the effects is further examined. Finally, experiences of companies implementing personalization are used to validate the results from literature.

4.1 IDEAL TYPES OF PERSONALIZATION

Fan and Poole (2006) define four ideal types of the use of personalization. Each type has another motive, goal and strategy to achieve that goal. The four types are summarized in Figure 12. Annotations are made by the author of this thesis.

Personalization Ideal Types			
TYPE 1	Architectural	TYPE 2	Instrumental
	Motive: To fulfill a human being's needs for expressing himself/herself through the design of the built environment		Motive: To fulfill a human being's needs for efficiency and productivity
TYPE 3	Goals: To create a functional and delightful Web environment that is compatible with a sense of personal style	TYPE 4	Goals: To increase efficiency and productivity of using the system
	Strategy: Individualization		Strategy: Utilization
	Means: Building a delightful Web environment and immersive Web experience		Means: Designing, enabling, and utilizing useful, usable, user-friendly tools
	User model: Cognitive, affective, and social-cultural aspects of the user		User model: Situated needs of the user
TYPE 3	Relational	TYPE 4	Commercial
	Motive: To fulfill a human being's needs for socialization and a sense of belonging		Motive: To fulfill a human's beings needs for material and psychic welfare
	Goals: To create a common, convenient platform for social interaction that is compatible with the individual's desired level of privacy		Goals: To increase sales and to enhance customer loyalty
	Strategy: Mediation		Strategy: Segmentation
	Means: Building social interactions and interpersonal relationships		Means: Differentiating product, service, and information
	User model: Social context and relational aspects of the user		User models: User preference or demographic profiling; user online behavior and user purchasing history

Figure 12 – Personalization Ideal Types (Fan & Poole, 2006), annotations made by author thesis

All four types seem to have “to fulfill a human being’s needs” as the primary motive. However, the commercial type, type 4, is different from the other three types because the company has the most benefit of personalizing with a commercial goal. The increased revenue is an incentive for the company to personalize. Thus, the motive, belonging to the commercial type, that is mentioned, “To fulfill a human’s beings needs for material and psychic welfare”, is not the primary motive. The primary motive of that personalization type is increase in revenue. The other three types are directed at the customers’ satisfaction, just as their motive suggests. Therefore, if the model of Fan and Poole is further summarized, two motives associated with personalization can be seen: customer satisfaction increase and company revenue increase. These were also the two primary motives found in literature and will be further explained in sections 4.2 and 4.3.

4.2 USER EXPERIENCE AND CUSTOMER SATISFACTION

The experience of the customer when interacting with a company is of large influence to the behavior of the customer in that interactions. For example, 74 percent of website visitors get frustrated when a website does not display content that is relevant to them, and a large part of them would leave a website if it displayed content that

did not match their personal characteristics, such as advertising for dating sites when somebody was married (Janrain, 2013).

If relevant content is displayed to users, they are more likely to engage in more activities with regard to the company, because they feel more understood and seen by the company. Personalized email marketing resulted in a 14 percent increase in click-through rate (Aberdeen Group, 2008). In an experiment with web surveys, the response rate was 8.6 percentage points higher when the survey was personalized (Heerwegh, Vanhove, Matthijs, & Loosveldt, 2005).

Also in the banking business, personalization is seen as something that can increase customer satisfaction (The Financial Brand, 2014). The better personalization is applied, the more customer satisfaction is increasing, as was shown in research about the accuracy of recommendations (Liang et al., 2007). Customers using a personalized website also perceive it as more useful (Liang et al., 2012).

When an interaction is personalized, the users feel more understood. This was already true in the analog age, when the shop around the corner was owned by somebody who knew his customers and had a good relationship with them (Mittal & Lassar, 1996). In the current digital age, this principle still remains: "Consumers will build a positive attitude when they feel the vendor cares for them and pays attention to their personal needs through the provision of customer services" (Liang et al., 2012). In a master thesis was concluded that "real personal attention" has a positive influence on customer loyalty at a Dutch wholesaler (van Es, 2012). Those positive emotions would also have a positive impact on the shopping behavior of customers (Pappas, Kourouthanassis, Giannakos, & Chrissikopoulos, 2014), which can increase the revenue of the company.

However, the positive effect of personalization on customer attitude and loyalty is contradicted by Dixon et al. (2010), which state that "delighting customers doesn't build loyalty". Because of different implicit definitions, it is not clear whether this statements really contradict or that the definitions are just confusing. Also, there exists confusion about the exact indicators of customer satisfaction. A lot of related terms are being used interchangeably, like customer satisfaction, happiness, loyalty and attitude.

Customer effort

A key factor in the customer experience is how much effort they have to make to receive a certain service or good. Zipf already stated in his famous Principle of Least Effort (Zipf, 1949) that people always try to find the way which involves the least effort to them: people choose their entire behavior based on the minimization of effort. Although Mahatma Gandhi said that "satisfaction lies in the effort", current knowledge shows that satisfaction specifically occurs when there's not too much effort involved.

Personalization can help reduce the effort customers have to make. Often, websites have an enormous amount of information to display and customers might be overloaded with that much information. Personalization works to reduce that information overload effect (Kosela, 2007) and therefore reduces the effort of users (Liang et al., 2007).

The Customer Effort Score has proven to be a predictive metric for customer loyalty, which is "customers' intention to keep doing business with the company, increase the amount they spend, or spread positive (and not negative) word of mouth" (Dixon et al., 2010).

4.3 REVENUE

There is currently a lot of buzz about the effects of personalization on revenue. Results are tangible and significant: companies that personalize interactions with customers are likely to outperform ones that do not do this, according to a report of McKinsey (2014). This report investigates the use of analytics by companies, which are used to personalize. Results are that personalization is related to better performance in sales, profit and ROI, compared to competitors. A survey by Econsultancy (2013) claims that personalizing companies achieve a 19 percent increase in revenue. However, they say, 41 percent of the companies do not get a notable return on their personalization efforts. This is because almost three-quarters of marketers say "they understand the importance of personalization, but don't know where to start and how to approach it" and if a company has started to implement personalization,

“few have implemented a well-thought-out and tested approach” (Econsultancy, 2013). Defining accurate and relevant metrics, using those to measure the impact of personalization and improving the implementation based on those measures is vital in order for companies to see their revenue increase because of personalization.

An important factor in increasing revenue through personalization is the use of personalized recommendations, tailored to what the customer might be looking for. A supermarket that experimented with personalized recommendations, saw a 1.8% boost in revenue thanks to personalization (Lawrence, Almasi, Kotlyar, Viveros, & Duri, 2001). A survey by Baynote indicates that customers with personalized recommendations have a much higher conversion rate: up to 355% compared to customers without personalized recommendations (Baynote, 2013). RichRelevance, a company that specializes in recommendations as used by companies like Amazon, notes a 3-15 percent increase in revenue for customers that use personalized recommendations (Koetsier, 2013). Personalization helps to increase conversion rates and thus revenue, even in its more basic forms (Aberdeen Group, 2008). Even though some research is likely to be somewhat affected by the opinions of the organization carrying it out, the effect of personalization on revenue increase is clear.

Another factor that could be tailored is the price of the products a company is offering. If prices of airline tickets, for example, are customized, based on the characteristics of the customer, revenue could increase by more than 7 percent compared to the ideal price (X. Chen, Owen, Pixton, & Simchi-levi, 2015).

4.4 NEGATIVE EFFECTS

The effects of personalization can, however, also be negative and could decrease customer trust. When customers discover their data is used for personalization purposes without their consent, they might feel exposed and threatened by the company delivering the service. Instead of a higher click-through rate and customer satisfaction, customers click through less and are less satisfied with the service because of this violation of their privacy. This is called the personalization paradox (Aguirre, Mahr, Grewal, de Ruyter, & Wetzels, 2015). Companies can prevent this negative effect from happening by being clear about the usage of personal data for personalization purposes: overt instead of covert personalization (Aguirre et al., 2015; Lee & Cranage, 2011). This increases the trust of customers, which influences their perception of advertisements, especially the personalized ones (Bleier & Eisenbeiss, 2015).

4.5 EXPERIENCES FROM PRACTICE

Results from the literature study can be applied by looking at companies that apply personalization. Companies actively applying personalization do this for various reasons. Some companies are trying to sell as much as they can to customers and will use personalization to offer them the most relevant product offerings as possible. Other companies are not profit-oriented and want to make sure their customers are as satisfied as possible about their services, which they can personalize in various ways. The third category of companies combines both and focuses on a combination of service and sales. NS falls into this last category. From each of the three categories, one case was explored by conducting an interview or doing online research.

4.5.1 WEHKAMP

An interview was conducted with a data scientist of Wehkamp, which is one of the largest online retailers in the Netherlands. On their web site, personalization is widely applied, in order to have a better alignment with the customers' wishes and desires. Customer experience is improved by adding personalized content based on data and algorithms. Revenue increase through increased conversion rates is an important goal with regard to personalization. Negative effects were experienced when Wehkamp was considering personalizing product prices, which reduced customer trust. Therefore, those plans were not executed.

Similar motives can be seen with other web shops, like Bol.com (Emerce, 2015) and Coolblue (Groot, 2015), which indicates its three most important Key Performance Indicators to be brand image, web site visits and sales. Booking.com is another example of a web shop which uses personalization to maximize conversion rates in order to increase sales (Barilliance, 2013).

4.5.2 ZILVEREN KRUIS

Zilveren Kruis is a Dutch insurance company which has a combination of sales and service and applies personalization mainly in their online channel. An interview was conducted with a web analyst of Zilveren Kruis. Personalization is done in order to generate extra revenue by trying to convince customers to sign up for their insurance. Also, it is done to decrease service costs. Increasing revenue is especially important in the final quarter of each year, in which customers can change their insurance. A lot of attention is paid to getting 'switchers' to transfer to Zilveren Kruis. Decreasing service costs is done, for example, by the reduction of waste calls to their help desk. Customer satisfaction is important because of its effects on sales and service.

4.5.3 DUTCH GOVERNMENT

For studying a case at which personalization is used solely for the benefits of user satisfaction, the Dutch digital government is chosen, as is described at <http://www.digitaleoverheid.nl>. This program aims to digitalize all governmental services by the end of 2017. As can be seen on their website, revenue increase or customer conversion aspects play no role in the application of personalization (Dutch Government, 2015). The government states that one of their key goals is to improve the accessibility, security and trustworthiness of the services, which have a positive impact on customer satisfaction. Also, digitalization of services will lead to cost efficiency.

4.5.4 COMPARING THEORY AND PRACTICE

When the results of the literature study are compared with the case studies documented in the previous sections, a number of conclusions can be drawn.

An overview of the effects found in case studies is given in Table 5. The literature study showed two primary objectives of applying personalization, customer satisfaction increase and revenue increase. However, when interviewing an employee from Zilveren Kruis and when looking at case material from the Dutch government, a third objective came to light which was barely addressed in literature: cost efficiency. Personalization can be used to direct customers to cheaper channels or to give customers more relevant information, so that less direct contact is needed between them and the company. Eventually, cost efficiency leads to an increase in profit, just like the increase of revenue generally does.

	Wehkamp	Zilveren Kruis	Dutch Government
Customer satisfaction increase	X	X	X
Revenue increase	X	X	
Cost efficiency increase	X	X	X
Customer trust decrease	X		

Table 5 – Personalization effects found in case studies

In all three cases, customer satisfaction was mentioned as a goal of personalization. However, this goal was often connected to the increase of profit. Customer satisfaction is not always a goal in itself, it can also be used as a means to other goals.

The possible negative effects of personalization were only mentioned by Wehkamp. The absence of this effect in the findings could be because companies are responsibly applying personalization, so that customer trust is not decreasing. However, a more probable explanation is that customers do not indicate their decrease in trust and companies do not directly ask customers if their trust decreases. Companies generally only see the positive side of personalization and are not very focused on possible negative side effects, as can be seen in several reports about personalization (Baynote, 2013; Forrester Consulting, 2013; Koetsier, 2013; McKinsey, 2014).

Also, literature mainly focuses on personalization enabling satisfying factors, like a special customer experience, instead of removing dissatisfiers, such as lowering customer effort. Herzberg has stated in his famous two-factor theory that factors causing job satisfaction are other factors than those causing job dissatisfaction: they are two separate sets (Herzberg, 1966). Johnston has applied this theory on service quality factors. He states: "Maybe without a strategy that includes both dissatisfaction removal and satisfaction increase, or at least dissatisfaction

removal first, (...) customers could become justly cynical of the organization's attempt to improve service quality" (Johnston, 1995). Personalization is seen as a key idea to improve customer satisfaction, but the ideas in literature concerning personalization are mostly about satisfiers, while removing dissatisfiers is maybe even more crucial.

As stated in section 1.4, this research focuses on decreasing Customer Effort, which is a dissatisfier, instead of aiming to increase a satisfying factor through personalization. The importance of removing dissatisfiers was stated by Johnston and is one of the reasons Customer Effort is chosen as the primary indicator in this research.

4.6 CONCLUSION

A summary of found effects of personalization is displayed in Figure 13. In total, three positive effects of personalization were found: customer satisfaction increase, revenue increase and increased cost efficiency. The first two of those were found doing literature search, the last by examining personalization cases from practice. Revenue increase and cost efficiency both influence the increase of profit. Indirectly, an increase of customer satisfaction can also influence the increase of profit of a company. Also, a possible negative effect of personalization was found: a decrease in customer trust, which influences other factors like conversion rates and customer satisfaction. This could happen when companies are not clear about their usage of personal data.

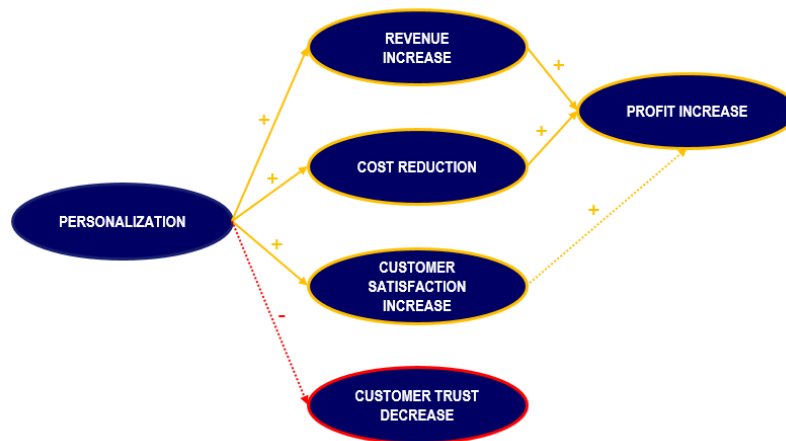


Figure 13 – Summary of found effects of personalization

Confusion exists about the effects of personalization on customer loyalty increase: several sources seem to contradict each other at this point. Some sources state that a personalized experience makes customers more loyal, while Dixon et al. (2010) state that this is not the case. Also, there exists confusion about the exact indicators of customer satisfaction. A lot of related terms are being used interchangeably, like customer satisfaction, happiness, loyalty and attitude. This could be caused by semi-scientific literature being dominantly present in this research field. Semi-scientific literature is often less precise regarding definitions and concepts and is sometimes driven by commercial goals instead of scientific rigor.

Case studies were used to validate literature search results. The cost efficiency goal, found at all three cases, was not found in literature and therefore literature regarding personalization is incomplete: it should be included as a main effect of personalization. Also, especially more popular literature, such as white papers and reports about personalization, are biased towards the more positive effects of personalization and tend to ignore the risks and possible negative effects. Furthermore, there exists a bias towards satisfiers, while removing dissatisfiers is often ignored.

The goals of NS closely match the effects of personalization found in literature and in the case studies. Personalization is suitable for NS, not only because it could increase profit by increasing revenue and decreasing costs, which is a basic goal of almost every company, but also because of its large effects on customer effort. The reduction of customer effort is chosen to be a central goal in this research and personalization is a very suitable instrument for that.



5 APPLYING PERSONALIZATION

5 APPLYING PERSONALIZATION

There are numerous ways to apply personalization. This chapter shows, using a literature study, the different dimensions of the execution of personalization. There is no single best way of applying personalization, but companies can choose the most suitable form of personalization in their specific situation. After this, experiences from three cases are used to compare reality against the theory in literature.

5.1 PERSONALIZED ELEMENTS

The most important aspect of personalization is of course the subject of personalization: what is actually personalized. Almost two decades ago, a difference was made between content and appearance (Gilmore & Pine II, 1997) and since then, a lot of other classifications have been written down. In the following subsections, the possible subjects of personalization are described.

Layout: the look and feel of a service or product (Fan & Poole, 2006; Gilmore & Pine II, 1997). This has nothing to do with the actual working of the product or service, but only with the appearance. Examples of layout personalization are the bottles and cans of Coca Cola in different colors and with different texts (Drupa, 2014), or the website of NS being adaptable for people with poor eyesight.

Content: which content is offered via a service (Compton, 2001; Fan & Poole, 2006; Gilmore & Pine II, 1997). Different people can, when content is personalized, get presented different information: personalized recommendations based on earlier purchases or interests, advertisements that match a person's interest or personalized search results. An example from the situation of NS is campaign management through the email newsletter, which shows different offers to different customer segments.

Functionality: a service consists of a set of process steps: what people have to do to receive a service (Compton, 2001; Fan & Poole, 2006). These steps can vary for different persons: a user that often makes use of a service does not need to fill in all of his information every time, but a new customer who is not known does have to do this. Also, personalizing functionality includes determining what every person can or cannot do, which services or products he has access to. A hypothetical example from the situation of NS would be that loyal and frequent travelers would have the possibility to have proactive claim generation when they would have forgotten to check out, while customers who do not travel often would not have that possibility.



Figure 14 – Authentication factors (Onegini, 2015)

Channel: there are a lot of channels via which customers can come into contact with the company. Determining which customers should use which channels is an important personalization subject (Fan & Poole, 2006). When trying to use a service, customer effort is for a large part dependent on which channels are used and how easily the customer can access them. Different customers have different channel preferences, so one customer could prefer digital channels, while another could prefer analog channels, like mail or telephone.

Authentication: when a service involves personal information, the user must be authenticated so that his/her identity is verified (Techopedia, 2015). Authentication can also be personalized, for example by taking into account the cognitive capabilities of customers, which was shown to lower the effort customers had to do when authenticating (M. Belk, Fidas, Germanakos, & Samaras, 2014; Marios Belk, Germanakos, Fidas, & Samaras, 2014). Another example is offering authentication at different security (and effort) levels, as is proposed by the Dutch government for its e-services (Forum Standaardisatie, 2014). Personalization of authentication can also have effect on the functionality a user has access to, those two categories can overlap.

Authentication can be done by checking one or more factors, as are shown in Figure 14. A combination of multiple factors leads to stronger authentication.

Handling employee: when there is personal contact between an employee of the company and the customer, the employee who handles a certain service can also be matched to the customer's preference. This is part of what Gartner calls "service personalization" (Compton, 2001). In the banking industry, it is common for regular business customers to have a specific employee handling all their services. With NS, this could be applied to customer service which can connect a calling customer to their regular service employee.

Price: personalization could also include dynamically or statically changing the price of offered products and services (Compton, 2001; Kwon & Kim, 2012). For example, when the demand is high, an airline company could increase the price to increase their revenue. When the demand is low or the flight is leaving on short term, the prices could be decreased to make sure the flight is fully booked and tickets are being sold (Petro, 2015). NS also offers products to a certain price and could personalize that to increase sales.

5.2 LEARNING METHOD

When personalizing, a choice has to be made about how the system learns the needs and wishes of the customer. The customer could specify exactly what he wants and how he wants to be treated by the company. He could choose the colors of the website, or determine which content is placed where (e.g. igHome: <http://www.ighome.com/>). This is called explicit personalization (Asif & Krogstie, 2012; Fan & Poole, 2006; Kwon & Kim, 2012).

On the other side of the spectrum, the company can offer personalized products and services without the customer having a choice, or maybe even without the customer knowing the products and services are personalized. The system will, using the data it has about the customer, determine itself how to treat him without the customer giving explicit input for the personalization effort. This way of personalization is called implicit personalization (Asif & Krogstie, 2012; Fan & Poole, 2006; Kwon & Kim, 2012).

5.3 INITIATING ACTOR

The second aspect of personalization is the actor that initiates the personalization (Kwon & Kim, 2012). Personalization could be initiated by the customer, stating how he would like to get a personalized experience, or automatically, by the system. These categories are also called reactive and proactive (Anand & Mobasher, 2005).

The newsletter NS regularly sends via email is personalized, based on the data about the customer NS possesses, without the customer actively stating that he wants to be treated in a personalized way. This is an example of system-initiated personalization. When a user wants to know information about his future journey with NS, he can choose from different options: calling customer service, looking at the website or logging in at the smartphone application and saving certain trips or routes. This is an example of user-initiated personalization: the user chooses whether he gets a personalized experience (using the smartphone application) or not.

Sunikka and Bragge (2008) call the categories mentioned in this section explicit and implicit personalization, but this does not exactly match user-initiated and system-initiated personalization. For example, a user can initiate the personalization by stating he wants to have a personalized experience, but the system can then still, implicitly, execute the personalization. This was also noted by Kwon and Kim (2012).

5.4 SPECIFICITY

Another aspect of personalization is the specificity. One can, for example, treat each customer differently based on his personal data, so that no two customers are treated the same. At NS, this is the case when a customer hands in a claim for a refund via the personal portal Mijn NS: that claim can only be based on travel history of that specific customer, so every customer sees the travels he has made and the claims that he could possibly file. This way of personalization is called individuated (Fan & Poole, 2006), individual (Sunikka & Bragge, 2008) or one-to-one (Kwon, Cho, & Park, 2010; Kwon & Kim, 2012).

Segmentation, the division of customers into different customer segments, is another level of specificity. Those segments could be based on all sorts of characteristics of users. During a train journey for example, NS personnel has a set of six segments, the Needscope personas (van Hagen, 2009), in which the train passengers can be categorized and treated in a different way. The email newsletter from NS identifies different segments based on age, travel frequency, preferences and hobbies. This is called categorical (Fan & Poole, 2006), group (Sunikka & Bragge, 2008) or one-to-N (Kwon & Kim, 2012) personalization.

Kwon & Kim (2012) identify a third level of this aspect: one-to-all. The company then gives the customer a general experience, not tailored to that individual or a segment. Therefore, this cannot be defined as a form of personalization, because different customers are not treated differently.

5.5 CUSTOMER DATA

Personalization is by definition based on the information the company has (or obtains) about the customer. That information is processed, integrated and analyzed in order to provide a personalized experience. Different types of data can be identified from literature. These types of data can all be used to provide a personalized experience in some way. Also, they can be combined and analyzed to discover connections between different data sorts. When this is done at a large scale and with many different types of data, this is called Big Data (Gartner, 2015).

5.5.1 BUSINESS INTELLIGENCE AND ANALYTICS CATEGORIES

Chen et al. define three types of data used for Business Intelligence & Analytics (BI&A), as can be seen in Figure 15. Those types of customer data can be used to personalize services or products.

Structured content from databases is called BI&A 1.0 content. Examples of this from the situation of NS are address data, names and birth dates. This data can be analyzed, for example, by dashboards, reporting and score cards, to enable personalization based on age, ticket type or travel history.

BI&A 2.0 content consists of data generated by users' behavior on the internet, such as clickstream data logs, browsing and purchasing patterns and social media interactions. BI&A 2.0 content is unstructured, unlike the database-content, which mostly has the same form and syntax. Analysis of this data can happen through text mining, web mining and social network analysis, which is often quite complex. Personalization can then be done, for example, based on purchasing behavior in the past, tweets about NS and trains or click statistics of the email newsletter.

Finally, BI&A 3.0 content is based on mobile and Internet-enabled devices, such as smartphones and tablets. With usage and location data from these devices, information about the user's context can be used to personalize his experience. This is only possible when data is analyzed and personalization happens in real-time.

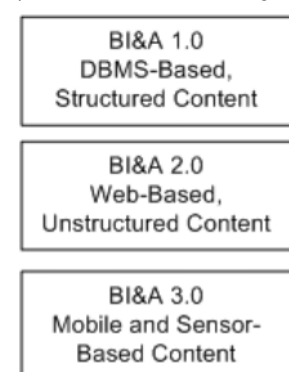


Figure 15 – BI&A categories (H. Chen et al., 2012)

According to Chen et al., companies are mostly busy with BI&A 1.0, while 2.0 and 3.0 are not widely seen in practice (H. Chen, Chiang, Lindner, Storey, & Robinson, 2012).

Companies can use all three content types when personalizing and with all three types, there are different challenges to overcome. BI&A 1.0 content poses challenges because in a lot of companies, there is an enormous amount of structured data and the companies often lack the capabilities to analyze all content and use that to personalize. BI&A 2.0 content is often unstructured and it is difficult to draw meaningful conclusions from it, in order to personalize. Techniques like text mining are being developed that should enable better analysis of unstructured data. BI&A 3.0 content poses personalization challenges because the personalization needs to happen in real-time. This means that the content should be analyzed and connected to other relevant information sources the company has, all within seconds or even less.

5.5.2 *SOFT AND HARD, STATIC AND DYNAMIC DATA*

Customer data can also be categorized in other ways. Petersen categorizes information about customers in the financial industry as soft and hard information (Petersen, 2004). Hard information is quantifiable, measurable, can be fact-checked and, in the words of Petersen, “can be reduced to numbers”. Soft information, however, is not quantifiable, cannot be summarized as a number, except for when the consumer himself explicitly states the information.

Data can also be split up into static and dynamic data (Asif & Krogstie, 2012). Static data does not change often. Examples of static data are personal customer data like name and address and historical data like customers' travel history. Dynamic data, however, is often real-time: the website browsing behavior of a customer can change all of a sudden, as well as temporary interests. It is also often context-based: the context of the customer determines his behavior and the data he produces. A lot of systems and companies are used to dealing with static data, but dynamic data also contains possibilities for personalization. According to a report by Forrester, using dynamic data for personalization is increasingly recognized as having high potential, but a lot of companies are still struggling with implementing it into their personalization projects (Forrester Consulting, 2013).

5.5.3 *DATA SOURCES*

To be able to use the information about the customer mentioned above, the information has to be collected from its source. There can be as many different data sources as there are different types of data. There are also different kinds of sources:

Internal data: the IT-systems and databases of the company contain most of the data the company possesses. This can be customer-related data or company-related data, such as product- or service-related data. Information often has crosslinks with other information in a different database, but unfortunately databases are often not connected, leading to big efforts in linking data together: data integration (Gartner, 2015).

External data: data, publicly available on the World Wide Web for example, can also be used to personalize. The main source that is used, are the tweets of millions of Twitter users, that can indicate the sentiment regarding a specific topic (Agarwal, Xie, Vovsha, Rambow, & Passonneau, 2011).

Context-based data: when customers visit the website of call customer service, there is context-based data about their behavior that can be used to personalize their experience (Dey & Abowd, 1999).

5.6 PERSONALIZATION PROCESS

A generic model for the different steps in executing personalization is defined by Vesanen and Raulas (2006), who integrate multiple personalization process models into one cyclic model containing four steps. The model is displayed in Figure 16. A similar model is defined for context-aware services, which take just the context data into account when personalizing (Guermah, Fissaa, Hafiddi, Nassar, & Kriouile, 2014). The arrows represent operations: actions that need to be taken to personalize. The blocks represent objects, which are needed to carry out the operations.

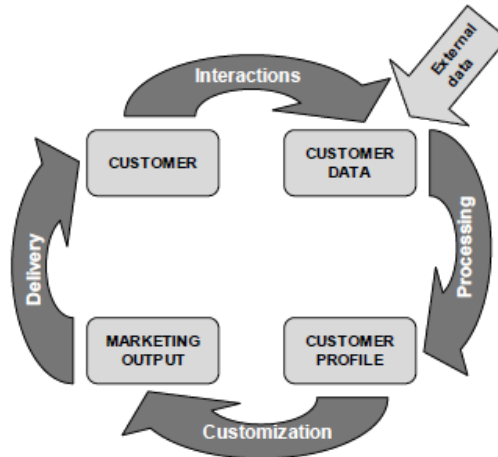


Figure 16 – Generic personalization process model (Vesanen & Raulas, 2006)

A connection can be made to the different data sources from section 5.5.3: internal data is represented by the block 'Customer data', external data by the arrow in the top right corner and real-time data by the arrow of 'Interactions'.

For each process step, techniques and systems are available to execute that step. More information about the realization in IT of the personalization process can be found in chapter 10.

The process model cycle, including data analysis and customer profile generation, can be carried out periodically, such as once per day. However, some applications require real-time processing and response of the personalizing company. In that case, the cycle is carried out on-the-fly, by real-time processing customer data and interactions and delivering a personalized response based on that information. The process model can be therefore applied in real-time and non-real-time scenarios.

Because the personalization process is cyclic, a very suitable way to implement personalization is by using pilot projects to test whether a certain personalization approach works. Testing can, for example, be done using A/B-testing (Madlin, 2015). The feedback from those projects can then be used to initiate new pilot projects. When a pilot project seems to work well, it can be implemented in the production environment.

5.7 COMPLEXITY OF PERSONALIZATION

There are numerous ways to apply personalization, which can be categorized into levels, ranging from no personalization to a complete personalized service and channel palette.

Asif and Krogstie (2012) define three levels for personalization in mobile services: 1) explicit personalization, in which the user explicitly defines his needs and wishes, 2) profile personalization, in which personalization is based on the profile of the user: the facts that the company knows about the customer, 3) context personalization, in which the context of the user, his location, time, current task is also taken into account. The more information is used in the personalization effort and the more real-time the information is, the more complex personalizing gets.

Furthermore, the BI&A categories mentioned in section 5.5.1 are an important indicator for the complexity of personalization. If only static, structured content is used, the personalization will be less complex than when unstructured behavior and context data is used as well. Companies often apply the simple forms of personalization (BI&A 1.0), but context-aware personalization (BI&A 3.0), a more complex form, is far less applied (H. Chen et al., 2012).

RichRelevance, a company that specializes in omnichannel personalization for retailers, has defined a personalization maturity model, ranging from no personalization to omnichannel personalization. The model can be seen in Figure 17.

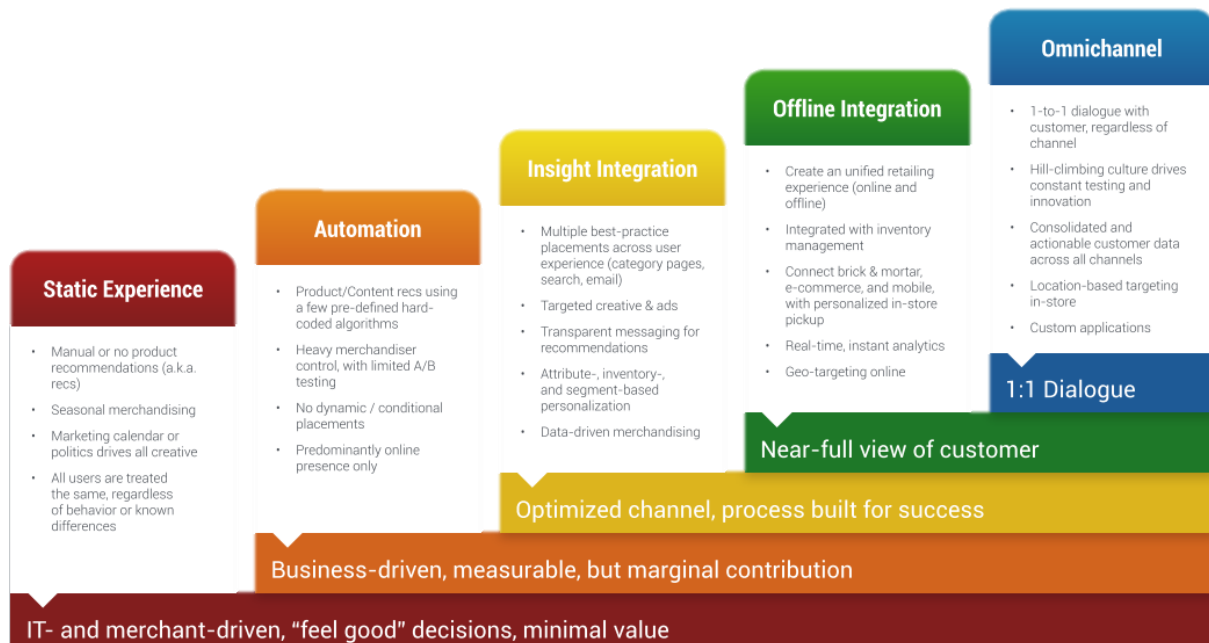


Figure 17 – RichRelevance Personalization Maturity Model (RichRelevance, 2013)

This can be worded differently by stating that the complexity of a personalization effort increases, when more of the following factors are being applied:

- Data from different sources
- Data of different types
- Real-time data
- Customer dialogue across multiple channels
- Continuous testing and improvement: a cyclic process
- Directed at individual customers
- Using and analyzing soft data
- Multiple services in scope

An example of low complexity is using a single structured data object like customer age, to make customer groups and personalize email newsletter content based on that. When unstructured data, like written reports or social media data are used to personalize at multiple channels to personalize for each individual customer, personalization gets more complex.

Companies wanting to apply personalization should determine how complex their personalization should be in order to achieve their desired goals. Companies should reach those goals but try to minimize the complexity of their personalization effort.

5.8 EXPERIENCES FROM PRACTICE

Next to the literature search, interviews were conducted and an internet search was done to determine how companies are approaching personalization nowadays. The same companies are discussed as in section 4.5.

5.8.1 WEHKAMP

Wehkamp applies personalization mainly on the elements of the website layout and content and in campaign management via email. Examples of this are re-targeting customers on other websites via advertisements, adapting email newsletter content, small layout adjustments to the website and giving personalized shopping recommendations. In the future, Wehkamp wants to apply personalization on the website on a bigger scale, by adjusting the grouping of elements and the placement of different items to the customer. There were plans to also personalize the product prices (Twinkle, 2013), but those were cancelled due to moral reasons.

Personalization at Wehkamp happens implicitly, because customers often do not want to take much effort in specifying how they would like to be treated. Data from multiple sources, like customer cookies, real-time online behavior and multiple internal databases is integrated into a data warehouse and analyzed using a data analysis tool. Both soft and hard data are used. Future plans include using data virtualization to make data retrieval and manipulation easier. The optimization of the website layout is done using A/B-testing, in which two versions of the layout are shown to customer groups to see which performs better.

5.8.2 ZILVEREN KRUIS

Zilveren Kruis also mostly personalizes on layout and content of their website. Also, the channel a customer should go to is personalized. Personalization is done based on individual characteristics but also on customer categories. Examples of this are age group, life phase, demographics and the MBTI personality model (Myers, 1962), with which customers can be identified e.g. as quick decision makers or doubters who would like to take longer time to decide. This information is purely used to improve the customer experience, provide personalized services and a tailored website, not for customer selection purposes.

Previously, Zilveren Kruis had a silo'ed architecture with customer information being spread out across multiple systems. Currently, more and more integrated information from e.g. email, Google Analytics, CRM is integrated to make data-driven decisions. The user experience design of the website is done using user testing. A/B-testing and multivariate testing are done to provide a rational foundation for certain redesign choices. Zilveren Kruis has the goal of making data-driven decisions for personalization purposes: every decision should be based on actual customer data. The process they use is cyclic, just as described in section 5.6.

5.8.3 DUTCH GOVERNMENT

The digitalization project at the Dutch government is very big and there are a lot of actions to be taken to achieve its goals. In order to structure this, an implementation agenda has been set up in which several measures and steps are defined (Regieraad Dienstverlening, 2015). However, this is still very high-level so most concrete techniques are not yet defined. The Dutch government tries to make online services easier by pre-filling forms that customers need to fill in (Dutch Government, 2015). The goal is making sure that customers only have to give their personal data once. Also, all services will be accessible via one single portal, for example by personalizing the authentication of services. One single message box will be set up for each customer, so that all relevant messages from different government services are in one place. This is an example of content personalization.

Detailed types of personalization, like varying the graphical layout or the groupings of elements at the website, are not yet identified as future steps: first, the foundation for that will be laid by connecting all governmental environments to a single portal and sharing customer information between them.

5.8.4 COMPARING THEORY AND PRACTICE

The findings from the case studies are summarized and compared with theory in Table 6. In some cases, the exact methods were not completely clear from the interviews and background information used. In that case, some assumptions are made to give a complete overview. Those assumptions are displayed in *italic*.

	Wehkamp	Zilveren Kruis	Dutch Government
<i>Elements</i>	Layout, content, (price)	Layout, content, channel	Content, authentication, channel
<i>Learning method</i>	Implicit	Implicit	<i>Implicit and Explicit</i>
<i>Initiating actor</i>	System	System	<i>System</i>
<i>Specificity</i>	Individual and categorical	Individual and categorical	<i>Individual</i>
<i>Content types used</i>	BI&A 1.0 and 3.0	BI&A 1.0, 2.0 and 3.0	BI&A 1.0
<i>Personalization process</i>	<i>Sometimes used iteratively</i>	Used iteratively	<i>Not used iteratively</i>

Table 6 – Personalization applications found in case studies

In general, the practice of personalization matches the theory found in literature: the aspects were recognized at the interviewed and studied companies. It was also clear that the implementation of personalization was still in progress: there is a lot to improve. Only some elements are being personalized and the elements that are personalized, are not fully personalized. Data is used from different BI&A categories mentioned in section 5.5.1, but a lot of customer data still is not used. Using the list of factors of complexity from section 5.7 can be concluded that data is already used from multiple sources and with different data types and that the process is partly cyclic and iterative. The companies examined used structured as well as unstructured, behavioral data to personalize. This shows that companies are a step further than in 2012, when Chen et al. stated that only BI&A 1.0 was widely applied (H. Chen et al., 2012).

However, improvements can be made by making the process fully iterative and data-driven, using more soft and real-time data and establishing a dialogue with the customer across multiple channels.

Also, the most state of the art knowledge about personalization is probably not present in literature: algorithms used by Facebook and Google to personalize customer experience are often not shared with the public. This leads to scientific knowledge not being up to date and prevents companies wanting to apply personalization from using the latest insights.

5.9 CONCLUSION

Several methods of applying personalization were found in literature. The most obvious factor in personalization is the elements that are personalized. Examples of those elements are product or service prices, layout, content and authentication. Next to that, choices have to be made about if the learning method is explicit or implicit, who initiates the personalization effort, at which specificity is personalized and which data is used and from what sources it originates. Applying personalization is best done via a cyclic personalization process which can be applied iteratively. It cannot be reduced to one simple form or sort: there are many types and flavors. The complexity of personalization can vary widely, from straight-forward to very complex, based on a number of factors listed in section 5.7.

By studying three cases, theory from literature could be matched to the real-world practices. In some ways, companies are only applying limited forms of personalization: there is a possibility to personalize using other elements and in a more extensive way. It was also found that companies are not only using BI&A 1.0 content, but also use BI&A 2.0 and 3.0 content to personalize, which shows that the statements from (H. Chen et al., 2012) are not fully up-to-date anymore. Also, in general, literature about personalization is probably not up-to-date because the latest insights are obtained by commercial companies which keep those insights for themselves.



6 REDESIGN PROCESS

6 REDESIGN PROCESS

In this chapter, the redesign process is explained. First, the redesign objectives are derived from the problem definition, defined before. Then, personas are defined so that the online services can be looked at from different viewpoints. After that, a theory about customer effort is formulated that further specifies customer effort into two components: initial effort and regular effort. Using those two components, the current situation is analyzed. This shows that the largest improvement opportunity lies in the authentication for online services of NS. Ideas for improvement and redesign are generated using a brainstorm session with experts from NS. These steps are all represented by the “customization”-step in the personalization process of section 5.6. More information about the consulted experts can be found in Appendix D.

6.1 REDESIGN OBJECTIVES

After the problem has been defined and background research has been done, the objectives for the solution need to be specified. These objectives give a clear direction to the designing process and make it possible to evaluate the value of the design. This is the second step of the Design Science Research Methodology (Peppers et al., 2008). The following three objectives are chosen for the redesign, based on the problem definition given in section 2.4 and the design science goal specified in section 3.4:

1. The redesign should decrease the customer effort score of the online services
2. The redesign should lead to an increase in the use of online channels and a decrease in the use of offline channels
3. The redesign should lead to an increase in the number of customers that can be identified at the online channels while using it

6.2 PERSONAS

To best reduce customer effort in the redesign, the wishes and needs of the different types of users need to be taken into account. A method to do this is using personas: ‘fictitious, specific, concrete representations of target users’ (Pruitt & Adlin, 2006). Personas represent types of users that will use products or services. They are mostly used and proven in product design (Miaskiewicz & Kozar, 2011) but can also be applied when (re)designing services (Idoughi, Seffah, & Kolski, 2012; Seffah, Kolski, & Idoughi, 2009).

Currently, NS is also working with personas that are created in two ways. The first type, Needscope personas, consist of six personas, based on research by TNS NIPO, that indicate how people experience traveling by train and the contact with NS personnel (van Hagen, 2009). An overview of the Needscope personas can be seen in Figure 1. The second type is currently mostly applied in the marketing departments and is based on the different stages of a human life, ranging from childhood to elderly. However, both persona sets do not show how the online services of NS are used by different types of customers. Therefore, new personas need to be designed in order to clearly show that.

After consulting experts within NS about characteristics that determine the way a customer uses the online services of NS, two characteristics were determined:

1. **Experience with NS, traveling with NS and its online services.** Some people travel multiple times per week and often make use of the online services. Other people rarely travel and seldom make use of those services.
2. **The motivation for traveling with NS.** NS here makes a distinction between lust-travelers and must-travelers: people who travel from and to leisure activities and people who travel for work and business-related activities.

Combining those two characteristics leads to four persona types, as can be seen in Table 7.

		Experience with NS (how often do you travel?)	
		Not much	Much
Lust or must (why are you travelling?)	Lust	1	2
	Must	3	4

Table 7 – The Persona Matrix

To formulate it differently, the four personas are:

1. **The NS-newcomer** has little experience with traveling by train and with the services of NS. He/she travels occasionally, and solely for leisure purposes.
 - Number of people matching this persona: approximately 5 million. This is based on the total number of travelers minus the sizes of the other groups of personas.
2. **The leisure traveler** travels regularly by train, almost solely for leisure purposes. He/she is familiar with NS and its services.
 - Number of people matching this persona: approximately 1.000.000, based on the number of season tickets for off-peak hours plus some other season ticket types.
3. **The certainty seeker** does not travel often by train, and when he/she does, it is for business purposes. There are some services of NS he/she needs to use sometimes, but there is not much familiarity.
 - Number of people matching this persona: approximately 500.000, based on the amounts sold of several season ticket types.
4. **The commuter** is travelling every work day, on the same route: from home to work. He/she is very familiar with the services of NS.
 - Number of people matching this persona: approximately 500.000. This is based on the number of business cards sold, plus the number of fixed route season tickets sold, plus a margin of other customers of this persona without one of those two season ticket types.

To create complete personas, additional information needs to be added. This is done, based on some of the persona components defined by Idoughi et al. (2012) and using internal statistics of NS showing the average travel frequency and behavior of travelers.

For more extended descriptions of the personas, which were also used in the redesign session, see Appendix A.

These personas were validated by showing them to an expert of Customer Service from NS, who mentioned some minor improvements, which were used to improve the persona descriptions.

6.3 SERVICE SELECTION

Out of all the online services of NS, two need to be chosen to redesign. Because the services are used differently by the personas, the channel preferences of the personas are indicated in Appendix B and an overview about which personas use which services can be seen in Appendix C.

Using that knowledge, it has to be determined which service is the most suitable for the kind of personalization by which customer effort is reduced. A service suitable for personalization in this research satisfies the following criteria:

- C1. *The service is used often:* This information is gathered from internal documents of NS, stating the usage of services (e.g. by measuring the usage of Mijn NS by Comscore) and experts of NS with knowledge of service usage.
- C2. *Personalization is possible:* The service is used by multiple personas. This information is gotten from Appendix C, which was generated using input from experts from NS.
- C3. *Customer effort could be decreased:* The customer effort to receive the service is too high, it could become lower through personalization. This information is gathered by talking to Customer Service,

which speaks customers about their efforts, and by observing customer feedback data from MarketResponse (2015).

The first two criteria are about the service being suitable for personalization in general, the third criterion assesses the suitability for the specific goal of this research: reducing customer effort.

The above criteria are applied to the central services listed in Appendix C, as is shown in Table 8. A five-point Likert scale is used to rate the services (Likert, 1932), ranging from 1, which represents a double minus (--) to 5, which represents a double plus (++). The scores are then summed up.

	C1 – Service is used often	C2 – Personalization is possible	C3 – Customer effort could be decreased	Total score
Refund because of forgotten check-in/out	5	5	4	14
Refund because of delay	4	4	5	13
View travel history and card information	4	4	5	13
Receive special offers and information	5	4	2	11
Plan train journey, view prices, view disturbances and delays	5	5	1	11
Overview recent personal messages and notifications	4	4	2	10
View information about railway stations and other background information	2	4	4	10
Stop or change season ticket	3	4	3	10
Lost and found objects	2	5	3	10
View and edit personal data	2	4	3	9
View previous claims	3	4	2	9
Buy tickets	3	2	4	9
Buy season ticket	2	2	4	8
Issue complaint	2	4	2	8
View invoices	3	3	2	8
Requesting temporary OV-chipkaart	1	4	2	7
Buy special offer tickets	2	2	2	6

Table 8 – Personalization suitability of services

From this matrix, three services are identified that would be suitable for redesign, based on having a high total score: Refund because of delay, Refund because of forgotten check-in/out and View travel history and card information.

The first two involve a possible financial transaction between NS and the customer, the last service is about providing personal information to the customer. Because redesigning two types of services gives a broad focus, only one of the two refund-services has to be chosen, together with the travel history and card information service. The refund because of delay-service can be used by all customers of NS, while the refund because of forgotten check-in/out-service is only used by customers with an OV-chipkaart. Also, the refund because of delay-service currently uses paper forms which are quite expensive and the only way to access that service online is via Mijn NS. The refund because of forgotten check-in/out-service on the other hand, does not use expensive paper forms and is accessible online via a web form, without using Mijn NS. Because of this, the most improvement is possible with the refund because of delay-service and therefore, the following two services are chosen to redesign:

- 1. Refund because of delay**
- 2. View travel history and card information**

6.4 THEORY OF INITIAL AND REGULAR EFFORT

Two services will be redesigned to reduce the effort that customers have to make to use those services. That effort level is not the same every time the customer uses the service. Often, the first time a service is used costs a lot of time: the customer does not know the service flow, has to register, create an account, connect his card or needs to find where every button and explanation is located. After that first time, the customer will get used to using the service and does not have to create an account all over again: he can authenticate himself using the account he created before. Therefore, a difference needs to be made between *initial effort*, which is the extra effort needed for a customer to use a service for the first time, and *regular effort*, which is the effort a customer has to make every time he uses the service.

Every service has an initial and a regular effort level. When those two effort levels are put in a graph, a service can be mapped onto that graph according to its effort levels. This is shown in Figure 18, which shows a service having a high initial and a low regular effort level.

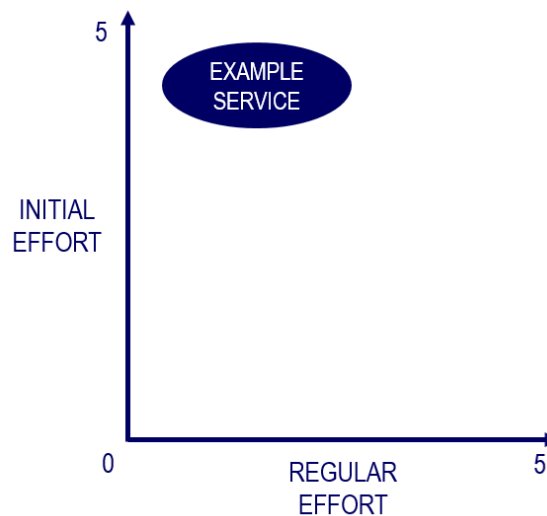


Figure 18 – Example mapping of service

6.4.1 PRIVACY, AUTHENTICATION AND EFFORT

When personal or otherwise sensitive data is involved, authentication is needed to ensure the user is who he says he is. “We deploy authentication systems when we need to control access and protect resources” (Millett & Holden, 2003). The more privacy-sensitive those resources are, the more strict and extensive authentication is required. For example, historical travel data is very sensitive information so in order to view his travel data, a customer needs to authenticate himself extensively. In general, extensive authentication costs more effort than simple or even no authentication. Therefore, a link can be drawn between the privacy-sensitiveness of a service and the amount of effort needed to access that service, as is shown in Figure 19.

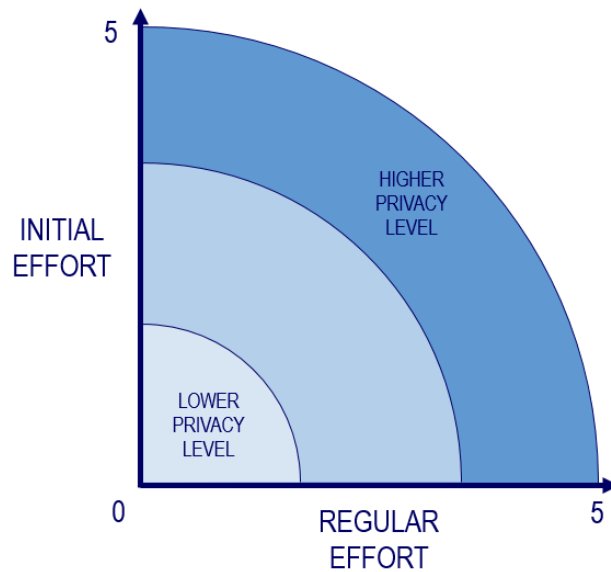


Figure 19 – Relationship between privacy-sensitiveness and effort levels

6.4.2 EFFORT AND SERVICE USE FREQUENCY

Of course, the user would most like a service with no effort required at all. Unfortunately, this is often not possible. There are differences in the preferences of users about whether they specifically prefer or dislike regular or initial effort. This is most obvious when looking at the frequency of service use by customers. Customers that often use certain services, prefer the regular effort level to be low: that is the effort they have to make every time they use the service. Customers that sporadically use certain services dislike a high initial effort: they probably are not going to use the service very often and they want to get a result as quickly as possible. This is also visible in the usage of different channels: sporadic users tend to use the channels that have a low initial effort, like the telephone. Frequent users more often use the personal portal Mijn NS, which has a higher initial effort but a lower regular effort, which benefits them. The channels which have a low regular effort and a high initial effort are mostly digital channels, while the channels with a lower initial effort and a higher regular effort are generally analog channels (Frambach, Roest, & Krishnan, 2007; Looney, Akbulut, & Poston, 2008). This can be visually displayed on the same graph that was shown earlier, as can be seen in Figure 20.

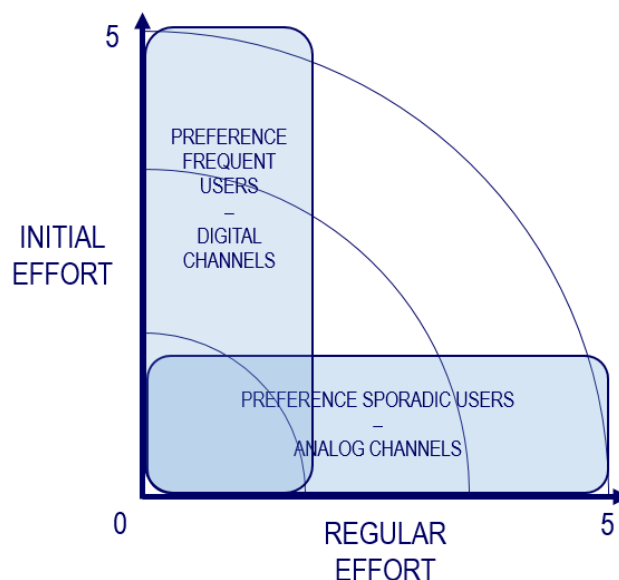


Figure 20 – Relationship between user and channel characteristics and effort levels

6.4.3 **MAPPING A SERVICE TO BENCHMARK AND IDENTIFY GAPS**

There are generally more ways to use a service: via different channels or on different levels of authentication. For example, when wanting to plan a train journey, one could go to the website NS.nl and use its travel planner. Another way to plan a journey could be to log in with a personal account, plan journeys quickly based on historical journeys, save them and receive notifications about future planned journeys. This last way has a higher initial effort because an account needs to be made and, in the case of viewing and using historical travel data, authentication needs to take place. The different ways to access a service and the corresponding levels of effort can be visually displayed, as is shown in section 6.5.

These mappings can be used to benchmark services, to see if a service has an effort level that is too high compared with other services so that can be determined which services should be improved to reduce the effort. Also, different ways of using the services can be mapped to each other and compared with the effort preferences of customers using the service. This way, gaps can be identified and ways to improve the service to match the customers' preferences.

6.4.4 **OBJECTIVENESS OF EFFORT LEVEL MEASURING**

Effort levels can be measured by questioning users about the level of effort they perceived when using the service. This is already being done by MarketResponse, which uses the Customer Effort Score (Dixon et al., 2010) to indicate customer satisfaction (MarketResponse, 2015). However, when these scores are translated into one figure for initial effort and one for regular effort in order to map them like in section 6.4.3, there are two ways in which the mapping could become subjective.

Firstly, the effort scores are affected by someone's expectations: one person may experience a high effort filling in an online form when he did not expect so, while another person is used to that and will give a low effort rating. Therefore, when mapping a service on the framework, averages should be used based on a large group of customers instead of a few, or a group of experts instead of one. Furthermore, this number could be refined by differentiating between the personas defined in section 6.2. When the mapping is done per persona, there is a bigger chance that the mapping matches the person's situation and experience.

Secondly, the regular effort when using a service is not constant. When a user gets used to using the service, it costs less (regular) effort. When, for example, somebody has filled in a form ten times before, it will cost him less effort than when he has only used it one time before. This could be confusing, because it might be unclear which situation the mapped service represents: the regular effort score of somebody using the service for the second time or, for example, for the tenth time. Therefore, there needs to be clearly stated which situation is used to map the service. Another option is to test different scenarios and take the average of those scenarios.

When comparing the effort scores of different services with each other, the two mentioned effects are cancelled out. Mapping and comparing different services is therefore also a suitable way to use the effort framework.

6.5 **GAP IDENTIFICATION USING INITIAL AND REGULAR EFFORT**

Using the theory about initial and regular effort defined in section 6.4, the gaps in the current situation can be identified. This was done in a brainstorm session with experts from NS. The gap analysis resulted in a direction for personalization to be applied: it showed where personalization would give the most improvement.

6.5.1 **METHOD**

A brainstorm session with three experts from NS was used to map the initial and regular effort levels onto existing online services NS offers. Two services were chosen to map the effort on: refund because of delay and viewing travel history. The effort levels were first filled in from the viewpoints of the four personas defined in section 6.2. Also, the experts assessed the effort levels from their own situation. After this, the effort levels of both services were analyzed and conclusions were drawn about where the largest gaps are and which personas are involved. Using the gaps as a focus for improvements, ideas for decreasing the gaps were generated.

This was done by first letting the participants write down their thoughts and analyses for themselves before discussing it in the group. This approach is also important in Group Decision Support Systems and reduces the chance a discussion is heading off-track (Desanctis & Gallupe, 1987).

6.5.2 PERSONAS AND EFFORT LEVELS

The main goal of the commuter persona is to have a low regular effort because he/she uses the services of NS regularly. The commuter has a high initial effort level, but a low regular effort level for the Mijn NS variants of the services, and this fits his needs.

The main goal of the other three personas is to have a low initial effort because they use the services less regularly and they would just like to use the service for a single time. The other three personas have a higher initial and somewhat higher regular level for the Mijn NS variants, because of less experience with technology and/or less experience with services of NS. Therefore, the service variant they will use is calling to Customer Service or filling in a paper form, because of the somewhat lower initial effort involved. However, this leads to higher costs for NS and still provides a quite high effort level.

6.5.3 SERVICE EFFORT LEVELS

The different variants of the two selected services were mapped on the effort framework. Then, discrepancies were analyzed between the effort levels of the services and the wishes of the different personas.

The experts concluded that the online channel should provide a variant of the services that will satisfy the personas' needs for a low initial effort. Also, offering an online service is cheaper per transaction than e.g. a call to Customer Service. Another conclusion was that authentication costs a lot of effort for the personas, especially the personas that are not experienced with technology or with NS. This is the main reason the initial effort for Mijn NS is at a high level for those personas. Therefore, a redesign of online services of NS should focus on lowering the effort that is needed for authentication.

Summarizing, the experts concluded that the two discussed services have effort levels that are too high for three of the four personas. A solution should be designed by modifying the online services of NS, such that authentication matches the persona type and the effort involved with authentication is reduced. Several improvement ideas were mentioned, which were taken into account when creating the redesign. A summary of the comparison between the current and desired situation can be seen in Figure 21.

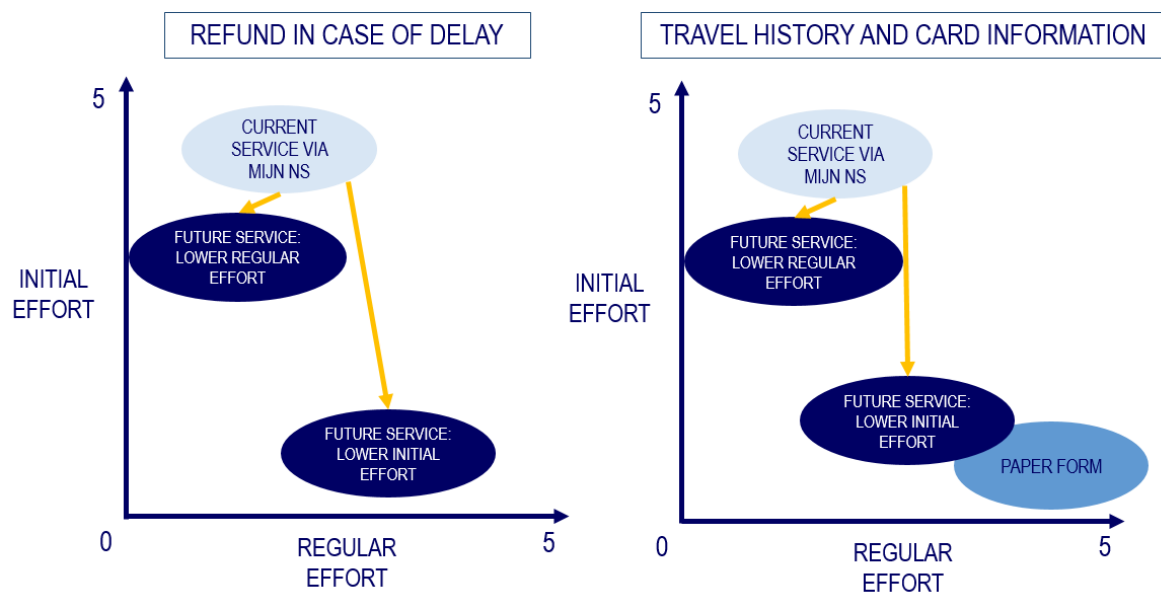


Figure 21 – Comparing current and desired situation for selected services



7 REDESIGN

7 REDESIGN

In this chapter, the redesign is explained. First, the general idea of personalizing authentication through layered authentication is shown and the designed authentication levels are explained. Then, in sections 7.2 and 7.3, both chosen services are presented in a redesigned form so that they fit in the step-up authentication framework. Section 7.4 summarizes the redesign.

7.1 REDESIGN: PERSONALIZING AUTHENTICATION FOR THE ONLINE SERVICES

As was determined in the expert session described in section 6.5, the focus of the redesign should be to personalize the authentication level for the online services of NS. It was found that the greatest reduction in customer effort can be gained in this specific area.

In the current situation, the two chosen services are only accessible online via Mijn NS. In order to access the service, an account has to be created and personal data and preferences have to be filled in. Possibly, the customer address has to be validated by sending a letter to the address with a code, which then has to be filled in at Mijn NS. Subsequently, the OV-chipkaart has to be connected to the account. The customer can do this by presenting his card at the vending machine at one of the train stations, or at another card reader, present e.g. in big supermarkets.

There is currently only one level of authentication for online services of NS which leads to a high initial effort. Also, there is a discrepancy here between the authentication level currently in use and the authentication needed to make use of the services. For a number of services, the demanded authentication level is higher than necessary to provide the service. Some users just want to use a service a single time, and the effort needed to fully authenticate is too high for those customers. This leads to a decrease in customer satisfaction. There needs to be a better match between the authentication level of the user and the authentication level needed to use the service: layered authentication, also called step-up authentication.

Other authentication factors, like biometric factors or a smartphone application, could be used to further reduce the effort required to authenticate. An overview of authentication factors can be seen earlier in this thesis, in section 5.1. Instead of remembering an email address and password, customers would just have to swipe their finger on a sensor or look in the webcam or camera. However, this does not resolve the problem of e.g. customers having to prove they possess an OV-chipkaart or live at a certain home address: those things are not part of a customer's identity. Therefore, the possibility to use other authentication factors does not resolve the need for layered authentication and should be used in addition to this. This subject is further explored in section 11.7, when discussing future research opportunities.

7.1.1 INTRODUCTION TO LAYERED AUTHENTICATION

Decades ago, US Government and Defence systems also needed to differentiate between employees with high and low clearance and access. For this, multilevel security¹ was developed, an authentication system with multiple authentication and access levels, from Unclassified to Top Secret (Smith, 2005). This system was mainly directed at the protection of information. More recently, service-oriented organizations are applying the same principle to the layered access of their services. STORK 2.0, a European research project which stands for Secure idenTity acrOss boRders linKed 2.0, aims to establish a single European electronic identification and authentication area. It has defined four authentication levels applicable to e.g. governments, banks and health institutions providing services at multiple levels (Körting & Ombelli, 2011). The Dutch government is applying those levels to their customer services, making them accessible at multiple levels of authentication (The Standardisation Forum, 2014) and SURFnet does the same for the services related to higher education (Oostdijk, Harst, & SURFnet, 2014).

¹ Multilevel security and layered authentication or step-up authentication are different from the frequently mentioned term Multi-Factor Authentication (MFA). MFA is about having multiple ways to authenticate oneself, named factors, which can be used in combination to increase the authentication level. Examples of those factors are regular passwords, security tokens and biometric information and were discussed in section 5.1. MFA can be used in a step-up authentication approach to facilitate authentication at different levels (IBM, 2013).

AirBnB is a commercial organization which also applies the layered authentication-approach to its services. It asks users to verify their identity through a third party service. Once a user's ID is verified, the user has access to more locations to browse, because of the increased trust in the user (AirBnB, 2013). VISA applies a variant of it, by checking if a transaction is possibly fraudulent, and if it is, requiring a higher authentication level (VISA, 2014).

Layered authentication is also a solution to effort gap discovered in last chapter: offering authentication levels which match the needed authentication for the service the customer wants to use. Authentication then does not happen on a single level anymore, but multiple levels are defined, which can vary from not authenticated at all to fully authenticated. This is also called step-up authentication (Oostdijk et al., 2012). Some services will be available on multiple authentication levels. This means that services will have multiple versions: easy-access, simple versions for lower authentication levels and more extended versions for the customers who are in a higher authentication level.

7.1.2 ENCOURAGING CUSTOMERS TO 'STEP UP'

The goal of this approach is to encourage customers to authenticate themselves further, to go to the next authentication level. This benefits the customers, because more and better services will be available to them, leading to a higher satisfaction. Also, increased authentication means that NS knows more about the customer and can use that knowledge to personalize even more. Therefore, it is beneficial for both NS and its customers that they proceed to higher authentication levels.

In order to motivate customers to take that extra step, the process of doing that should be made as easy and transparent as possible. It should not be limited to some "authentication page" hidden at the website somewhere, but embedded in the services themselves, so that the barrier is as low as possible. How and when the customer is encouraged to step up, should also be personalized so that the chance that the customer accepts the invitation to step up, is as big as possible. An example of this can be found at Booking.com, which at the end of a booking process makes it easy to create an account: customers just have to fill in their desired password and an account is made for them, based on the information they already entered in the booking process. Because the moment of notification is carefully selected, the customer will probably accept the invitation to make an account.

In the NS case, customers can also be motivated by sending emails to known customers, in which a link is displayed that creates an account for them. The customers just have to click the link and fill in their desired password. In the same way, an account can be created or a card can be connected pro-actively when a customer buys a season ticket at the website of NS. In this way, the account is also immediately connected to the customer NS knows.

7.1.3 DESIGNED AUTHENTICATION LEVELS

The core of the step-up authentication approach naturally consists of the authentication levels used. For the online services of NS, a number of authentication levels will be defined. Defining too many levels makes the online services too complex, so that customers do not understand the logic anymore. Also, when services need to be defined at a lot of authentication levels, the IT landscape will become more complex, leading to higher development and maintenance costs.

The decision to use certain authentication levels is based on the data that needs to be authenticated: the difference between authentication levels is the validation of information about the customer. However, not all data related to a customer needs to be authenticated and therefore, not all customer data influences authentication levels. For example, whether a customer has entered his most used train route has no influence on his level of authentication. That data is just needed to execute a service, but has no meaning in the authentication process, when the identity of the customer is verified.

In the case of NS, there are two types of information that can and will be used to verify his identity: personal account and OV-chipkaart. A personal account is needed, for example, to be able to record and show personal information about the customer, and showing his service history with NS. The certainty of ownership of a certain OV-chipkaart is needed, for example, to show travel history and season ticket data. Other customer data, such as phone number,

home address and contact preferences, are used to deliver services but not necessary for authentication. A summary of this is shown in Figure 22, which highlights the two attributes relevant for authentication.



Figure 22 – Overview of relevant customer data attributes

Based on above two authentication attributes, three authentication levels can be defined, as graphically displayed in Figure 23. At level 0, the user has neither got an account, nor has he connected a card to his account. At level 1, the customer has logged in to his account but has not connected a card to his account. At level 2, the customer has logged in and also has connected a card to his account. Connecting a card to an account means that the account owner has proved he possesses a certain OV-chipkaart.

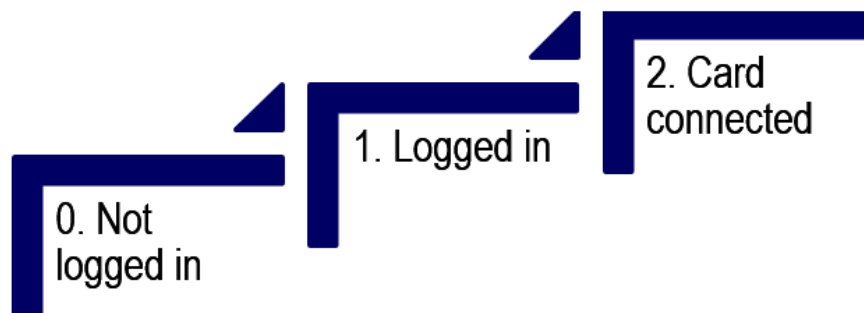


Figure 23 – Layered authentication levels

When the customer is not logged in, personalization is still possible based on cookies stored on the customer's computer. Cookies enable recognition of some of the customer's data and therefore makes personalization possible, even without explicit authentication steps. However, even though this enables personalization, data from cookies is not trustworthy enough to actually authenticate a customer and therefore, customer recognition through cookies does not affect authentication levels.

Next to the levels above, it is also possible to partially prove that somebody is the owner of an OV-chipkaart. This makes it possible to view some information about the card, even when the customer is not in the highest authentication level. The partial authentication of the OV-chipkaart is done by just asking information about the customer without him needing to prove he has the card in his possession: he just needs to provide one

authentication factor instead of two (see section 5.1 for more information about authentication factors). Because of privacy and misuse reasons, this has to be done every time a customer accesses a service. Therefore, this does not lead to a higher authentication level, but is a separate authentication possibility.

Connecting an account to an existing customer record in the NS database is also some way of authentication, because it gives access to the personal information and history of that customer. However, it does not give access to other services and therefore it is not counted as a separate authentication level in the in the scheme.

It is also possible to take multiple authentication steps at once. For example, a customer can buy a season ticket and request a new OV-chipkaart for that. When he creates an account in that same process, he has also proven that he is the owner of the new OV-chipkaart requested by him. Therefore, the customer will go to the highest authentication level in one step, skipping the middle level.

7.1.4 AUTHORIZATION: SERVICES AT AUTHENTICATION LEVELS

Different authentication levels give access to different services. Some services are just available at a single authentication level. Other services are available at more than one level, but the service could be filled in differently at different levels.

A summary of service characteristics at the different authentication levels can be seen in Figure 24.

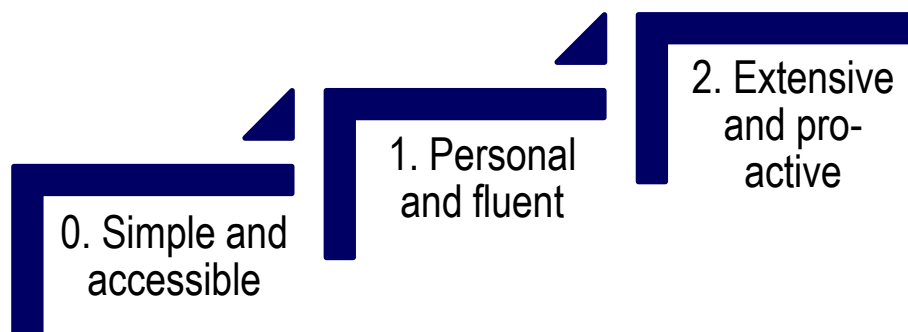


Figure 24 – Summary of services at authentication levels

At the lowest authentication level, the services should be as accessible and understandable as possible, to encourage people to switch from offline to online channels and to lower customer effort. This can be done by making the services look similar to offline alternatives, for example by making an online form look similar to a paper form that would formerly be used. Also, because the customer is not known well, the services are quite simple and do not contain any privacy-sensitive functionality. The services at this level do not display any personal information, but merely validate the information the user fills in.

At the middle authentication level, the customer has logged into his account. Therefore, personal customer information the customer fills in will be remembered and showed the next time the customer wants to use a certain service. This saves time for the customer and enables him to use the services more fluently. Also, previous claims and service history are shown, to make the online environment more personal.

At a higher authentication level, the customer is fully trusted. Therefore, he can receive privacy-sensitive and extensive functionality. Also, NS knows more about the customer that has been fully authenticated. That personal information will be used to pro-actively provide services whenever possible, to further decrease customer effort and increase customer satisfaction. Pro-active and extensive services are also an incentive for customers to fully authenticate themselves.

Not all services will be able to be accessed on every authentication level. Services can be categorized with respect to that as follows.

Some services can be accessed on all three authentication levels. They do not require authentication, however, when authenticated, the service can be enhanced or automated. An example of this is the journey planner. This is accessible to every customer, whether logged in or not. However, when a customer is logged in, planning history and regular journeys can be remembered to make the planning process smoother.

Other services that are connected to an account and are only accessible by people who are logged in: people who are at the middle or high authentication level. An example of this is the viewing and editing of personal information connected to an account.

Also, there are services for which card authentication is needed. They are only fully accessible by people who are at the highest authentication level. Customers who are not at the highest authentication level, can access a limited service version by partly authenticating their card. An example of this is Refund because of delay: when customers have not connected their card to their account, they can still file a claim via a web form.

All online services can be fit into one of the above categories. This gives an overview of which services are available on which authentication level and will be used to redesign two chosen services in detail. The mapping of all online services, listed in Appendix C, to the above categories can be seen in Table 9.

Name of service	Authorization category
Refund because of delay	Card authentication needed
Refund because of forgotten check-in/out	Card authentication needed
View travel history	Card authentication needed
Generate travel history overview	Card authentication needed
Overview recent personal messages and notifications	Account needed
View and edit personal data	Account needed
Stop season ticket	Not available online
Change season ticket	Account needed
Buy tickets	Available at all authentication levels
Buy special offer tickets	Available at all authentication levels
Buy season ticket	Available at all authentication levels
Issue complaint	Available at all authentication levels
Lost and found objects	Available at all authentication levels
Receive special offers and information	Available at all authentication levels
View invoices	Account needed
View previous claims	Account needed
Plan train journey, view prices, view disturbances and delays	Available at all authentication levels
View information about railway stations and other background information	Available at all authentication levels
Request temporary OV-chipkaart	Available at all authentication levels
Check status OV-chipkaart (e.g. checked in/out, current balance)	Card authentication needed

Table 9 – Services and authentication categories

7.1.5 MULTICHANNEL APPROACH

There are two main online channels: smartphone and computer. The channels should be connected to the same back-end systems, so that the services are the same, whether one uses the smartphone or the pc. Both channels should use the step-up authentication model and the authentication should be cross-channel as well: when a user

has created an account on the pc, he should be able to log in with it on his smartphone, and vice versa, when a user has connected his card via his smartphone, he should be able to see his travel history on his pc.

However: not necessarily the same services need to be supplied at the different channels. For example: sorting and filtering travel history and generating declaration overview in PDF will probably not be needed on smartphone. But filing a claim during a journey should be possible and be more prominent at the smartphone application.

7.1.6 SERVICE PRINCIPLES

Using the previous sections, services in the desired situation can be worked out in more detail. To guide decisions that have to be made at lower levels, principles can be defined. The Open Group explains why they add value: "Architecture principles define the underlying general rules and guidelines for the use and deployment of all IT resources and assets across the enterprise. They reflect a level of consensus among the various elements of the enterprise, and form the basis for making future IT decisions" (The Open Group, 2011). NORA, the architecture framework for Dutch municipalities, contains ten basic service principles, indicating how services should be designed (Nederlandse Overheid Referentie Architectuur, 2014). These principles are also applicable for NS and can be used to fill in more details of the layered authentication approach. The basic principles defined by NORA, applied to the situation of NS are the following, with the principles that are the most relevant to this situation displayed in italic:

1. *Pro-active: NS should give every customer the services he or she needs*
2. Findable: services of NS should be easily findable for customers
3. *Accessible: everyone should be able to access services of NS*
4. *Uniform: NS should provide consistent services across different channels*
5. Bundled: NS should provide related services in a bundled way
6. Transparent: customers should have insight in their relevant information
7. *Necessary: NS asks customers only necessary and no redundant questions*
8. Confidential: NS handles customer information confidentially
9. Trustworthy: NS keeps the promises it does to customers
10. Feedback: customers can always give feedback about the services they receive

7.2 REDESIGN: REFUND BECAUSE OF DELAY

European Union law states that refund must be given in case of delay of more than 60 minutes (European Union, 2009). NS has extended this law by also giving refunds in case of a delay between 30 and 59 minutes. Different tariffs have been established for the different types of tickets NS is offering.

Approximately 650.000 claims are being filed each year, with a total value of 6,5 million euros (Treinreiziger.nl, 2011). There are two ways of filing a claim with NS in the current situation: via a paper form, which can be ordered on the website, by telephone or taken at a local NS balie, or via Mijn NS, for which an account must be created and an OV-chipkaart must be connected. Currently, the online version of this service is therefore only accessible at the highest authentication level. The brainstorm resulted in the conclusion that people should also be able to access this service while not or partially authenticated, in order to improve the accessibility of the service.

For filing a claim in case of a delay, only little data about the customer needs to be known. A card number needs to be entered, together with the details about the journey at which the delay was experienced, in order to validate the truthfulness of the claim. The customer's name and email address are needed to be able to have a way of contacting the customer. If the customer has connected his/her card to an account, the refund can also be paid out by a bank transaction and for this, a bank account number is needed. If this is not the case, the money can be refunded by increasing the balance on the OV-chipkaart with which the travel was made.

7.2.1 FRAUD ASPECTS

When the authentication barrier is lowered, an increase in fraud using claims is possible. Measures should be taken to keep the risk of fraud low. Claims for an OV-chipkaart which are not fully authenticated will be paid out as a

balance increase on the chipkaart. This makes sure the customer needs to possess the card in order to receive the refund and reduces the chance at fraud.

With paper tickets, fraud could happen when people fill in other people's card numbers and travel data with their own bank account number. Via the web form, they do not need to send the physical card via mail anymore. However, in the current situation fraud is also possible when paper cards are stolen from other people. Also, as a fraud detection method, NS can check if people try to claim multiple times on a single timeframe.

7.2.2 FINANCIAL ASPECTS

There could be an increase of costs at the side of NS because more people will file a claim because of delay. However, claims filed via the online channel are easier to process and therefore the process costs will decrease. Also, the lowering of the authentication barrier will probably lead to higher customer satisfaction, which possibly has positive effects on sales figures. A balance has to be found between customer friendliness and cost-effectiveness. Experts will be consulted about this subject, to determine if the redesign finds that right balance.

7.2.3 SERVICE AT DIFFERENT AUTHENTICATION LEVELS

The redesigned services is filled in differently at the three defined authentication levels. Figure 25 shows which three variants of the service can be used by customers.

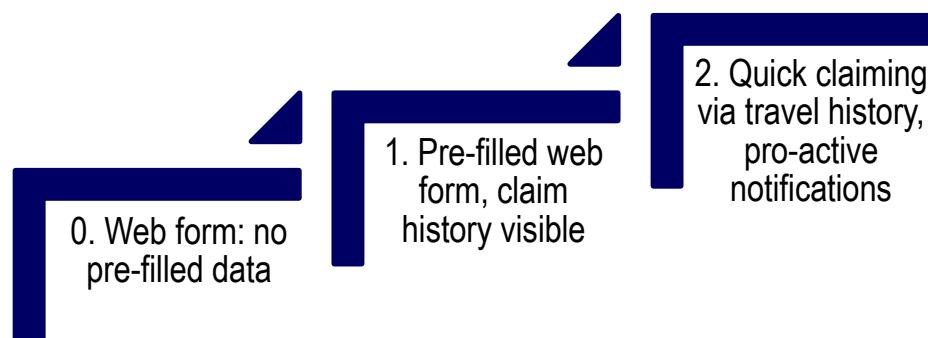


Figure 25 – Variants of refund in case of delay service for authentication levels

When a customer is not logged in, a web form can be filled in in which the minimal information is entered. A link is sent to the customer's email with the claim number, so that the customer in the future can inquire about the status of the claim.

When a customer is logged in but has not connected an OV-chipkaart, the service is essentially the same as for customers who are not logged in. NS remembers the personal details of the customer so that he/she does not need to fill those in each time a claim needs to be filed. Also, previous claims can be viewed, together with their current status: whether they are approved or disapproved.

When a customer has connected an OV-chipkaart, a claim in case of delay can be filed through the travel history overview, just like the service currently works at Mijn NS. This is already a very fluent and effort-efficient way of filing a claim: in under a minute, a claim can be filed. Optionally, an email can be sent to the customer if he/she has probably had a delay or refund can be pro-actively paid out when there is enough certainty that the customer had a delay. This is currently already happening with NS International.

7.2.4 OTHER FUNCTIONALITY

It will be possible to not only file claims for an OV-chipkaart, but also for other travel tickets, like a paper chip-card or an e-ticket. This will be possible in all situations, whether an OV-chipkaart has been connected to an account or not.

Also, this service will be available on smartphones via an application, for even quicker claim filing when and where the customer wants to. The service is the same as the computer version, so that consistency is guaranteed.

Currently, customers have to wait until 48 hours after they have completed their journey. This increases their effort, because they cannot file their claim at the moment when it is relevant, namely during or just after their journey. Therefore, it will be possible to file claims earlier than 48 hours after the journey and even when the journey is not finished yet. NS will temporarily save the claim until the transactional data are available, and then process the claim.

When a customer has created an account, he will be able to connect previous claims to his account from the time that the account was not created. This happens by sending an authorization link via email to the address that the claim was filed on.

7.3 REDESIGN: TRAVEL HISTORY AND CARD INFORMATION

Everybody with an OV-chipkaart has the possibility to view his/her travel history and card information. This can be just out of interest, but is often used to check if somebody has recently forgotten to check out or not, to make an overview of travel history and costs for the employer or to file a claim based on past travels. There are two kinds of information about an OV-chipkaart that can be viewed: *current status* (whether the card is checked in or out) and *current balance*.

Travel history can be seen via NS services in two ways. Firstly, it can be seen by going to a vending machine at a train station: when an OV-chipkaart is displayed, the last ten transactions can be displayed on the screen. The other, more extensive option is to view one's travel history via Mijn NS. Also, TLS, the overarching organization that connects all transport carriers, offers a service to view travel history on their website OV-chipkaart.nl. The travel history overview via Mijn NS is visited almost 1.8 million times in 2014, which makes it by far the most popular part of Mijn NS.

Card information can be retrieved in three ways. Firstly, it can be seen at a vending machine. Secondly, card information is visible at the gate or validator when checking in or out. Thirdly, the status and balance can be seen via the smartphone application of NS, Reisplanner Xtra.

This redesign effort looks broader than the display of travel history records. This is because customers use this service also because they would like to know if they have recently forgotten to check out and to file a claim regarding the forgotten check-out. The redesign should therefore be done with those goals in mind as well.

7.3.1 PRIVACY ASPECTS

A customer's travel history related to a card is privacy-sensitive information. For instance, this was recognized by the Dutch Data Protection Authority, which has made sure NS does not use this data for direct marketing purposes (College Bescherming Persoonsgegevens, 2012). Also, in 2014, the minister of Safety and Justice, Ivo Opstelten, wanted to store all personal travel data for criminal investigation purposes and this was fiercely opposed by a number of political parties, stating that the privacy of customers was not guaranteed. This forced Opstelten to cancel the plan (Nu.nl, 2014).

We make a distinction between the information visible at the partial card authentication level and the full authentication level (see section 7.1.3). There is no information about the card that can be viewed without any authentication. However, there is some information that can be shown to the customer when he has partially authenticated himself: authentication 'light'.

7.3.2 SERVICE AT DIFFERENT AUTHENTICATION LEVELS

In this case, the service which can be received and the personal information shown depends on to what extent the customer has proved he is the owner of the OV-chipkaart. As was explained in section 7.1.3, there are two ways in which the customer can do this: partially, e.g. via control question(s), and fully, by connecting his card via a card service code.

Connecting an OV-chipkaart and thereby fully authenticating it can only be done when logged in, but partial card authentication can be done both when logged in and when not logged in.

The redesigned service functionality is described in Figure 26 based on the card authentication levels.

Partial authentication	Full authentication
• View card status • View card balance • View anonymous travel data of past 30 days, without times and subscription, not searchable or sortable • View deviant travel records of past 30 days with claim links	• All information from the partial authentication level • Full travel data: view, sort, filter • Generate declaration overview (also automatic) • View previously generated overviews • File claims directly from travel history overview • View subscription data • View personal information related to card holder

Figure 26 – Functionality available at card authentication levels

Unfortunately, NS does not always know the actual balance of a card: it only knows the balance after the last transaction with NS. If in the meantime, there was a transaction with another transport company, the balance and card status known by NS is possibly not actual anymore.

7.4 SUMMARY OF REDESIGN

In this chapter, a redesign was made of two online services based on layered authentication. Three authentication levels were defined: the basic level where the user is not identified, the middle level, when a user is identified and the highest level, when a user has connected his OV-chipkaart to his account. Users will be encouraged to increase their authentication level, which is beneficial for the customers as well as for NS.

Based on the layered authentication approach, two services were redesigned in order to enable customers to partly or fully use the service, even when they are not at the highest authentication level. In the process of refund because of delay, a possibly higher risk of fraud and higher refund costs were accounted for. The redesign for the travel history and card information process has taken into account privacy aspects relating to the privacy-sensitiveness of travel history data.

A man with dark hair, wearing an orange sweater, is shown in profile, focused on his work. He is sitting at a desk, typing on a laptop. The background is a bright, modern office space with large windows, indoor plants, and contemporary furniture. A blue banner with white text is overlaid on the bottom of the image.

8 REDESIGN DEMONSTRATION AND EVALUATION

8 REDESIGN DEMONSTRATION AND EVALUATION

In this chapter, the redesign from last chapter is demonstrated and evaluated. First, the method of demonstration and evaluation is explained. Then, the redesign is demonstrated using HTML mockups. After that, the results of the validation are listed and compared to the knowledge from literature. Finally, conclusions are drawn about the suitability of this solution to solve the problem it was designed to solve.

8.1 HYPOTHESES

According to the DSRM, evaluation means “comparing the objectives of a solution to actual observed results from use of the artifact in the demonstration”. The objectives of a solution are defined in section 6.1. From this objectives, a number of hypotheses about the effects of the redesign are derived.

- Hypothesis 1: The customer effort to receive both redesigned services is reduced
- Hypothesis 2: The number of people that use NS services online compared to offline increases when this redesign is implemented
- Hypothesis 3: The number of people creating an account and connecting their OV-chipkaart increases

8.2 DEMONSTRATION AND VALIDATION METHODS

Methods used to demonstrate the redesign were HTML mockups, also called wireframes, which look like an actual website but are not connected to back-end systems. These wireframes were used to validate the redesign by expert opinion, using semi-structured interviews and a questionnaire afterwards.

8.2.1 DEMONSTRATION THROUGH HTML MOCKUPS

To show that the redesign meets its solution objectives, it could be demonstrated and tested with actual customers in a real-life situation, where customers want to use the services that were redesigned. This could be done by implementing the redesign into the current NS website and letting customers try and use the redesigned service using e.g. A/B-testing. Unfortunately, this is not possible in this research because of time and permission constraints. It would take too much time to fully develop, test and implement this redesign into the NS IT infrastructure. Furthermore, there needs to be permission from higher management to do this, which they will probably not give.

Therefore, mockups were made that look like an actual working website with interactive elements. This simulates the redesigned services with about the same user experience, but costs far less time. It is also one of the methods mentioned by Wieringa for making a validation model (Wieringa, 2010). Mockups were made using the tool Axure (<http://www.axure.com>), which was chosen because of the low effort needed to make appealing and working wireframes in HTML, its possibility to host them online and the fact that it was free for university students. The uploaded wireframes can be found at <http://tiny.cc/personalizeNS>. An example of a wireframe can be seen in Figure 27 and other screenshots can be found in Appendix E. The wireframes are in Dutch because of the primary use being internal validation.

[Consumenten](#)
[Zakelijk](#)
[NS International](#)
[Over NS](#)

[Welkom A.W. van den Berg!](#)
[English](#)
[Contrast](#)
[A A A](#)

[Overzicht](#)
[Plan een reis](#)
[Mijn Reishistorie](#)
[Mijn Producten en Kaarten](#)
[Webshop](#)
[Contact](#)

Kaartinformatie

Op deze pagina kunt u:

- Bekijken of u momenteel in- of uitgecheckt bent met uw OV-chipkaart
- Bekijken of u in de afgelopen 30 dagen bent vergeten uit te checken, en versneld geld terugclaimen
- Geanonimiseerde reisgegevens van de afgelopen 30 dagen bekijken

Dit is een formulier met gelimiteerde opties.
Wilt u het overzicht van uw reishistorie bekijken, automatisch uw reishistorie in uw mailbox ontvangen, uitgebreid zoeken en eerder gemaakte reishistorieoverzichten bekijken?

Maak gratis een account aan en koppel uw OV-chipkaart.

OV-chipkaartnummer: 3528 0200 1234 1234

Naam kaarthouder: A.W. van den Berg

Geldigheid kaart: Oct 2019

Controle vraag: in welk station bent u als laatste ingecheckt? Zwolle

Toon kaartinformatie

Kaartoverzicht

Kaartnummer: 3528 0200 1234 1234

Status kaart: Uitgecheckt (laatst bijgewerkt: 16-09-2015 11:45 uur)

Saldo kaart: €8,53 (laatst bijgewerkt: 16-09-2015 11:45 uur)

Afwijkende reizen in de afgelopen 30 dagen:

Datum	Vertrek	Bestemming	Afwijking	Dien claim in
15-09-2015	Ermelo	-	Niet uitgecheckt	link
08-09-2015	Haarlem	-	Niet uitgecheckt	link

[Download reisgegevens van de afgelopen 30 dagen](#)

De reistijden en persoonlijke gegevens bij de kaart worden niet getoond om privacyredenen.

Figure 27 – Screenshot from HTML wireframe

These wireframes can be demonstrated and evaluated by showing them to NS customers and asking those customers what they think of the redesign, e.g. through an online questionnaire or through the NS customer panel. However, the redesign and the idea behind it, step-up authentication, are not easily understood by customers who do not have much experience with NS and its services. Also, to give a good understanding of the idea, the respondents would have to think like other types of customers, which is quite hard for people in an online questionnaire. An online questionnaire would thus probably not carry trustworthy results.

8.2.2 VALIDATION THROUGH EXPERT OPINION

Wieringa (2010) defines four methods for treatment validation: expert opinion, single-case mechanism experiment, technical action research and statistical difference-making experiment. The last three methods validate the solution by actually implementing it into a problem context and collecting the results from what happens. The first method, expert opinion, does not do this and lets experts imagine what would happen if the solution would be implemented into the problem context it was designed for.

From the four treatment validation methods defined by Wieringa (2010), only expert opinion remains as a viable option for this research. The other three cannot be carried out because an actual implementation and test with customers will cost too much time and will probably yield less trustworthy results. Therefore, expert opinion is chosen to validate the redesign. Twelve employees of NS were asked as experts, because of their high experience with services of NS and their ability to imagine how different types of customers, the types defined as personas, perceive those services. Experts from specific fields and with backgrounds were selected, among others from Customer Service, Fraud Detection, Marketing and Change Management. Also, some experts were selected because they did not have any relationship to this subject matter and have an unbiased view. For an overview of all spoken experts from inside NS, see Appendix D.

8.2.3 INTERVIEWS AND QUESTIONNAIRE

Asking experts about their opinions can take place in interviews. Three types of interviews can be defined: structured, semi-structured and unstructured interviews (Bernard, 1988). Semi-structured interviews are most suitable for the expert interviews in this research, because they provide the possibility to interview experts about certain topics that are fixed, while still being able to pursue topical trajectories that also seem interesting (Cohen & Crabtree, 2006). The interviews can take place in an individual or a group setting. In this research, an individual setting has been chosen, to ensure that experts can give their own opinion and are not distracted by others.

The interviews, together with the redesign demonstrations, were set up in six phases, as follows:

1. **Introduction** of the general idea: layered authentication in three steps
2. **Demonstration** of the travel history and card information service
3. **Demonstration** of the refund with delay service
4. **Validation questions** about the redesigned services, derived from the hypotheses
5. **Validation questions** about the general idea of layered authentication and related subjects, derived from the hypotheses

In the interviews, experts mentioned some new points which needed to be verified against other experts' opinions, to see if there was consensus among the experts about those subjects. Also, the hypotheses needed to be quantified. For this, a questionnaire was set up and sent to the experts after the interviews had taken place. A detailed account of the interview setup, as well as the questions and answers from the questionnaire can be found in Appendix F.

8.3 EVALUATION RESULTS

The answers of the experts at both the interviews and the questionnaire can be used to validate the hypotheses and collect further feedback about the redesigns or the research in itself. The evaluation results are divided into results regarding the hypotheses and other remarks which can be used to improve the redesign, lead to further research or improve the IT impact analysis.

8.3.1 HYPOTHESIS 1: THE REDUCTION OF CUSTOMER EFFORT

All experts agree that through the redesign, customer effort is reduced and customer satisfaction will go up on average. The main reason for this is the lower authentication barrier for customers who are not fully authenticated. Experts differ about how big the group will be for which the effort level will improve, which is the group that currently does not use online services of Mijn NS but using the redesign is able to use the services while not being fully authenticated. Five out of eleven experts think the group size will be approximately 100.000 – 250.000 customers, about 1 – 2.5 percent of all customers of NS. This is the most given answer. The other answers are quite broad: two experts think the size will be below 100.000 customers but another expert thinks the group affected will be bigger than 1.000.000 customers.

8.3.2 HYPOTHESIS 2: GOING FROM OFFLINE TO ONLINE

Experts agree that there will be more people using online services in the redesigned situation than there are currently. This aspect will therefore lead to less service costs because cheaper channels are used. However, experts do not agree about how big the group is that makes the switch from offline to online. Again, most experts think the group size is somewhere between 100.000 and 250.000 customers that are affected, although the average estimate is lower than at the previous question.

8.3.3 HYPOTHESIS 3: THE AMOUNT OF ACCOUNTS AND CARDS CONNECTED INCREASES

Some experts think that when account creation and the connection of a card to an account is stimulated and that process is made fluent, the number of customer accounts with connected cards increases. Also, a factor that will lead to this is that services at higher authentication levels offer clear benefits and added functionality. Other experts mentioned in the interview that, because services are available for non-logged in users, most people will not take that extra step of logging in and stay at the lowest authentication level.

In the questionnaire, however, all experts indicate the number of newly created accounts per month will increase. Nine experts think this will be an increase of less than 20 percent of the 25.000 accounts that are created per month, while two experts think it will be more than 20 percent. The majority of experts also think more cards are going to be connected to user accounts because of the increased accessibility of the services. Eight experts think the amount of new cards connected per month will increase with less than 20 percent while one expert states that the increase will be higher than 20 percent. One expert states the amount of monthly new connected cards will decrease with less than 20 percent and two experts state that amount will stay the same.

In order to increase the amount of created accounts and connected cards, a balance has to be found. On the one hand, the lowest level of authentication should provide enough functionality to attract customers from the offline to the online channel. On the other hand, higher levels of authentication should provide enough added value for customers to go to those higher levels of authentication. The experts think the redesign finds this balance, according to their answers to the questions in the questionnaire.

8.3.4 POSSIBLE INCREASE IN NUMBER OF CLAIMS AND REFUND COSTS

When the barrier to file claims in case of delay is lowered, the risk is that more customers will file claims. This could lead to higher payout costs and higher personnel costs because of the increase in claim validation work. However, when customers use online channels instead of the paper form, the process costs could go down.

Experts think the number of filed claims will increase, nine out of eleven think this will be with less than 20 percent and the other two think it will be with more than 20 percent. Regarding the total costs of refund in case of delay: ten out of eleven experts think this will increase with less than 20 percent and one thinks the total costs will decrease with more than 20 percent.

When asked about their opinion about the increasing claim numbers and costs, all of the experts indicate the cost increase should not be a reason to renounce the changes as proposed in the redesign. They state that customers have the right to refund in case of delay. It must be noted that these experts do not have financial responsibility for the online services, so they might be understating the importance of keeping costs low.

8.3.5 SMARTPHONE APPLICATION

An expert mentioned that a smartphone application regarding services would have a lot of added value for customers. In the questionnaire, the other experts were asked if they agreed. All experts did agree, indicating a smartphone application would have minor (five out of eleven) or major (six out of eleven) added value, although one expert noted that the services need to be carefully chosen to match the mobile platform. NS should not just copy everything from its website and put it in an application. For example, a detailed and extensive travel history overview will not be suitable for small screens and will also probably not be what customers are looking for when requesting their travel history via a mobile application. Instead of that, a summary should be provided of the most relevant travel history information.

When the refund in case of delay-service is also delivered via a smartphone application, it is possible that the number of filed claims may increase even more because claims could then be filed during the journey in which the delay is experienced. A benefit of this is the higher customer satisfaction: customers instantaneously can file a claim for the refund they are entitled to and this will probably reduce their frustration.

8.3.6 RISKS

A few risks were mentioned which have to be taken into account when implementing the redesign. Possibly, the chance of fraud increases because people generally have to give less information so they cannot be tracked as well. Fraud scenarios need to be clearly described.

Another risk is related to information clarity: if customers are not properly informed or the services are not easy to find on the website, the usage of the online services may be lower than expected. A solution to this could be that the change in online services is announced via other channels, like telephone and email, as well. Also, customers should really be stimulated to take another authentication step. This process should be made visible and fluent.

With the redesign of the NS website which is to be released soon, the visibility of online services has already been improved much.

The uniqueness and completeness of data is emphasized. A risk is that customers share less of their information and data completeness is reduced. When the same customer occurs in the database multiple times, records should be merged, otherwise the data is not unique. When merging records, clear rules should be defined about which information is overwritten in case of conflicts.

Expectation management should also be taken into account. Some of the redesigned services depend on real time or near-real time data. If the data cannot be retrieved in time in order to deliver the service, customers will be dissatisfied. Clear communication is important about what the online services can do and what they (probably) cannot do.

8.3.7 CHANGES TO CARD CONNECTION PROCESS

Another expert mentioned changes to the card connection process of NS, that are currently not executed yet but still in the pipeline. These changes include removing the need to go past a vending machine to receive a card service code in order to connect an OV-chipkaart. In the future, it suffices to just specify some information that is displayed on the card. This is the same as the partial card authentication level defined in the redesign. Because that authentication level is going to be seen by NS as “full”, this also influences the redesign, which is then being too strict with respect to card authentication.

The redesign will then be even more straightforward and will have two authentication levels, namely not logged in and logged in. However, full travel information will not be displayed to non-logged-in users because of privacy reasons. On the non-logged-in level, a customer can fill in certain card information and view the simple version of the card information, while when logged in, full card and travel information will be visible and the card will be immediately connected to the account. The card connection to the account could be restricted by obliging customers to disclose more personal information. Also, the card holder could be notified when his or her card is connected to an account.

Incorporating the change into the redesign will cause the redesign to be more straightforward, but the principle of layered authentication and its effects on customer effort and customer satisfaction remain intact. Unfortunately, this research lacked time to improve the redesign based on this knowledge, so the changes in the card connection process are not reflected in the redesign.

8.4 CONCLUSION

All three hypotheses stated in section 8.1 were confirmed by the experts. However, statistically, the quantified results of the evaluation are not valid. Larger groups of people have to be asked in order to achieve significance. Also, the granularity of the answers was quite low, because the experts did not have the detailed knowledge required to make precise predictions. This leads to answers that are quite rough, and not so precise. The experts agreed that the redesign definitely has positive effects on customer satisfaction, but the extent of the effects could only vaguely be established.

Several risks were identified by the experts, some of which were already accounted for in the redesign description and others need to be addressed when the redesign is being worked out in more detail. The process and refund costs of the refund in case of delay will go up because of the lower initial effort required claims. However, the experts say the extra costs are worth the increase in customer satisfaction it will likely cause. Creating a smartphone application for customer services or integrating customer service functionality into the existing application would add value for NS, according to the experts.

Finally, a future change was discovered of the card connection process, which has a large impact on the authentication levels that were defined in section 7.1.3. However, this does not change the way layered authentication reduces customer effort and increases customer satisfaction: that remains intact.



9 REDESIGN IMPACT ON IT

9 REDESIGN IMPACT ON IT

The impact on IT is analyzed on two levels. First, on a high level, the impact will be analyzed on the architecture of NS, mainly looking at the applications used to facilitate the services, their respective responsibilities and the collaboration between them. This will give an overview of the impact of implementing layered authentication and cross-channel service delivery, as described in section 7.1. Second, on a more concrete level, the current and future processes of the two redesigned services will be analyzed to determine how those services should change in order to facilitate the layered authentication approach. This will give insight into the effects of the redesign as described in sections 7.2 and 7.3.

ArchiMate, an open and independent enterprise architecture modelling language managed by The Open Group, is chosen as the way to visually display architecture and processes. ArchiMate was chosen because of its capability to display high-level architecture diagrams as well as low-level process diagrams and the possibility to connect between those two. Furthermore, the author already is experienced in using ArchiMate, which is another reason to use ArchiMate as the modelling language for this research. NS is currently not using a single overarching modelling language.

9.1 ARCHITECTURE

First, a high level overview of the current architecture is shown. Then, the main changes are analyzed based on a generic process model of customer service delivery. Those changes are incorporated in a high-level model of the architecture in the future situation. Finally, the main changes to architecture are listed.

9.1.1 HIGH-LEVEL AS IS ARCHITECTURE

The current high-level architecture can be seen in Figure 28. The authentication of customers happens in the channel systems itself and not on a central location. For example, Mijn NS manages its user accounts in its own systems. Middleware contains a lot of process orchestration and workflow management functionality and the back-end systems store and manage data. Process logic is mostly centralized in the middleware system of NSC (“Middleware Commerce”) and business logic regarding e.g. the processing of claims is located in several back-end systems.

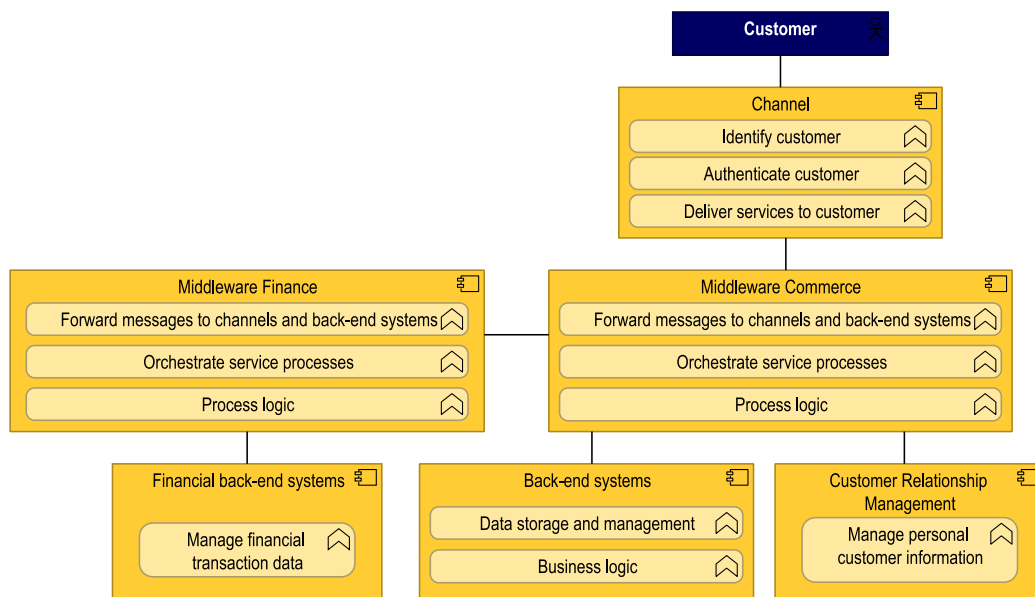


Figure 28 – High-level architecture AS IS view

9.1.2 CENTRALIZE OR DECENTRALIZE?

Much of the change from AS IS to TO BE at this high level relates to the same question: which system/group of systems should have which responsibilities? And more specific: should responsibilities be decentralized, in the channel systems, or centralized?

Before services are delivered to an authenticated customer, four generic steps take place, as can be seen in Figure 29. They are based on definitions of identification, authentication and authorization by Steve Riley from Microsoft (Riley, 2006).

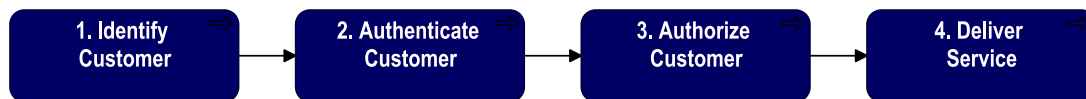


Figure 29 – Generic service process

First, the customer has to identify himself: to make a declaration of who he/she is. This can be done for example by filling in a username. Then, the customer has to prove he is who he says he is by authenticating himself. This can be done by logging in to his account through a password, SMS verification code or another authentication method. The customer can authenticate himself even further by proving he possesses a travel card or lives at a certain address. By doing this, he increases his authentication level. In the third step, it is determined which services the customer can use and which parameters are needed for that. In the fourth step, the service is delivered, which includes business logic to make all sorts of choices in the business process.

For each step, it should be determined which system or group of systems is responsible for carrying out the step. A central system taking care of identification, authentication or authorization is generally called an Identity and Access Management system (Gartner, 2015). That term will also be used in the remainder of this thesis.

Step 1. Identify customer

The responsibility for this step could lie at a system responsible for identity and access management, the middleware or at the individual channels. Centralizing this functionality has many benefits, including increased security and enabling a cross-channel approach. Currently, the identification step is decentralized: customer identification takes place in the channels, such as Mijn NS, the web shop and customer service via telephone. Third-party identity providers can also be used to identify customers.

Step 2. Authenticate customer

The authentication process could happen in the separate channel systems or in a central system, like an identity and access management system. Currently, the first option is the case for Mijn NS: all Mijn NS accounts are authenticated in Mijn NS itself. In the second option, this would be facilitated by a central system which takes care of this, regardless of the channel which is used for authentication. This central system should then a separate system which manages customer identities. That central system could also use third-party identity providers to authenticate customers.

Step 3. Authorize customer

When a customer is authenticated, the channel should present the services and information to the customer for which he is authorized. This process could be orchestrated by the channels, which send requests to back-end systems do determine what to display to which customer. Also, authorization could be orchestrated by the middleware or another system that manages customer identities. The balance between those two options is partly centralizing and partly decentralizing the authorization. The central systems provide the decentral systems with relevant information about the customer, which then decide which services the customer can use.

The difference between centralization and decentralization in steps 1 to 3 is visible in Figure 30. For the sake of clarity, the authorization step is only displayed as fully centralized or fully decentralized.

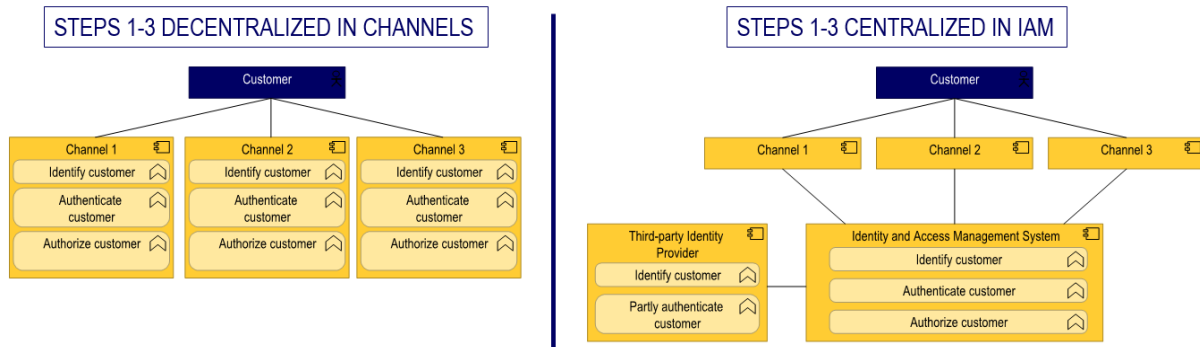


Figure 30 – Comparison of scenarios in steps 1 – 3

Decentralization is also possible when multiple identity providers are used to execute steps 1 – 3. This is shown in Figure 31. However, this would only be preferable in large companies where departments already use different identity providers and do not want to converge to a single one (Milenković, Šošević, & Simić, 2012). This is not the case with NS and therefore, this option is not taken into consideration when determining the future architecture.

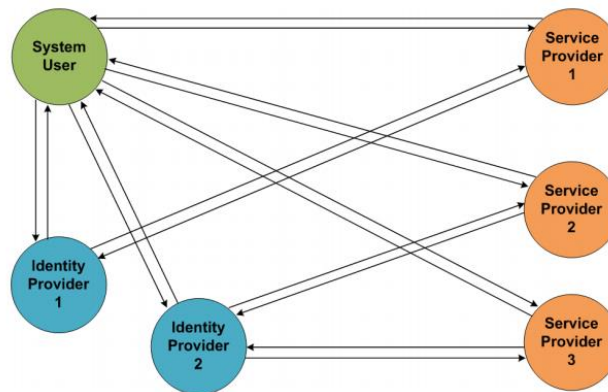


Figure 31 – Heterogeneous mash IAM architecture (Milenković et al., 2012)

An identity and access management system can also use third-party identity providers to identify and authenticate customers. Milenković et al. call this a Federated IAM architecture, as is shown in Figure 32 (Milenković et al., 2012). Benefits of using third-party identity providers from customer perspective are increased privacy protection, better security and improved usability. For a company like NS, benefits of this approach include increased security, reduced costs and improved data quality (Jensen, 2011).

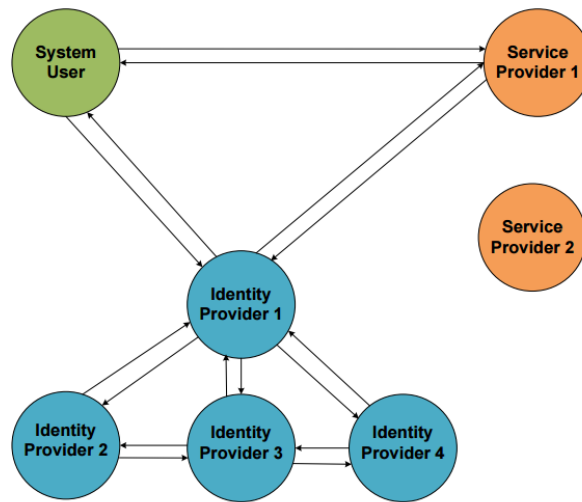


Figure 32 – Federated IAM Architecture (Milenković et al., 2012)

Step 4. Service delivery

In the delivery of a service, the channel is always responsible for the interaction with the customer: the customer dialogue. Next to this, process logic is very important in the delivery of services, especially in the case of extensive services like Refund in case of delay. Process logic consists of rules that determine how a process is carried out, which steps are taken by which systems and what the results of a process will be.

Currently, front-end systems, e.g. regarding Mijn NS, do not contain much process logic. In the process of refund in case of delay, for example, Mijn NS does only some superficial data validation but the middleware, SAP PI, does the rest: process orchestration and communication with back-end systems. As an alternative to this, the process logic can be partly moved to the front-end systems, giving them more a process orchestrator role. The middleware is then more a message processing tool and contains less logic. A visual overview of the two options is visible in Figure 33.

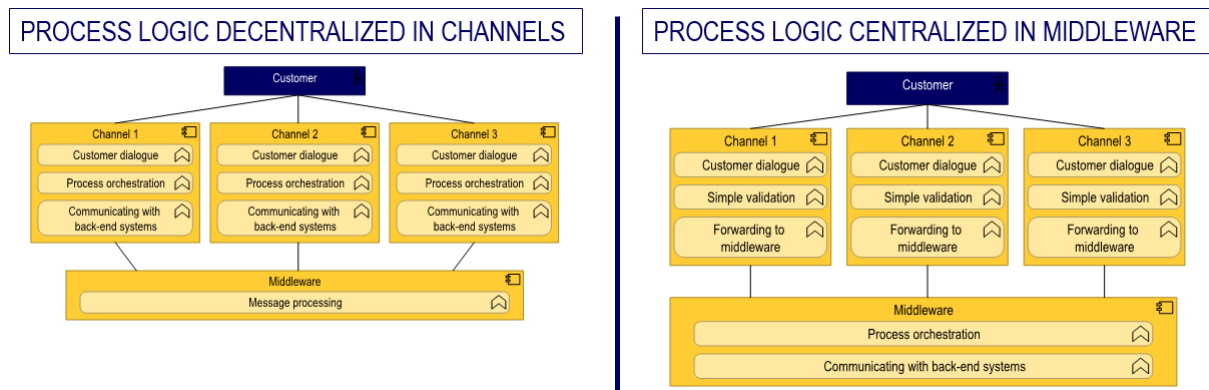


Figure 33 – Comparison of scenarios in step 4

Advantages of centralizing and decentralizing

To decide whether to centralize or decentralize for each generic step, the advantages and disadvantages are listed in Figure 34.

Advantages centralization	Advantages decentralization
• Facilitates multichannel approach more easily • Logic is centralized: gives more overview • Change in business logic happens in only one place • Uniformity across channels • Easier to adapt to future changes • Especially suitable and cheaper if processes are similar across different channels	• No single point of failure • Too many business rules in one place could become too complex • Less flexibility for channels: logic in middleware has to be a trade-off • Especially suitable if processes differ per channel to a great extent

Figure 34 – Overview of advantages centralization and decentralization

9.1.3 HIGH-LEVEL TO BE ARCHITECTURE

Based on the advantages and disadvantages combined with the characteristics of the processes associated with each step, the following choices should be made:

- Step 1. Customer identification should be centralized, at an identity provider system. This is because the customer identification process is very similar across different channels and thus cheaper and more logical if centralized. Naturally, every channel has a different interface to the central customer identification system. Also, third party identity providers can be used to identify customers.
- Step 2. Authentication of customer accounts should also be centralized. Connecting personal information or a card to an account involves the same process, regardless of what system is used for that. Therefore it is cheaper and more understandable if those processes are also centralized in some sort of identity and access management system.
- Step 3. Authorizing of customers involves deciding which customers can use which services on a specific channel. The offered services might differ per channel, but they should be based on the same customer data so that the service offering is consistent across channels. Therefore, this step should be partly centralized and partly decentralized. The channels should be responsible for deciding which services to present and presenting them to the customer. A centralized system like an identity management system or middleware should provide the channels with data about the customer which enables them to do that.
- Step 4. Service delivery should be as much centralized as possible, to ensure consistent service delivery across different channels. Process logic shared by multiple channels should be kept in a centralized system. Customer dialogue should be the responsibility of channels.

Using third-party identity providers increases user-friendliness and decreases the authentication barrier because they can login using a service they recognize (Jensen, 2011). Therefore, using third-party identity providers is desirable and will also be part of the future architecture.

A visual overview of the TO BE situation based on the choices made above can be seen in Figure 35. The middleware is used as a place to orchestrate service processes and do the majority of calculations and thorough validations in business processes.

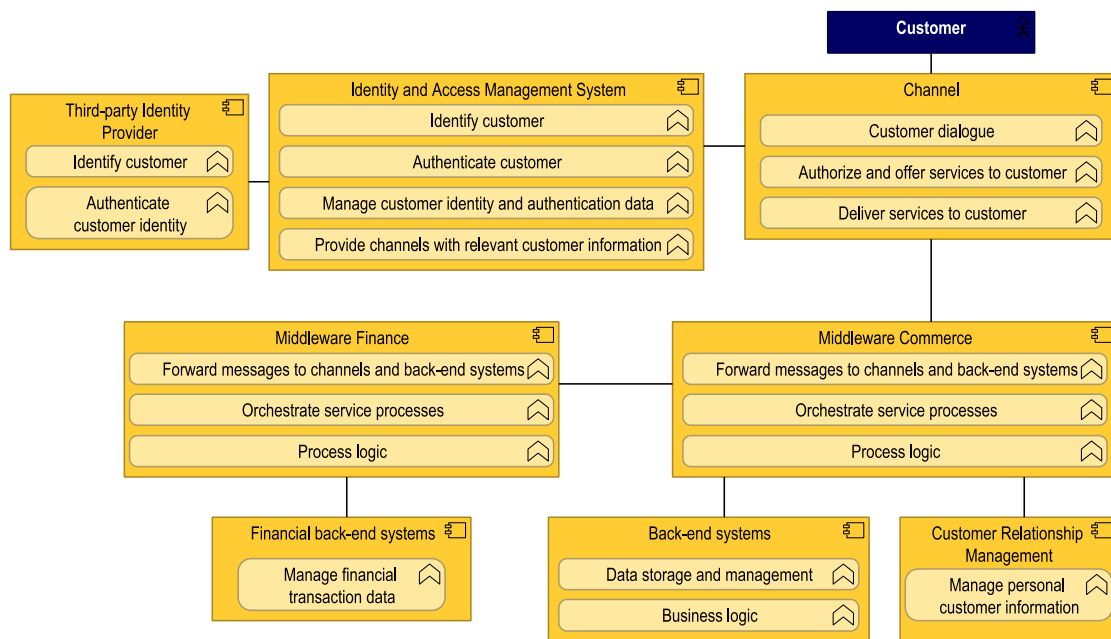


Figure 35 – High-level architecture TO BE view

9.1.4 BASELINE - TARGET ANALYSIS

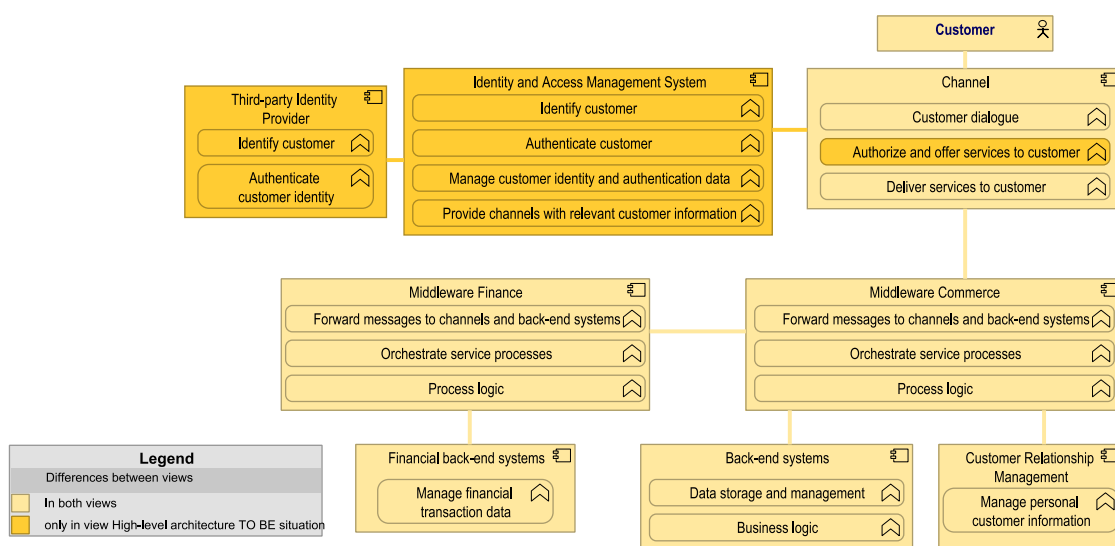


Figure 36 – New and existing architecture elements in TO BE architecture

Figure 36 shows which elements of the TO BE-architecture already exist in the current situation (the light yellow elements) and which elements are new (the dark yellow elements). The main difference between the current and future high-level architectures is the introduction of an identity management system which verifies the customer's identity, authenticates accounts by connecting them to NS customer data and provides channels with relevant data related to customer accounts. This system can also be connected to one or multiple third party identity providers, which can also verify a customer's identity.

This also leads to changes in the channels, which are not responsible anymore for the identification and authentication of customers but connect to the identity management system for that functionality. Regarding the

authorization process, channels need to have processes which take as input the customer information provided by the identity management system and then decide which permissions to give the customer.

Currently, middleware contains quite some process orchestration functionality, which will be the same in the future situation. On a high level, no significant changes seem to be needed to the design of the middleware. However, separate versions of processes are often still separated inside the middleware, leading to unnecessary complexity, especially when more and more channels will offer the same services. Other channels should be connected without much changes needed to the processes in the middleware.

9.1.5 IMPACT ON DATA QUALITY

Applying the step-up authentication approach to the online services impacts the data quality of NS. Data quality can be made concrete by discerning six dimensions, as defined by DAMA UK (DAMA United Kingdom, 2013): completeness, uniqueness, timeliness, validity, accuracy and consistency. The first two dimensions are affected by the redesign, the latter four are not.

Completeness: data that is complete is not having any blank values, all the records are completely filled. Marketing would like to know as much as they can about every customer interacting with NS and the completeness of the data is an important indicator of this. Obliging customers to validate their address and their card in order to make use of the online services, gives a lot of information.

Layered authentication means that customers have the possibility to use the services without making all of their personal details known to NS. Just the necessary information should be filled in. This means there will be a lot more customers that will be only partially known.

However, according to the opinions of experts in chapter 8, more customers will use the services of NS than before. Therefore, information about more customers will be available when layered authentication is introduced.

Uniqueness of data can be determined by “analysis of the number of things as assessed in the 'real world' compared to the number of records of things in the data set”. It is the inverse of the assessment of the amount of duplicates (DAMA United Kingdom, 2013). In other words and applied to the situation of NS: a customer of NS should only be in the records once. This is important for Customer Service: when somebody calls or mails them, they should be able to see all information related to that person. To make that possible, there should not be any duplicates of the same customer.

In the current situation, customers can also make accounts and they mostly get connected to existing customers. To facilitate this and avoid duplicates, NS has created a process which calculates the percentage of overlap between the data the customer fills in when the account is created and the data already existing in the database. When the percentage is high enough, the account is directly linked to existing customer data. Next to this, a process is carried out every night to merge remaining duplicates, also based on a percentage of overlap.

The redesign possibly reduces the data uniqueness in two ways. Firstly, when customers are not logged in and use services, that data is possibly not connected to other data that might exist of that same customer in the databases. Secondly, when a customer creates and uses an account but does not connect his card, that data is possibly not connected to other data that might exist of that same customer in the databases (e.g. when he has previously bought a season ticket).

The difficulty is, that the data known about customers is not the same for each record. Record X might contain a customer's name, address, telephone number and season ticket history, while Record Y contains a customer's name, email address and a claim filed online. It is difficult to determine overlap between different records when the structure of the data is different.

NS should reduce the impact of layered authentication on data completeness and uniqueness by taking four actions. Firstly, processes of merging and duplication avoidance should be expanded, so that even customer records having different attributes can still be merged. Secondly, a process should be put in place in which a customer can easily but securely connect his account to an existing record in the database of NS. This process can

be similar to the process that is currently used by NS to connect Mijn NS accounts to an existing database record. Thirdly, a focus should be on establishing clear and well-thought data governance, which consist of rules and guidelines as to how NS should handle the different types of data coming in via different channels. Oracle has defined Data Governance Best Practices which can be used by NS (Oracle, 2011a). Fourthly, data management can be taken into account at the architecture level, by splitting authorization responsibilities between the Identity and Access Management system and the channels. The Identity and Access Management System is responsible for providing channels with relevant customer data and the quality levels of that data. Channels can use this quality information to determine if the quality is high enough to authorize a customer. If not, the channel could require additional information verification.

9.1.6 ARCHITECTURE PRINCIPLES

The current and future architectures are described at a high-level. On lower levels, a lot of decisions have to be made regarding business processes, the setup of applications and the connections between them. Listing all those decisions goes beyond the scope of this thesis. However, a few architecture principles will be stated that can be used as guidelines in service design, based on the service principles stated in section 7.1.6, together with some implications for architecture and processes.

- *Consistent service delivery across multiple channels*: this can be done by decoupling front-end and back-end systems, so that service logic in the back-end or middleware can be used by multiple channels.
- *Making accessible services*: this is done, for example, by implementing the layered authentication approach. Authentication then needs to be centralized in order to realize this.
- *Customer has access to own data*: there needs to be clarity about which data is stored where. Processes need to be in place to let customers view and change their personal information.
- *Only the necessary information is asked to deliver the service*: this implies that services need to be flexible and should not be bound to one way of customer authentication and retrieving customer information.

9.2 PROCESSES

On a more detailed level, business processes in the current and future situation can be used to determine the effects of the architecture change, defined in the previous section, on the process steps a customer takes to use services. This is done, based on the generic user process defined in Figure 29. First, the current and future processes are defined regarding the customer authentication process steps. Then, business processes of the redesigned services are explored in detail. A summary of the relationship between the generic process, the current and future processes and the needed changes is given in Table 10.

<i>Subject</i>	Customer authentication (step 1-3 of generic process)	Customer service use (step 4 of generic process)
<i>Redesign form</i>	Layered authentication framework	Two redesigned services
<i>Current and future processes described in</i>	Swim lane processes in 9.2.1 – 9.2.2	Business processes in 9.2.3-9.2.8
<i>Needed changes described at</i>	Architecture level section 9.1.4	Process level sections 9.2.5 and 9.2.8

Table 10 – Summary of process impact analysis relating to generic service process

First, the customer authentication process is described for the current and future situation in section 9.2.1. Because it is important to show which system or person executes which process step, this is done using swim lanes (van den Berg et al., 2013). Also, above the swim lane diagrams, ovals explain which steps from the generic service process are depicted. Step 4 of the generic service process is only concisely displayed and will be worked out more concretely for the two redesigned services.

Then, for the two redesigned services, the customer service use processes are displayed in the current and future situation. This details the fourth step of the generic service process. For each redesigned service, the needed

changes are given, in order to go from the current to the future situation. The service of Refund in case of delay is given in section 9.2.2, the service of Travel history and card information in section 9.2.3.

9.2.1 CUSTOMER AUTHENTICATION PROCESS

In the current situation, the only two actors involved in customer authentication are the customer himself and the channel he wants to authenticate himself on. The current authentication process is depicted in Figure 37. Vertical lines between similar processes mean that those processes need the cooperation of more than one actor.

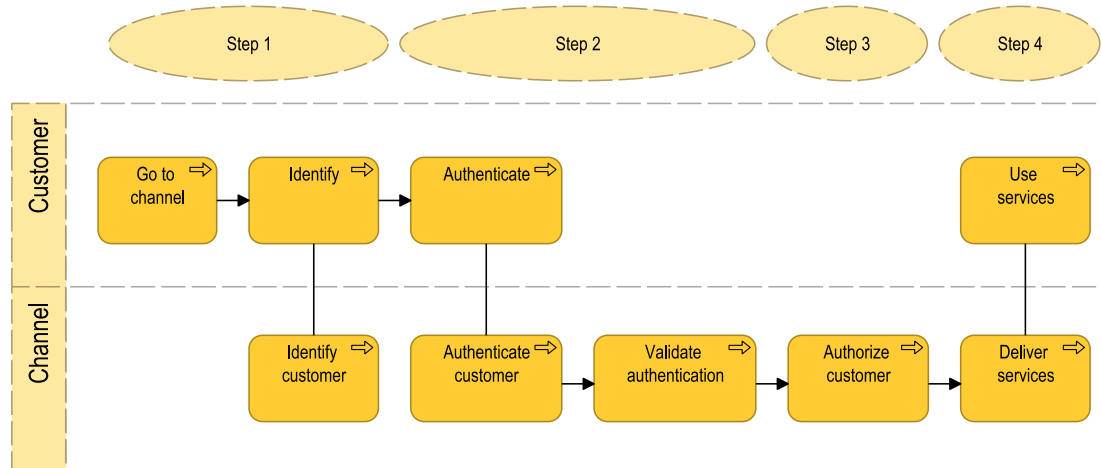


Figure 37 – AS IS Customer authentication process

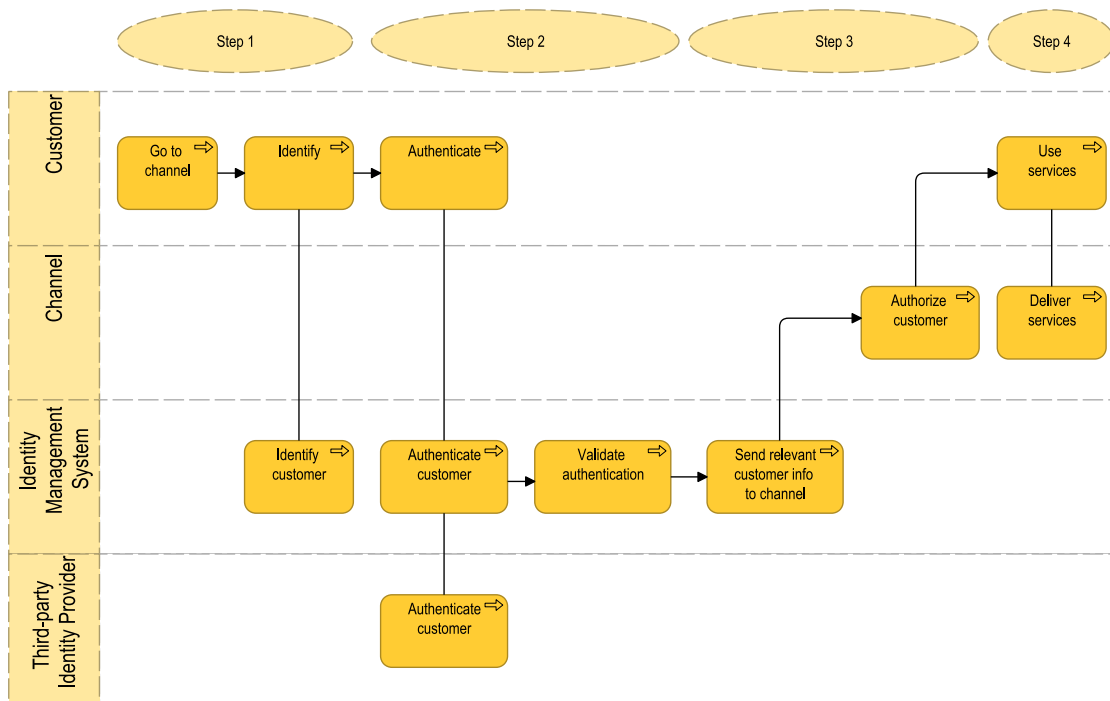


Figure 38 – TO BE Customer authentication process

The difference between the AS IS and TO BE situations is that in the future situation, the channel is not the leading actor in the authentication process anymore. The authorization step is partly done by the Identity Management

System and partly done by the channel. The swim lane diagrams show what the architectural differences mean for the process of authentication.

9.2.2 REFUND IN CASE OF DELAY

The process of refund in case of delay can be divided into a number of generic process steps. Those steps are executed in a specific way in the AS IS situation and will be affected by the redesign, so that in the TO BE situation, the process is carried out differently. An overview of the generic process and the concretization of that in the current and future situation can be seen in Figure 39: the generic process is colored blue, the AS IS process light yellow and the TO BE process bright yellow. This gives a quick overview of how many different processes should be created and maintained. Naturally, process steps can also change internally, at a lower level.

The processing of a claim slightly differs dependent on the travel product: an OV-chipkaart, an e-ticket or a paper ticket. However, the differences are not making the processes fundamentally different and therefore, they are modeled as a single process.

As Figure 39 shows, the most obvious changes because of the redesign happen in the first few steps of the process: the front-end systems. An opportunity should be created to fill in a web form online, with or without being logged in. Also, the web form output should be validated and processed, just like the other online claims, currently done via Mijn NS.

However, there are more changes needed to facilitate this redesign that cannot be shown in a high-level process model. New processes and changes to current processes are the following:

- [1-2 | Change] Generate claim history overview: use current Mijn NS process and revise it to give it more possibilities
- [2 | New] Pre-fill web form for people who are logged in but have not connected their card
- [3 | New] Quick validation process to check if travel has taken place on this ticket: in real-time, must be based on output data of web form
- [3, 5 | Change] Adapt validation processes so that e-tickets and paper tickets can also be validated. This is already being made for paper tickets because of other changes
- [4-8 | Change] Change claim processing processes so that they can handle claims without address and telephone data
- [4 | New] Process web form output so that it can be thoroughly validated and go through the rest of the process
- [4 | Change] Modify process to connect web form claim to NS account, based on current process of Mijn NS
- [5 | New] File claim when the travel journey is not complete yet/travel records do otherwise not exist in database: hold the claim for a certain period, then validate it. Can be based on current process regarding forgotten-checkout-claims
- [7 | New] Claim payout via card balance. Can be based on process to payout forgotten-checkout-claims via card balance, currently in use by NS Extra
- [1-9 | Change] Adapt the process logic in middleware system to account for above process changes

The above process changes are quite concrete and small. The effort points need to be estimated and the work needs to be planned by the development department.

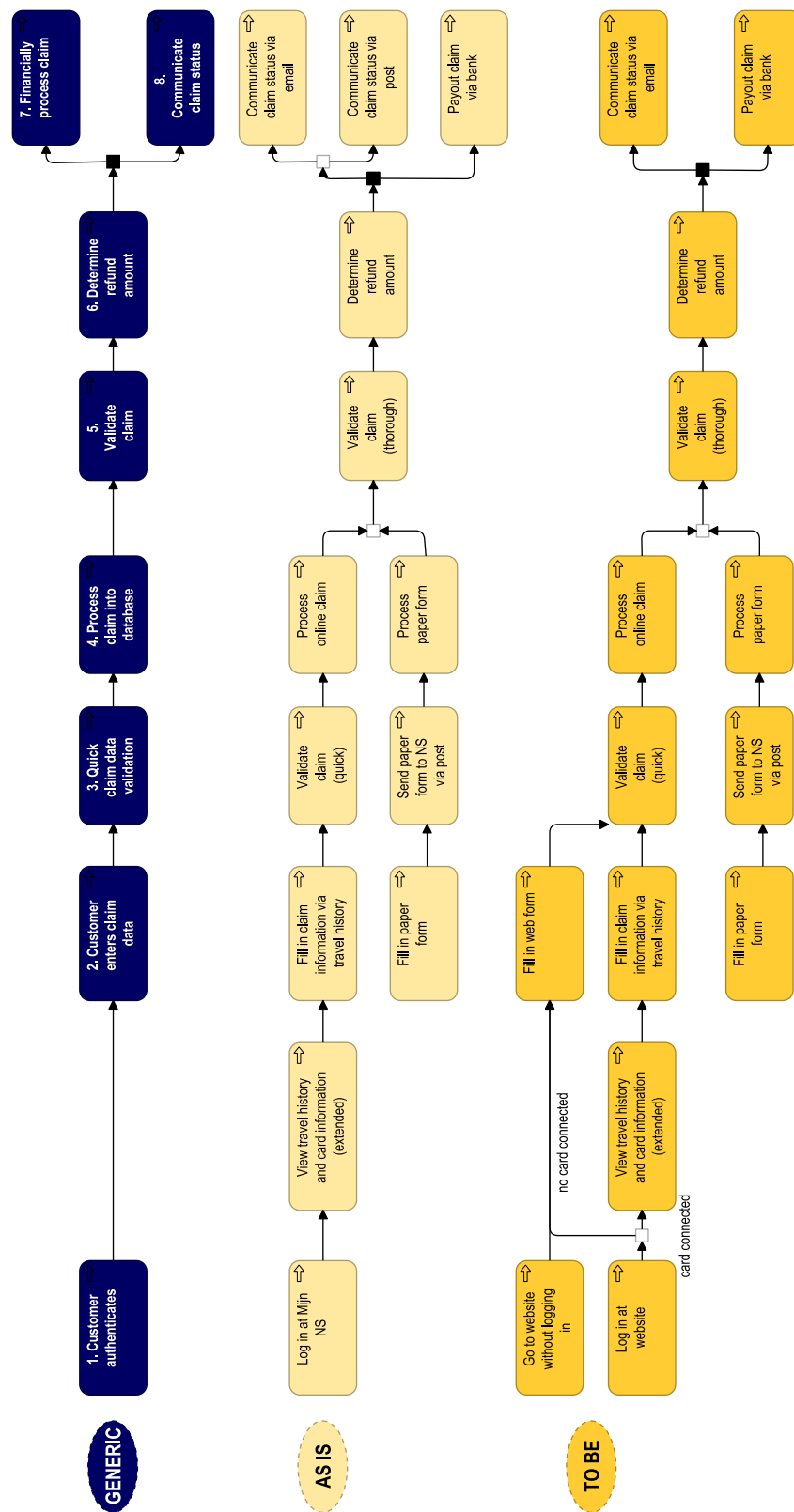


Figure 39 – Generic, AS IS and TO BE processes of Refund in case of Delay service

9.2.3 TRAVEL HISTORY AND CARD INFORMATION

Figure 40 shows the generic travel history process and the concrete process in the current, AS IS, and future, TO BE situation.

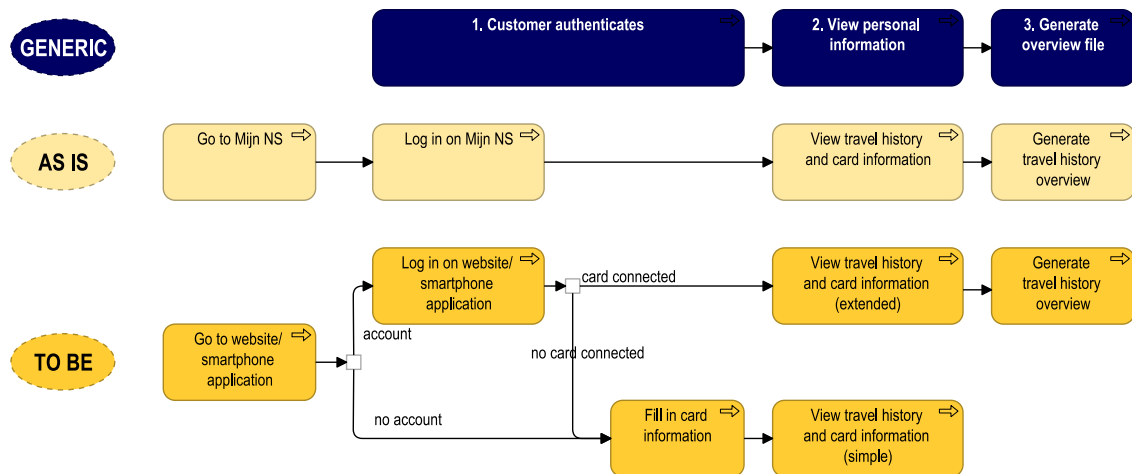


Figure 40 – Generic, AS IS and TO BE processes of Travel history and card information service

The AS IS process looks quite simple: it only consists of the user authenticating himself and viewing personal information. A user can also generate a declaration overview, which can only happen using the travel history overview. In the TO BE situation, the authentication part has two branches, namely via an account with a connected or without an account that has a connected card. These two branches lead to two ways of viewing personal information, namely the extended and the simple version.

The lowest branch, which leads to the simple version of viewing personal information, does not exist yet and has to be created, based on existing processes as much as possible. Next to that, the existing viewing of travel history and card information needs to be extended to include more sorting and filtering options, as well as a process for automatic overview generation. An overview of the affected processes is the following:

New: simple, lower authentication level

- [1, 2 | New] Web form to collect card data to authenticate customer
- [2 | New] Process to pre-fill front-end form based on customer data, in case customer is logged in
- [1 | New] Partial card authentication: validate customer based on data from database
- [3 | New] Show simple card information and travel history
 - o Show simple card information (balance, status) based on data from RTS. Reisplanner Xtra already shows this, process could be re-used
 - o Show deviant travels in past 30 days based on data from RTS
 - o Generate anonymous travel history overview. Based on current process of generating travel history overviews

Change: extend existing full travel history overview

- [3 | Change] Travel history overview: add additional sorting and filtering options
- [3 | New] Overview already generated travel overviews
 - o Generated overviews should be saved in a database, which can then be read and records displayed in the overview
- [3 | New] Automatically email periodical travel history overviews to customers

Next to this, the process logic in the middleware should be adapted to account for above process changes.

The above process changes are quite concrete and small. The effort points need to be estimated, the changes need to be concretized and the work needs to be planned by the development department.

9.3 VALIDATION

Two experts from NS and two external architecture experts from BiZZdesign were consulted and were asked if they thought the IT impact analysis was valid, complete and useful. More information about the background of the experts can be found in Appendix D. Several comments were made regarding the readability and understandability of the diagrams and analysis. These were used for further improvement. Regarding the impact analysis itself, all four experts stated the analysis was viable and sound and gave a good impression of the redesign impact on the IT landscape of NS.

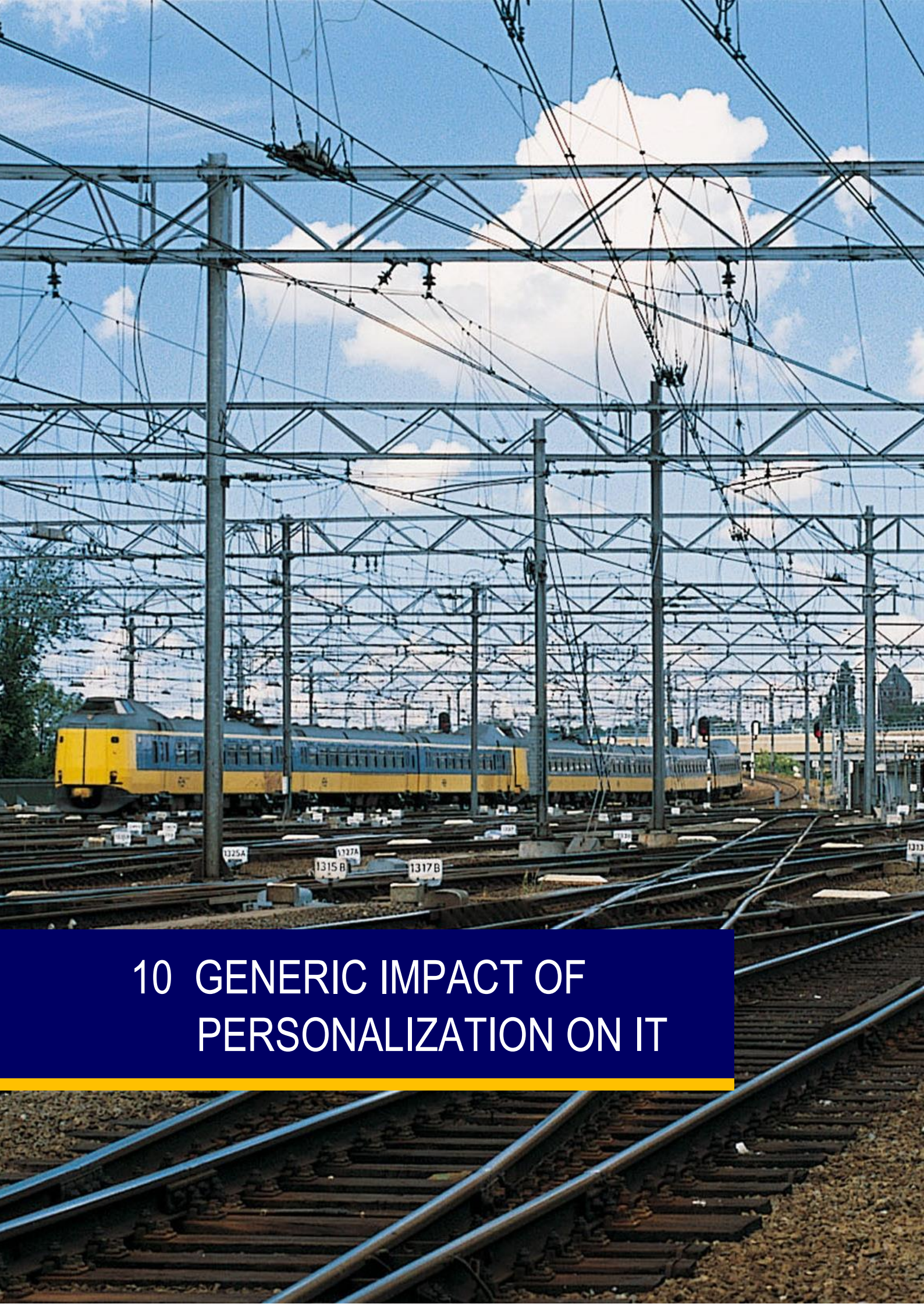
An expert from NS mentioned that different sources of customer information often have different accuracy and timeliness levels. A customer address, filled in when ordering an OV-chipkaart, is validated because the order is sent to that address. However, at a refund form, the address filled in is not checked and could be non-existent. When customer information is merged from different sources, data of different qualities could be merged, leading to lack of clarity with respect to data quality. Authentication and authorization based on that data could become untrustworthy. Therefore, when merging data from different sources, the data quality should be taken into account and data from different quality levels should only be merged if it poses no threat to authentication and authorization processes. More information about the impact of layered authentication on data quality can be found in section 9.1.5.

9.4 CONCLUSION

In this chapter, the impact of the redesign, which consists of layered authentication, on the IT landscape of NS is analyzed. This is done on two levels. Firstly, the impact is assessed at an architectural level, which describes the systems involved in applying layered authentication, the connections between them and their responsibilities. Secondly, the impact is assessed at a processual level, which describes the sub-processes needed to carry out the two redesigned services. At both the architectural and processual level, the current, AS IS, situation is compared with the desired, TO BE, situation and needed changes are identified. The impact assessment is validated by two internal and two external experts.

At the architectural level, the largest impact of layered authentication is caused by the introduction of an Identity and Access Management (IAM) system, which takes care of customer identification, authentication and, partly, authorization. The IAM system can also use third-party identity providers because of cost saving and customer effort reasons. Furthermore, data quality is impacted by the redesign. Data completeness and data uniqueness are probably decreased because of an increased number of customers that is not fully authenticated but still interacts with NS. This risk can be reduced by establishing data governance regarding customer data and by developing an extensive and intelligent duplicate avoidance and record merging process.

The largest impact of layered authentication to the service processes can be seen at the front-end side which is responsible for the customer dialogue. The different layers of authentication all require a different way of interacting with the customer: sometimes, a new web form is needed for that but in other situations, the current way of interacting suffices. The process steps carried out in the back-end systems are sometimes affected but mostly stay the same. Several changes to processes are identified which can be worked out in use cases.



10 GENERIC IMPACT OF PERSONALIZATION ON IT

10 GENERIC IMPACT OF PERSONALIZATION ON IT

In this chapter, an overview is given of the generic impact of personalization on IT. It tells what impact on IT companies can expect when considering to personalize their products or services. Figure 41 shows the different information sources that are used to generate that overview. The literature review and the real-world cases and the impact analysis of last chapter are used to identify impact factors. Semi-scientific literature is then used in addition to that to find more information and to generalize the impact and steps to be taken.

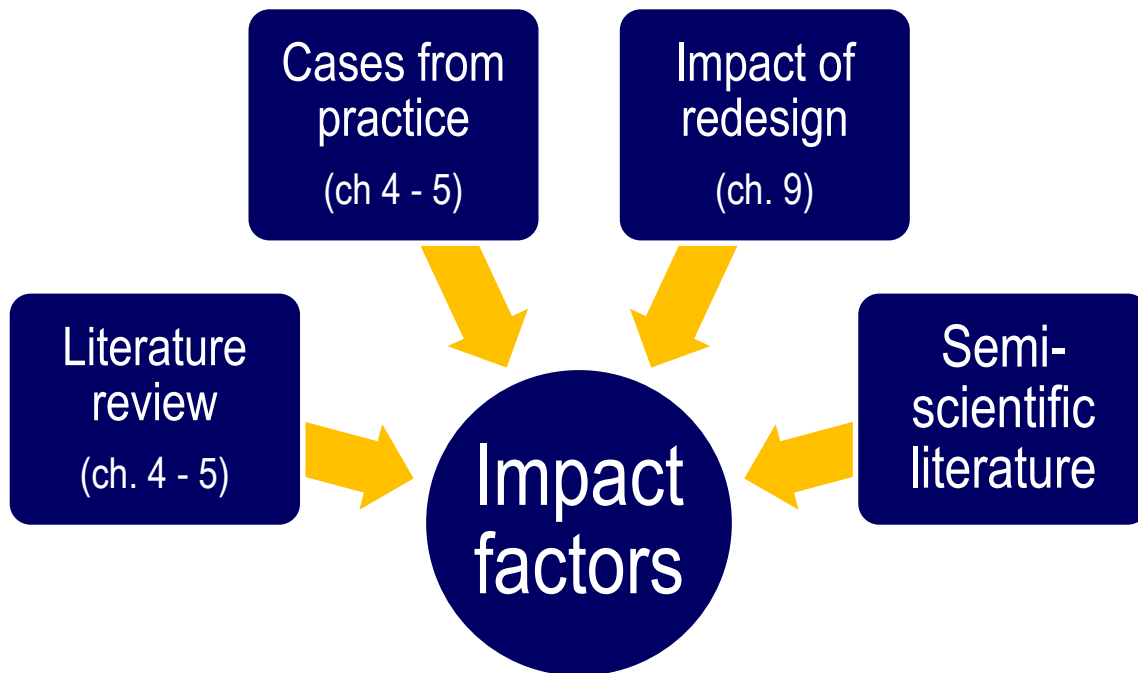


Figure 41 – Use of information sources for generalized impact

Naturally, the impact of personalization goes much further than just IT architecture and processes. McKinsey's 7-S Framework identifies 7 organizational factors that need to be aligned when a change is successful, as can be seen in Figure 42 (Bryan, 2008).

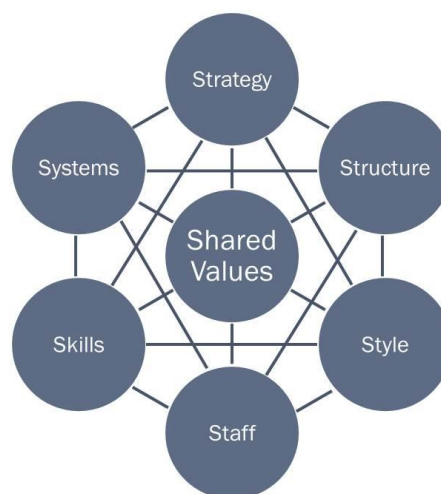
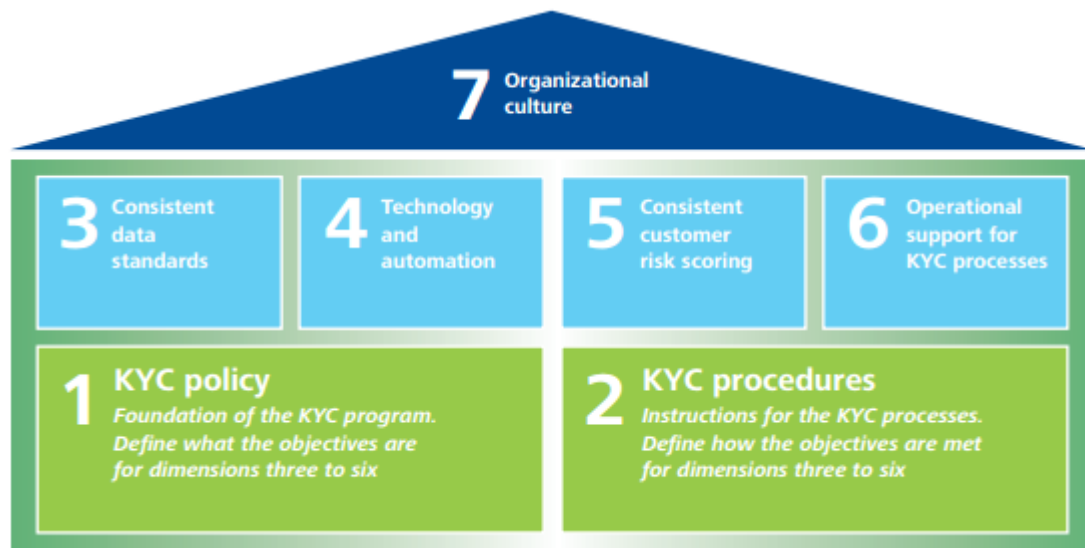


Figure 42 – The 7-S Framework by McKinsey (Bryan, 2008)

Figure 43 shows the dimensions of a broad Know Your Customer program, which is similar to personalization efforts. Consistent data standards and Technology and automation, items 3 and 4 in the figure, are related to IT, but policies, procedures and people are also essential in realizing the change to personalized services or products.

Figure 43 – Dimensions of a broad KYC program (Shepard & Fernandez, 2015)



However, this chapter will focus on the IT-related changes that companies wanting to apply personalization need to make. Firstly because of the limited time available for this research, a scope needs to be determined and secondly, because IT plays a large role in enabling personalization.

Four main themes are identified regarding the impact of personalization on IT. Personalization requires IT to have data integration and analysis capabilities. Secondly, customer identities and authentication need to be managed. Thirdly, the service architecture needs to be adaptable and finally, IT complexity needs to be reduced because of the effect of personalization.

10.1 NEED FOR DATA INTEGRATION AND ANALYSIS

Personalization is by definition data-driven, as was also stated in section 5.5. It often includes merging, comparing and analyzing multiple data sources to derive conclusions about the preferences and behavior of the customer, in order to provide more relevant services (Vesonen & Raulas, 2006). Business Intelligence (BI) capabilities are needed when companies want to personalize. Gartner defines BI as “an umbrella term that includes the applications, infrastructure and tools, and best practices that enable access to and analysis of information to improve and optimize decisions and performance” (Gartner, 2015).

The redesign discussed in this thesis does not use and analyze a lot of customer data sources in order to provide a personalized experience and therefore, this theme was not important in the impact analysis of the NS case in chapter 9. The difference between services is mostly based on the authentication level of the customer, which can be derived from a single variable. However, other examples of personalization, shown in sections 1.1 and 5.8, are far more data-driven.

Several organizations define a more or less generic architecture that facilitates BI capabilities. Oracle (2013) defines both a conceptual and a logical view on their Big Data & Analytics reference architecture, and IBM shows their Know Your Customer process which is functionally quite similar to Oracle’s reference architecture. However, these architectures are specified for the solutions of the software vendors creating the diagrams. Chaudhuri, Dayal and Narasayya (2011) define a more generic BI architecture, which can be seen in Figure 44. In 2013, Maier published his Master’s thesis “Towards a Big Data Reference Architecture”. The proposed reference architecture looks very much like the one depicted in Figure 44 (Maier, 2013). Because of the vendor-independence and the clarity of the diagram, this architecture will be used to illustrate the impact of personalization on the IT landscape regarding BI.

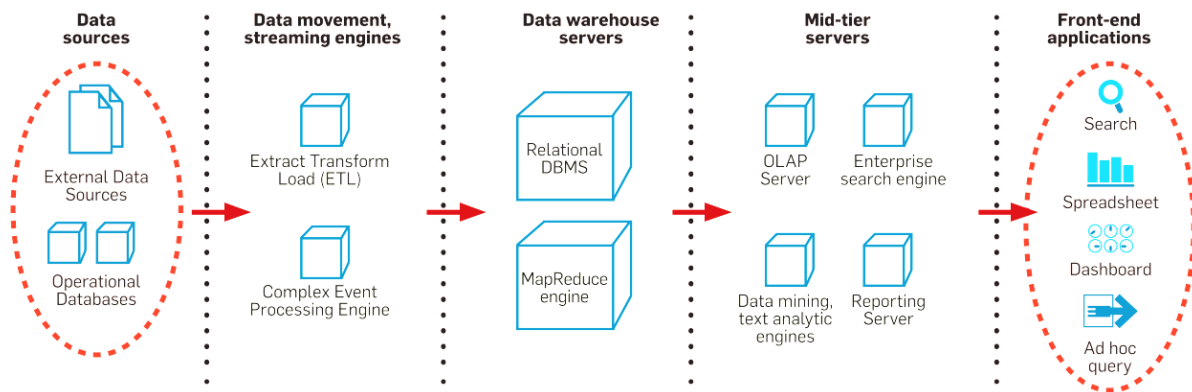


Figure 44 – Generic components of BI Architecture (Chaudhuri et al., 2011)

The generic BI architecture shows that data from different sources is integrated and analyzed by a sequence of three BI components and can then be used by front-end BI applications. This generic architecture can be applied onto the subject of personalization, as can be seen in Figure 45. The analysis results from the front-end BI applications are used by channels to personalize their services, using, for example, systems that profile customers, generate recommendations and take care of customer experience. The BI elements at the left side of the figure are prerequisites for personalization. They need to be in place when a company wants to offer personalized services or products.

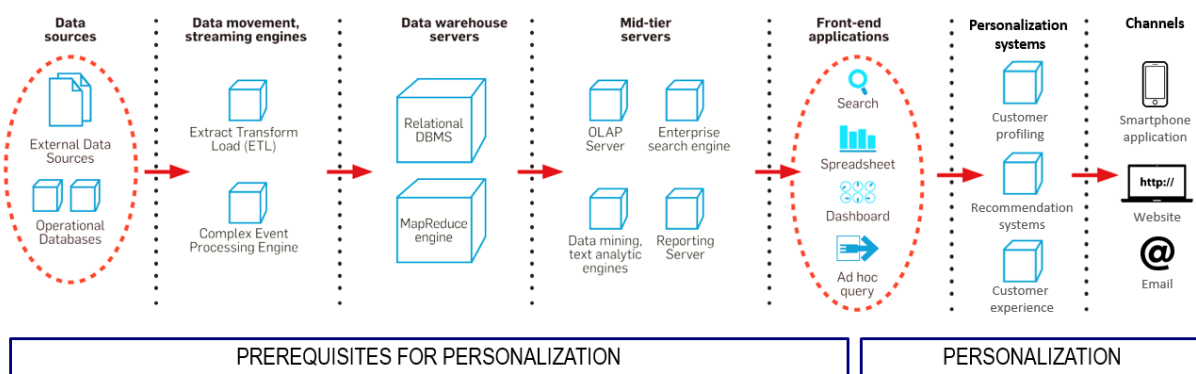


Figure 45 – Relationship between BI architecture and personalization (based on Chaudhuri et al., 2011)

In the mid-tier servers, integrated customer data is analysed: this is where companies need to focus when determining how their IT is going to support personalization. Data analysis can be done in various ways, based on the data that is analysed. An overview of the different analysis techniques is given in Figure 46. Technologies especially relevant for personalization are highlighted for the purpose of this research. As can be seen, there are a lot of relevant and useful technologies that can be used to analyse different types of customer data for the purpose of personalization.

	(Big) Data Analytics	Text Analytics	Web Analytics	Network Analytics	Mobile Analytics
Foundational Technologies	• RDBMS • data warehousing • ETL • OLAP • BPM • data mining • clustering • regression • classification • association analysis • anomaly detection • neural networks • genetic algorithms • multivariate statistical analysis • optimization • heuristic search	• information retrieval • document representation • query processing • relevance feedback • user models • search engines • enterprise search systems	• information retrieval • computational linguistics • search engines • web crawling • web site ranking • search log analysis • recommender systems • web services • mashups	• bibliometric analysis • citation network • coauthorship network • social network theories • network metrics and topology • mathematical network models • network visualization	• web services • smartphone platforms
Emerging Research	• statistical machine learning • sequential and temporal mining • spatial mining • mining high-speed data streams and sensor data • process mining • privacy-preserving data mining • network mining • web mining • column-based DBMS • in-memory DBMS • parallel DBMS • cloud computing • Hadoop • MapReduce	• statistical NLP • information extraction • topic models • question-answering systems • opinion mining • sentiment/affect analysis • web stylometric analysis • multilingual analysis • text visualization • multimedia IR • mobile IR • Hadoop • MapReduce	• cloud services • cloud computing • social search and mining • reputation systems • social media analytics • web visualization • web-based auctions • internet monetization • social marketing • web privacy/security	• link mining • community detection • dynamic network modeling • agent-based modeling • social influence and information diffusion models • ERGMs • virtual communities • criminal/dark networks • social/political analysis • trust and reputation	• mobile web services • mobile pervasive apps • mobile sensing apps • mobile social innovation • mobile social networking • mobile visualization/HCI • personalization and behavioral modeling • gamification • mobile advertising and marketing

Figure 46 – Technologies related to different types of analytics (H. Chen et al., 2012)

Because the sources are already a few years old at the time this thesis is written, the latest developments in business intelligence are not reflected in the displayed architecture. Missing in the technology overview is data virtualization: instead of using a number of physical data marts in which data is presented that can be analyzed and reported, virtual data marts are used on top of the physical data warehouse (van der Lans, 2015a). This saves costs and time needed to establish the physical data marts using ETL-processes. Also, data virtualization enables self-service analytics, in which the end user analyzes data and creates reports, instead of the IT department doing that (van der Lans, 2015b). Furthermore, Data-as-a-Service (DaaS) is used more and more, which is the concept of providing end users with relevant data through the cloud, regardless of geographical or organizational separation between the provider and the consumer (Bhagattjee, 2014).

Companies wanting to implement personalization need to make sure two capabilities are present in their IT landscape, regarding the analysis and processing of customer data.

First, the prerequisites for personalization that can be seen in Figure 45 need to be available. Data from all relevant sources should be moved by ETL-systems, in case of non-real-time data, and complex event processing systems, in case of real-time data, to a place where the integrated data is stored. For integrating data sources, data

virtualization, which has been upcoming in the last few years, can also be used (Chandramouly, Patil, Ramamurthy, Radha Krishnan, & Story, 2013).

Second, the integrated data should be analyzed using one or more technologies displayed in Figure 46. Which technologies should be used depends on the type of data that needs to be analyzed, as displayed on the top of Figure 46. Also, the suitability of the technologies depends on the application to which they would be used. When the company makes a detailed plan of the goals and methods of personalization, the most suitable technologies can be chosen to support that plan.

Of course, the impact on the IT of a company depends on how far the IT landscape already supports data integration and analytics. If the company already has a fully functioning data warehouse, connected to relevant data sources and used on daily basis by front-end applications, directly or indirectly, the IT landscape will quite easily enable the data integration and analysis aspects needed for personalization. The needed change might be significantly bigger when these systems are not in place.

Summarizing, a company that has the required data integration and analysis capabilities satisfies the following four conditions:

1. All relevant customer data sources are available and readable
2. The customer data is integrated and merged, for example through a data warehouse, data virtualization or a MapReduce solution
3. The customer data is transferred from the original sources to their integrated location, either physically or virtually, either real-time via a complex event processing system or batch-wise via ETL-processes
4. Integrated customer data is analysed for personalization purposes using the appropriate techniques shown in Figure 46

Data integration and analysis capabilities are not just usable for personalization purposes. They can also be used for a multitude of other applications, like Decision Support Systems which provide useful management information (Power, 2008), optimizing business processes (Grigori et al., 2004) and customer risk analysis as part of a Know Your Customer-principle used in banks (Jones & Stahl, 2011).

10.2 IDENTITY AND ACCESS MANAGEMENT

As was discovered in the redesign of chapter 7, customers' identities need to be authenticated and authorized in order to provide personalized experiences. The architecture impact analysis of section 9.1 showed that an Identity and Access Management system (IAM) is the best way to enable an overarching, cross-channel view of customers' identities and authentications in the case of NS. In other situations, IAM might be less needed, for example, when only one customer channel is used.

When a company wants to centrally manage their customers' identities and authentications, the first step is to determine the main goals of that system. Those goals can then be further translated into more concrete architectural requirements: a "top-down" delivery approach. This method is, for example, executed by Harvard University, which first created a project plan with four strategic objectives and then developed their own IAM system based on those objectives (Witty, Allan, Enck, & Wagner, 2014).

When a company does not want to develop their own IAM system, functional and non-functional requirements should be used to choose an existing IAM system. Different software vendors, like Oracle, OpenIAM and Hitachi, provide a list of core functionalities of their IAM system (Hitachi, 2011; OpenIAM, 2015; Oracle, 2011b). Hitachi provides the most generic list of functionalities in their Identity Management Project Roadmap. The core functionalities, as defined by Hitachi, are the following (Hitachi, 2011):

- **Automation** to leverage data that is already entered into an HR system, or some other system of record, to automatically propagate changes to target systems.
- **Workflows** to accept change requests from users, request and track authorization, and update accounts and access rights on target systems.

- **Consolidated user management** allowing a security administrator to manage one user across a variety of systems with a single program / GUI.
- **Delegated user management** to allow local managers and IT resources to manage just some users, on just some systems, using the consolidated user management facility.
- **An auto-discovery process**, to periodically extract user data from each system, search for discrepancies, and respond either by applying corrections directly or by requesting authorization for change requests.
- **A login ID reconciliation system** to connect user records across systems.
- **Password management** that spans every system, including a strong, uniform password policy engine, password synchronization and self-service password reset.
- A secure process for **password initialization**.
- **Audit logs** that track all access change requests, authorizations and implementation.
- **A reporting engine** that can provide reports about current and historical user access privileges.
- **Standards enforcement** for change authorization, and new account configuration.”

Above list gives a global overview of the needed functionality, but the list is not complete, nor is it up-to-date. Also, Hitachi’s product is directed at employee access, rather than at customer access, as well as most other traditional IAM systems do. However, personalization is mainly directed at customers, which requires a different focus.

Therefore, some core functional requirements should be added to the list of Hitachi to make it applicable to the case of personalization:

- **Connections to third-party identity providers** which can identify and authenticate customers
- Support for a variety of authentication methods, like biometric authentication and multi-factor authentication
- **Connections to other customer recognition systems**, like systems which track a customer’s online behaviour via cookies to recognize him at a later time
- **Automated customer authentication** based on analysed customer data
- **Customer information reporting service** handing over relevant customer information to a channel for the purpose of authorization

Furthermore, an identity management system should satisfy the following non-functional requirements (Hitachi, 2011):

- **Scalability**, to support future growth of the system
- **Flexibility**, to support changing requirements from the business and to deal with channel systems having different definitions and processes
- **Security**, to block attempts to obtain customer information and to reduce the chance of unauthorized authorization changes
- **Rapid deployment and minimal ongoing maintenance**: the channels depend on the identity management system for customer identification and authentication. Therefore, the downtime because of errors or maintenance should be very low

With respect to the non-functional requirements, Hitachi remains quite vague and does not define key indicators for each of the non-functional requirements. The exact requirements depend on the company’s situation and wishes.

When companies want to apply personalization, central identity and access management is often needed. An overview of the functionality of such a system was given in this section by citing and complementing a list. An overview of a possible architecture and the relationships with surrounding systems was given in section 9.1.3. The process related to customer authentication was given in section 9.2.1. Companies wanting to apply personalization can use those three information sources and adapt them to their own situation.

10.3 NEED FOR ADAPTABILITY

Personalization also requires IT to be adaptable, to support anticipating to changes in customer behavior and preferences, or in changes to the availability of that information. The IT architecture should be able to easily handle the adding or removing of service channels, changes in services or data sources being connected or disconnected. This was recognized in the case of NS, described in chapter 9. The need for adaptability caused several tasks to be moved from the individual channels to a centralized place, in order to ensure adaptability when channels need to undergo changes or are added or removed.

A way to enable this adaptability is to incorporate the principles of Service-Oriented Architecture (SOA) into the IT architecture (Erl, 2007). Through SOA, channels, business services and data repositories can be loosely coupled so that changes in one of these elements do not affect the others. Companies applying personalization should apply the Logic Centralization Design Pattern, which specifies that “each reusable service be the sole access point for the body of logic it represents” (Erl, 2007). Process logic should be specified in one place and reused by the different applications that use it. The difference between architectures that are and are not based on SOA can be seen in Figure 47. Some crucial elements of an architecture are missing, such as customer channels and a data integration and analysis layer, but it clearly shows the centralization and reusability of business logic, contained in business services².

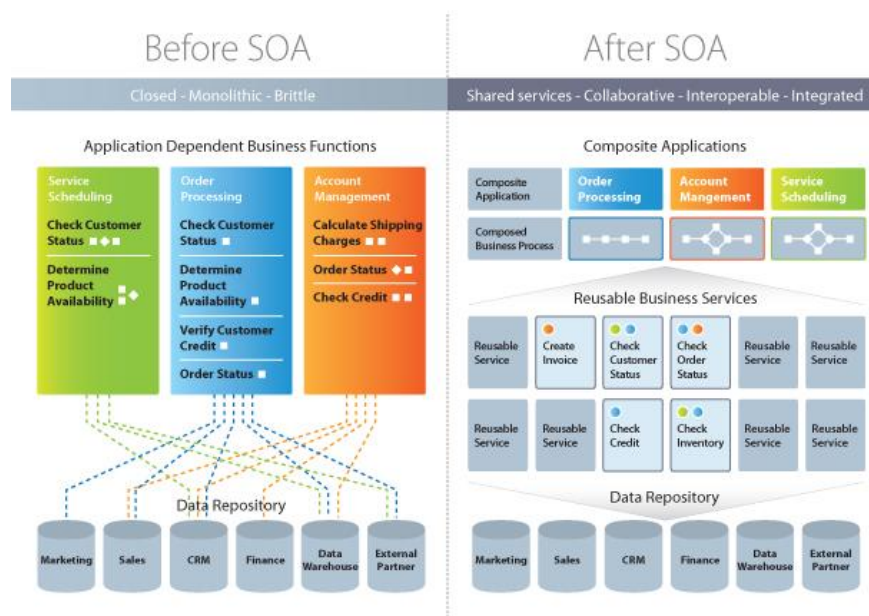


Figure 47 – SOA – Before and After (Tridens, 2014)

Companies wanting to apply personalization can validate whether their architecture is adaptable enough by looking at the eight SOA principles defined by Erl (2007):

1. **Standardized Service Contract:** "Services within the same service inventory are in compliance with the same contract design standards."
2. **Service Loose Coupling:** "Service contracts impose low consumer coupling requirements and are themselves decoupled from their surrounding environment."
3. **Service Abstraction:** "Service contracts only contain essential information and information about services is limited to what is published in service contracts."
4. **Service Reusability:** "Services contain and express agnostic logic and can be positioned as reusable enterprise resources."

² The business services in Figure 47 are not the same as the services a company provides to its customers. Those services are realized by "Composite Applications" and "Composed Business Processes" in the diagram.

5. **Service Autonomy:** "Services exercise a high level of control over their underlying runtime execution environment."
6. **Service Statelessness:** "Services minimize resource consumption by deferring the management of state information when necessary."
7. **Service Discoverability:** "Services are supplemented with communicative meta data by which they can be effectively discovered and interpreted."
8. **Service Composability:** "Services are effective composition participants, regardless of the size and complexity of the composition."

Just as in the previous sections, the actual impact on the company's IT depends on if they have an architecture similar to SOA in place. In the NS case described in chapter 9, logic was already centralized in the middleware system, which made the process change needed much smaller. If NS would have all business logic dispersed across back-end systems, channels and other systems in between, a lot more effort and money would have gone into making the architecture service-oriented. However, service descriptions of NS are often ambiguous: the Service Level Agreements of the Service Contracts (Erl, 2007) are not clear. An example of this is the Refund-system, which handles refund transactions. This is a legacy system and there is some confusion about the functionality of the refund services. Not knowing the exact functionality of a service makes reusability, the fourth SOA-principle, more difficult.

10.4 COMPLEXITY REDUCTION

IT complexity can be split into two types: functional complexity, which defines how much functionality a system contains, and coordination complexity, which describes how many connections a system has to other systems (Sessions, 2011). Functional complexity is also mentioned in Glass's law, which states that when the functionality of a system increases with 25 percent, the complexity of that system doubles (Glass, 2002).

Personalization increases both types of complexity, as was discovered in the process impact analysis of the NS-case in section 9.2. Because of personalization, more functionality is added to systems in order to serve customers in multiple ways. Also, a personalized service can generally be delivered via multiple channels and uses more data sources than a non-personalized service, which implies that more connections between systems have to be established. This increase in complexity causes more system development and management costs and increases the chance of errors because of lack of overview. For an overview of factors that increase complexity, see section 5.7.

Therefore, companies implementing personalization need to make effort to reduce IT complexity. Gartner has indicated complexity reduction to be a Top 10 Tech Trend to 2015 (Gartner, 2013). In an article by McKinsey, ways are given to reduce IT architecture complexity by "consolidating similar systems and standardizing technologies" (Akella, Buckow, & Rey, 2009). It is key, they state, that applications doing similar things are merged so that functionality is reused instead of duplicated. "The main objective now is to decide if different pieces of the existing IT setup are truly needed rather than trying to optimize them".

The Boston Consulting Group (Grebe & Danke, 2013) introduces an approach to reduce IT complexity which consists of six facets, displayed in Figure 48.

Intelligent demand management	Provide the transparency necessary for the business to make informed decisions about its demand for IT services	- Improved interactions between the business and IT - Reductions in business demand for IT of 10%–15% - Potential related IT cost savings of 4%–8%
Scenario-based application rationalization	Optimize the number of applications through consolidation, replacement, and decommissioning using a top-down, bottom-up approach	- Decommissioning of up to 40% of applications - Greater speed and adaptability to changing business requirements - Potential reduction in total IT costs of 15%–20%
Infrastructure technology-pattern reduction	Reduce the number of patterns in the IT infrastructure, thereby minimizing the variety of technologies, processes, and skills necessary for application delivery	- Potential to reduce the number of patterns by half, with a resulting savings of 5%–15% of total IT costs - Greater ability to leverage economies of scale
A simplified IT organization and an enabled IT workforce	Trim management layers and optimize spans of control; ensure an appropriately sized and skilled IT staff	- Lower costs, faster decisionmaking, and greater transparency - A workforce optimized for current and future challenges - A potential reduction in IT management staff of 20%–30%
Effective governance and simplified processes	Establish a comprehensive framework to optimize business-IT governance; simplify processes through use of lean and agile methodologies	- Better alignment between the business and IT - Significant streamlining of processes - Shorten development times by up to 60% and free up as much as 40% of capacity in the affected processes
A shared-services model and optimized sourcing	Adopt a shared-services model to service delivery; develop a unified, companywide sourcing model	- Optimized use of internal resources and greater ability to capture scale and factor cost advantages - Greater negotiating power with vendors

Figure 48 – A Multipronged Approach to reducing IT Complexity (Grebe & Danke, 2013)

Four facets of this approach are specifically relevant for personalization. These are marked yellow in the figure. They are the following:

- **Scenario-based application rationalization** involves optimizing the number of running applications. Often, legacy applications are still being used, even though they are outdated and do not function optimally: they do not have the flexibility required for personalization. This is also the case with some applications running at NS.
- **Infrastructure technology-pattern reduction** seeks to reduce the number of used patterns: configurations of hardware, system software and middleware elements. The result is a more consistent IT infrastructure that can be managed using less diverse knowledge. This is relevant for companies implementing personalization, because having a more consistent IT infrastructure will lead to more consistent services across multiple channels.
- **Effective governance and simplified processes** means having overarching vision and policies about the connection between business and IT. This is essential when companies want to implement personalization: simplified and consistent business processes will make them more adaptable to personalization. It is very important that personalization is approached holistically and is shared by all relevant business functions and units. Lean and agile methodologies are currently already used by NS in the development departments.
- **A shared-services model and optimized sourcing** removes the disadvantages of decentralizing IT functionality by establishing shared services that can be used cross-company. It contains similarities with the service-oriented approach described in section 10.3, which shows that shared services positively influence the way personalization can be implemented by companies.

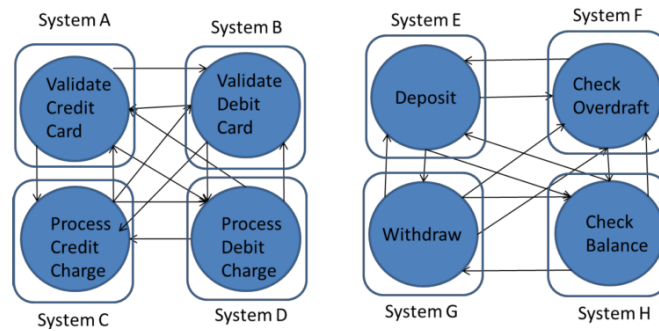


Figure 49 – A non-optimal way to partition business functions (Sessions, 2011)

“Scenario-based application rationalization” and “Infrastructure technology-pattern reduction” include finding a balance between putting too much functionality in a single system, which increases functional complexity, and separating functionality too much, which increases the coordination complexity of the IT architecture. A mathematical way to find that balance is the synergistic partitioning method defined by Sessions (2011). Using this method, every way of partitioning can be evaluated based on its complexity figure and the least complex partitioning strategy can be chosen. A non-optimal partitioning with lots of connections between systems can be seen in Figure 49. The disadvantage of this method is that it pays less attention to reuse, which is one of the goals of the SOA principles described in section 10.3.

10.5 VALIDATION

Two internal and two external experts were consulted and asked if they thought the generic IT impact analysis was correct, complete and useful. Based on their comments, the analysis was extended and made more practical. More information about the consulted experts can be found in Appendix D.

10.6 CONCLUSION

Applying personalization affects the IT of companies in four ways.

Companies need **data integration and analysis capabilities**. This should be done by firstly establishing relevant data sources, transfer systems and integration systems (virtual or physical). Then, analysis can be done to generate useful customer information by using techniques displayed in Figure 46.

Companies need to manage **customers' identities and authentication**. This can be done by establishing an Identity and Access Management system that fulfills business requirements and connecting it to all relevant other systems in the IT architecture. A checklist for functional and non-functional requirements of an IAM is given in section 10.2.

Service architecture of a company applying personalization should be **adaptable**. This can be done by implementing Service-Oriented Architecture and checking if the eight principles as stated in section 10.3 are kept.

Finally, applying personalization will increase complexity. Companies need to apply **complexity reduction** measures. Four facets of the approach of Boston Consulting Group, which is shown in Figure 48, are especially applicable to personalization: scenario-based application rationalization, infrastructure technology-pattern reduction, effective governance and simplified processes and a shared-services model and optimized sourcing.

A man in a white shirt and dark trousers is riding a blue bicycle with a yellow frame on a bridge over a canal in Amsterdam. The background shows traditional Dutch architecture and a church spire. A dark blue banner with white text is overlaid on the bottom of the image.

11 CONCLUSIONS AND DISCUSSION

11 CONCLUSIONS AND DISCUSSION

In this chapter, answers to the research questions are summarized and evaluated and the main conclusions of this research are stated. Then, the research methodology is evaluated and limitations are shown. Added value of the research is stated from a theoretical and practical viewpoint. Furthermore, some interesting future developments are stated. Recommendations are given for future scientific research. Finally, a set of recommendations is given to enable NS and other companies to use the ideas from this research in daily practice.

11.1 ANSWERS TO RESEARCH QUESTIONS

In this section, answers are given to the research questions defined in section 1.7. For each question, its research method is was which was determined in chapter 3. After this, the main conclusions for each question are stated and a short reflection is given on the suitability of the research method.

RQ1. What is the effect of personalization on customer effort and what other effects does it have?

This research question was answered in chapter 4 by conducting a literature review based on the methodology by Wolfswinkel et al. (2013). Also, three cases from practice were examined. This was done by interviewing an employee from the studied company. When an interview was not possible due to time constraints, explanatory company documents were studied.

The effect of personalization on customer effort, which is an indicator of customer satisfaction, is that it is reduced. The main reason for this is that personalization reduces information overload by removing irrelevant information. Customers have to make less difficult choices and get presented more relevant information, reducing search time and effort. Three other effects of personalization were found: revenue increase, increase in cost efficiency and reduce in customer trust. Increase in revenue and cost efficiency both lead to an increase in profit, and customer satisfaction also indirectly influences profit increase. Customer trust reduce is a negative effect of personalization, the other effects are positive.

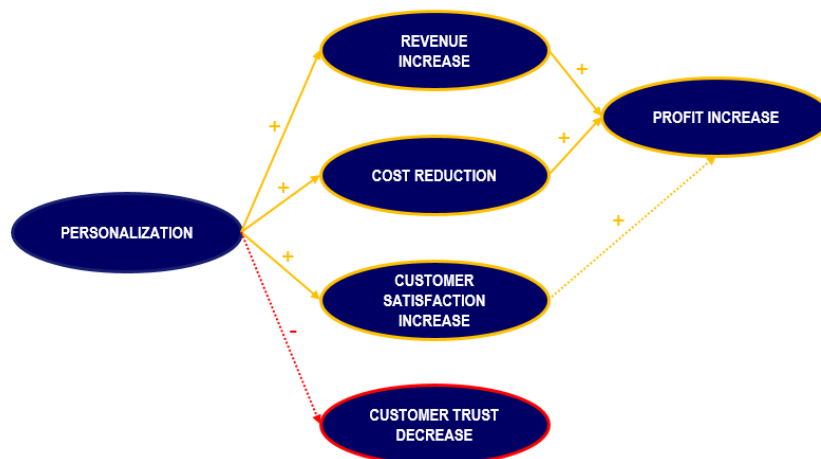


Figure 50 – Summary of found effects of personalization

Literature was found to be incomplete, because the increase in cost efficiency is barely mentioned as an effect of personalization. Also, it was found to be biased towards the positive effects of personalization and tended to ignore the risks and the possible negative effects associated with personalization. Furthermore, a bias was found towards personalization increasing satisfying factors, while the possible reduction of dissatisfiers is often ignored.

Some confusion exists about the construct of customer satisfaction. It is often used interchangeably with other concepts like loyalty, happiness and attitude, while they are not necessarily the same. Also, some sources claim a positive effect of personalization on customer loyalty, while another source contradicts this.

The combination of studying literature and reviewing case studies turned out to be very suitable to answer the research question. The literature provided the theoretical basis and the case studies helped to validate the theory found in literature, which resulted in interesting conclusions about literature gaps and biases.

RQ2. What are the best ways to apply personalization?

This research question was answered in chapter 5 by using the same methodology as was used when answering RQ1. A literature review was conducted, based on the methodology by Wolfswinkel et al. (2013). Also, three cases from practice were examined.

The optimal way of applying personalization depends on the situation and the goals chosen for the personalization project. Literature study revealed a number of factors a company can use to adapt the personalization setup.

Elements, such as layout, content or authentication need to be chosen which are going to be personalized. The system learning method, implicit or explicit, should be chosen, as well as the party that initiates the personalization: is it the customer that states he wants a personalized experience or does the system decide that for him? The specificity of personalization should be chosen. Customer data should be integrated and analyzed in order to personalize the experience. It can be categorized according to three content types, ranging from structured data from databases, to unstructured, real-time, context-based data (H. Chen et al., 2012).

The examining of cases from practice showed that in the different cases, personalization was applied in various ways. Although the most suitable elements and data types used to personalize vary per situation, personalization is best applied through the four-step cyclic process described in section 5.6. Complexity of personalization can vary widely, dependent on how personalization is applied, as was indicated in section 5.7, where a list of complexity factors are given. Furthermore, it was found that companies use data from all three content types as defined by Chen et al. (2012), whereas Chen et al. state that in 2012, only BI&A 1.0 content was being used. This shows that in three years, companies have made significant improvements in this field. Another finding was that companies use only a few elements, like layout and content, to personalize their services. Personalization efforts could improve by also using other elements like channel, authentication and employee to provide a personalized experience.

The research method of studying literature and reviewing real-world cases was found to be suitable to answer the research question. Literature provided a grounded theoretical basis and the cases could be used to validate the findings in literature, which produced some interesting conclusions. However, literature about personalization is probably not up-to-date because the latest insights are obtained by commercial companies which keep those insights for themselves. Therefore, a literature study alone is not sufficient to obtain the needed knowledge about the latest insights regarding personalization: real-world cases need to be studied more thoroughly to gain insight about the most recent developments.

RQ3. Which impact can personalization have on the IT of a company?

This research question was answered in chapter 10 by integrating findings from the literature study, case studies and IT impact analysis for the redesign. These findings were then complemented by searching in semi-scientific literature for more detailed information about the impact of those factors on IT. The generalized IT impact was validated by interviewing architecture experts from inside and outside NS.

Four conclusions can be drawn about the impact of personalization on the IT of a company.

Firstly, personalization requires a company to be capable of data integration and analytics. Personalization is data-driven by definition: a company treats customers differently based on the information it has about them. Companies should be able to integrate and analyze this data. This can range from a limited number of sources containing structured data, to a variety of sources containing structured and unstructured data (H. Chen et al., 2012). Companies can use a number of technologies to achieve those capabilities, as were shown in section 10.1.

Secondly, consistently recognizing and serving customers across different channels requires the company to have sophisticated identity and access management in place. Requirements for such a system are stated in section 10.2.

Thirdly, the architecture of the company needs to be flexible in order to deliver consistent services across different channels and respond to changes in the company's context. This can be achieved by a Service-Oriented Architecture, for which eight architectural principles are stated in section 10.3.

Finally, applying personalization causes increased complexity in the architecture of the company, as was discovered in the process impact analysis of the NS-case in section 9.2. Because of personalization, more functionality is added to systems in order to serve customers in multiple ways. Also, a personalized service can generally be delivered via multiple channels and uses more data sources than a non-personalized service, which implies that more connections between systems have to be established. Four practical ways to reduce IT complexity, based on an multipronged approach defined by the Boston Consulting Group (Grebe & Danke, 2013), were applied on personalization in section 10.4.

The integrative method that was used to answer this research question, suited well: the question was very broad by nature and by integrating different information sources, a broad overview could be generated of the impact of personalization. Using additional semi-scientific literature caused the impact analysis to be more grounded. However, a limitation of this method, which is further explained in section 11.3, is that only one case, the NS case, is thoroughly studied, the studies from literature and the cases from practice are not studied extensively. This might bias the impact overview.

RQ4. How and to which extent does personalization affect the customer effort of the online services of NS?

Literature study described in chapter 4 indicated that personalization would affect customer effort. Based on these findings, hypotheses were set up in section 8.1 and validated in the rest of that chapter, by estimating the effects of the redesign made in chapter 7. Validation was done by using the Expert Opinion method defined by Wieringa (2010). Twelve experts were spoken to and filled in an online questionnaire afterwards.

Experts agreed the redesign did have a significant and positive effect on customer effort, and therefore on customer satisfaction. However, it was not possible to quantify precisely how big this effect was and how many customers experienced a positive change. This limitation is further explained in section 11.3. Experts further indicated a number of risks and opportunities relating to the redesign. The most important and frequently mentioned risk was that the redesign would cause an increase in the number of claims in case of delay, which would increase the costs relating to that process.

The Expert Opinion method used was not a very suitable method for answering the fourth research question. Because experts could not estimate very precisely to which extent personalization affects the customer effort score, the question could only be answered vaguely. A more suitable method is, for example, Technical Action Research as defined by Wieringa (2010), in which the redesign would actually be tested with real customers, to see the effect on their customer effort score. However, due to time constraints, this was not possible in this research.

RQ5. How can NS best personalize its online services in order to reduce customer effort?

This question was answered in chapters 6 and 7 by redesigning two online services of NS in a framework of layered authentication and in chapter 8 by demonstrating the redesign using HTML mockups. A brainstorm session with experts from NS was used to generate ideas for the redesign.

The two redesigned services were chosen to be refund in case of delay and travel history and card information. Customer effort was found to be highly affected by the authentication process, and therefore, authentication was chosen as the personalization subject. Layered authentication was found as the best way to personalize authentication. Three authentication levels were defined, as can be seen in Figure 51.



Figure 51 – Layered authentication levels

Online services therefore appear in three versions, corresponding to the three authentication levels. At the first level, when customers are not logged in, services are **simple and accessible**, in order to provide customers with basic services for minimum effort. When customers are logged in, services become more **personal and fluent**. This is enabled by, for example, form pre-filling, remembering personal preferences and displaying personal customer data. When customers go to the highest authentication level, the services become **extended and pro-active**. In exchange for the information customers give to NS by connecting their card, they can use all available services. Using that information, the services are pro-active whenever feasible, thereby reducing customer effort even more.

The steps of the Design Science Research Methodology (Peffer et al., 2008) were found to be a suitable way to answer the fifth research question. The redesign produced using the method is practical, because it aligns with the actual real-world situation of NS, but also grounded, because of the extensive brainstorm done and the rationale behind the choices that were made to develop the redesign. HTML mockups were a suitable way to show how the redesign would look like in practice, given the time constraints attached to this research. When more time is available, the redesign should be developed in the actual production environment, so that customers can actually use the redesigned services, so that thorough testing is possible.

RQ6. Which changes in IT architecture and processes are needed to apply personalization on the online services of NS?

This question was answered in chapter 9 by using the enterprise architecture language ArchiMate to indicate needed changes to the IT landscape when implementing the redesign described in chapter 7. ArchiMate was used because the language can model both at an architectural and a process level and is able to connect both levels. Furthermore, the author of this thesis is experienced in using ArchiMate. At the architectural level, the IT impact of implementing the general functionality of layered authentication is described, and at the process level, the IT impact relating to the two redesigned services is described. At both levels, the current and future situation are stated and compared to identify needed changes.

The IT impact on the architectural level, described in section 9.1, consists mainly of the question whether to centralize or to decentralize application functionality. An identity and access management system (IAM) should be added to the IT landscape, responsible for identifying and authenticating customers, and providing channels with relevant customer information. Channels are still responsible for customer authorization and service providing and need to connect to the centralized IAM. The service business logic and process orchestration should largely be located in the middleware.

On the process level, described in section 9.2, several processes need to be changed or created in order to implement the two redesigned services. The main changes are located in the front-end systems which are responsible for the contact with the customer. The needed changes are quite small and often, new processes can reuse existing processes.

Based on the validation by internal and external experts can be stated that the usage of ArchiMate to describe the IT impact was suitable: it provided the needed overview. Textual descriptions further clarified the diagrams and provided more detail. The chosen division between architecture and processes was found to be logical and gave insight into the different dimensions of the IT impact.

11.2 MAIN CONCLUSIONS

In this section, the main conclusions are stated that answer the main research question defined in section 1.7, which is:

How can the online services of NS be personalized, so that customer effort is reduced, and how does that affect its IT?

This thesis shows that the online services of NS can be personalized by implementing layered authentication, which likely reduces customer effort. More validation is needed to quantify to what extent layered authentication affects customer effort.

Personalization has large effects on IT. For the introduction of layered authentication at NS, architectural changes included adding an identity management system to manage customer identification, authentication and, partly, authorization. For the two redesigned services of NS, several process changes and new processes were identified that mainly impact the front-end. In general, personalization affects IT by demanding data integration and analytics capabilities and a high flexibility in the IT landscape. It causes the IT landscape to be more complex, which needs to be accounted for.

Literature regarding personalization was found to be incomplete, because reduction of cost efficiency was not recognized as an effect of applying personalization and state-of-the-art technologies are probably not present in literature. Also, it was found to be biased, for two reasons. Firstly, possible negative effects of personalization were understated in literature. Secondly, little attention is paid to the ability of personalization to remove dissatisfying factors, while almost all literature is about the effects on the increase of satisfying factors.

11.3 RESEARCH METHODOLOGY AND LIMITATIONS

In this section, the used research methodology is stated and discussed. From this, some limitations of this research are derived.

Literature study was done in chapters 4 and 5 using the methodology defined by Wolfswinkel (2013). Using pre-defined keywords made sure all relevant directions were explored. Essential to this method was the iterative way in which it is used. Article recommendations by websites like SpringerLink were used to find articles related to the articles already found, so this thesis itself was also helped by personalization.

Using case studies to validate the literature search findings was useful: it discovered several shortcomings of and additions to literature regarding personalization.

This research used the Design Science Research Methodology (Peppers et al., 2008) for the redesign of online services of NS. The redesign provided much added value on top of just doing literature research. Through the redesign, the concept of personalization could be made practical and could be verified in the real world context. Therefore, the DSRM was a suitable methodology for achieving the goals of this research.

The Expert Opinion method (Wieringa, 2010) was used to evaluate the redesign. The semi-structured interviews conducted, defined by Cohen & Crabtree (2006) enabled experts to think and comment from their own perspectives, while some specific subjects and questions were retained. A limitation of this method is the limited precision with which experts can estimate the redesign effects: in order to make the validation quantifiable, a research methodology like Technical Action Research is needed (Wieringa, 2010).

The Demonstration and Evaluation phases of the DSRM were not carried out in the actual production environment of NS, but virtually, through mockups and using expert opinions. This gives an estimation of the effects of the redesign, but they cannot be measured and statistically validated. Future studies could build the redesign in practice and validate it, for example using A/B-testing. Indicators like the Customer Effort Score could then be measured and compared to the situation in which the services are not personalized, enabling more precise validation of the hypotheses defined in section 8.1.

Another limitation is that the design steps of the DSRM were only executed once, due to time constraints, while the design science approach could be used iteratively. As a consequence, some changes, for example the change mentioned by an expert in section 8.3.7, could not be incorporated in the redesign. Future studies could iterate over the DSRM-cycle multiple times to include the feedback in the redesign.

In chapter 10, several conclusions of the literature study, case studies and the redesign at NS were synthesized, integrated and generalized to provide an overview of the impact of personalization on IT. A limitation of this method is that only one case, the NS case, is studied thoroughly. The literature studies and the three cases from practice were not studied extensively. This might bias the overview towards the situation of NS. Further studies could thoroughly study more cases of personalization and, based on that, determine a more grounded and objective overview of the impact of personalization on IT.

Finally, the scope of this research is limited. Demonstration and evaluation was done based on mockups for just one channel, namely the website. Reduction of customer effort was the central goal of the redesign, while personalization could benefit other goals as well. Layered authentication was used to personalize online services, while personalization has many other forms, as described in chapter 5. Future studies could investigate other personalization scenarios and measure its effects on customers and the company, as well as its impact on IT and the organization.

11.4 RESEARCH CONTRIBUTIONS

In this section, research contributions to science and practice are stated.

11.4.1 CONTRIBUTIONS TO SCIENCE

The **theory of initial and regular effort** is defined in this research in section 6.4 and splits up the Customer Effort Score into two types of customer efforts: Initial effort and Regular effort. These effort levels were used to assess customer services, indicate where the largest gaps are and thus prioritize and indicate service improvements. Existing theory does not differ between initial and regular effort and therefore, the theory defined in this research adds value to the research field.

This research also adds value by **connecting theory and practice about personalization**, thereby validating those theories from literature. Most literature about personalization found during the search is not brought into practice and most real-world applications of personalization are not based on theory but ad-hoc and using common sense. Examples of these applications were found during interviews and case research, the results of which are stated in sections 4.5 and 5.8.

The literature study led to the conclusion that several concepts related to customer satisfaction are used interchangeably while not necessary being the same, leading to confusion. Sources contradict each other regarding the effect of personalization on customer loyalty.

Validating literature by case studies led to two observations. Firstly, literature, especially semi-scientific literature, was found to be **subjective** in two ways. Underestimating negative consequences and costs of personalization leads to a biased view of the effects of personalization and could cause companies to be overly optimistic when making plans to apply personalization. Also, literature mainly focuses on personalization enabling satisfying factors and tends to ignore dissatisfying factors, while removing dissatisfying factors can be of high influence to improve customer satisfaction. Secondly, literature was in some ways **incomplete**: cost efficiency was not found in literature as an effect of personalization, whereas in practice, it was recognized in the cases studied in section 4.5. Also, literature was incomplete regarding the most recent developments in personalization, of which knowledge is often kept inside companies applying personalization, instead of sharing it with the community.

This research also adds value to science by specifying future research opportunities with which new knowledge can be gained. These research opportunities can be found in section 11.6.

11.4.2 CONTRIBUTIONS TO PRACTICE

In the first place, added value in the real world is provided for NS. NS has certain problems, described in section 2.4, which are addressed in this research. This research shows that implementing layered authentication at online services will likely have positive effects on the Customer Effort Score and on customer satisfaction. NS will therefore, when this redesign is actually implemented and brought to the production environment, likely solve part of the current problem it has. This research adds extra value by not only showing the result of the redesign, but also indicating how big the impact on IT is going to be.

Other companies wanting to implement personalization can benefit from this research. The concept of layered authentication, which was generated in the redesign process, can be used by other companies in their own situation. Also, the process of creating a redesign, demonstrating and validating it and the theories and literature used in this research can be used by other companies to start such a redesign process themselves. Furthermore, chapter 10 describes the impact of personalization on the IT of companies, together with practical ways to achieve an IT landscape that is suitable for personalization.

Both NS and other companies can benefit from this research by carrying out recommendations for practice stated in section 11.7.

11.5 FUTURE DEVELOPMENTS

This section provides an overview of the most important developments of the coming years, which will define the way personalization will be used, specifically in the public transport sector.

The **smartphone** will become the **predominant customer channel** in the coming years. Currently, the smartphone application of NS is only used for delivering information-related services. The smartphone will in the coming years be developed as a travel product (Nationaal Beraad Openbaar Vervoer, 2014). Furthermore, digital authentication via smartphone is already mainstream, using applications, biometric identification or SMS codes (Harley, 2015). Mobile sensors are becoming more and more sophisticated, smartphone applications will collect sensory information and analyze it to deliver context-based personalization (Walker & Cearley, 2015). Because of this combination of functionality and authentication possibilities, the smartphone is the ideal channel to deliver personalized, context-aware services.

Companies should follow this trend and create or adapt a smartphone application and a mobile website in order to have relevant and personalized customer contacts. Customer expectations regarding smartphone applications are very high (Kirschner & Kenney, 2015) and the development of an application with a good user experience is crucial in determining success. In order to make the mobile channel user-friendly and intuitive, the User Experience should be designed according to design guidelines, which are e.g. provided by Apple (Apple, 2015) and Google (Google, 2015). Making the website or application responsive is mandatory and it is recommended to use existing User Interaction (UI) patterns (VenturePact, 2015). An example of a highly rated application is the Airbnb app for Android and iOS, which turns the complex process of booking a room into something easy, fast and convenient (Android App Store, 2015).

Personalizing customer interactions via the smartphone channel poses some specific challenges and opportunities. A big challenge in providing context-aware personalization is not only collecting and analyzing context data in real-time, but also connecting it to structured data from all sorts of databases. Only then, a complete customer view can be developed and personalization can be applied optimally. Another challenge is creating services that are relevant and optimized for the mobile channel. Nearly all current services of NS can function on smartphones, but do not use all possible opportunities the smartphone offers, like contextual information and behavioral information from the customer using his smartphone. For example, the journey planner is currently static: it only gives the times and platforms the customer needs. Using the opportunities of the smartphone, the journey planner could tell customers exactly how to walk, how much time is left and where to sit strategically, so that at the next transfer, the walking distance will be minimized.

The most important development of the coming years in the public transport sector will be the development of **Mobility-as-a-Service (MaaS)**, which means a shift from buying means (e.g. cars or bikes) or tickets (e.g. train or tram tickets) for transport, to buying mobility services, in which the key is that the traveler needs to get from A to B. MaaS makes public transport fully demand-driven and data-driven and is enabled by the smartphone being a dominant multifunctional customer channel. It enables more efficient use of resources, a decrease in congestion and a higher customer satisfaction. The European Commission has stated MaaS to be a key theme in their Work Programme 2016-2017 regarding transport (European Commission, 2015) and the European Innovation Partnership on Smart Cities and Communities also focuses on “better integration and management of collective city transport for door-to-door seamless multi-modality” (Heuser & Schroer, 2015). McKinsey states that urban mobility is at a tipping point and that new technologies will revolutionize the way urban transport is being carried out (Bouton & Knupfer, 2015).

Several projects are already being carried out to start realizing MaaS in smart cities. The most commonly known and widely spread example is **Uber**, a company connecting taxi drivers and passengers via a smartphone application. Passengers can book a ride and instantaneously, they can see where their driver is and how long it is going to take until they get picked up. People without a taxi driver's license can drive passengers around via the application UberPOP, which is controversial in a lot of countries. Currently, Uber has more than 160.000 drivers and every day, more than 1 million Uber rides are being made (Huet, 2014). Other ridesharing applications like Blablacar, Lyft and Sidecar are also growing quickly (Alba, 2015).

Finland is currently very busy realizing MaaS in parts of their country. The first step was taken by implementing **Kutsuplus**, a flexible bus service in the Helsinki area which can be requested via a smartphone application and which automatically adapts its travel routes and schemes based on the passenger demand (Kutsuplus, 2015). The Dutch National think tank has also described this idea as the first step towards a travel system that completely offers MaaS (Hovenkamp, 2014). Based on their experiences with Kutsuplus, 23 private and public companies such as the Helsinki Public Transport company, taxi company Uber and Siemens are now collaborating in an open market model with broad co-operation to create the **first full MaaS ecosystem in the world** (MaaS.fi, 2015).

Personalization plays a crucial role in realizing MaaS. Travelers need to have up-to-date, correct and relevant information to their disposal in order to choose how they would like to travel, to prevent information overload (Liang et al., 2007). This can be realized by real-time, context-based personalization that uses data from all relevant travel modes. A working example of this concept from Finland can be seen in Figure 52, which shows a smartphone application that provides personalized information about available travel options. Estimating how busy a vehicle is and where it is located, can be done by measuring how many devices are present in a certain environment using a travel application. Google and TomTom already use this method to measure road traffic (Barth, 2009).



Figure 52 – Example of MaaS-application (MaaS.fi, 2015)

Applying real-time, context-based personalization to enable seamless, multimodal transport will result in a personal journey for every customer. Customers will have detailed information about their travel times and delays and the expected availability of seats, which removes the two most important dissatisfiers of public transport in the current situation (CROW, 2015). NS will have to collaborate with relevant Dutch public transport companies as well as with technology partners in order to realize MaaS. At a technical level, data sources from different environments will need to be connected and applications will need to be developed that can provide optimal transport options. At a political and organizational level, people from a lot of companies will need to work together closely to avoid organizational barriers. Different and, sometimes, conflicting stakeholder goals will need to be integrated towards common goals.

11.6 RECOMMENDATIONS FOR SCIENCE

In this section, a number of interesting opportunities are provided for future research. Firstly, future studies can focus on overcoming the limitations mentioned in section 11.3. Other opportunities are defined below.

Scientific research can have four goals: describing, explaining and predicting phenomena and controlling variables to produce a desired phenomenon. Characteristics of scientific research are that it operationalizes variables and that replication of scientific research is possible.

In the research field of personalization, **semi-scientific literature** is dominantly present. Semi-scientific literature is often less precise regarding definitions and concepts and is sometimes driven by commercial goals instead of scientific rigor. This may cause conclusions to be overly optimistic towards the effects of personalization. A concrete example of this was found regarding customer loyalty: several sources were claiming positive effects of personalization on customer loyalty, while a more rigorous study claimed no effects of that kind.

Therefore, rigorous scientific research is needed to study the **effects of personalization on customer experience**. Different indicators of customer experience need to be identified and operationalized. Differences between those indicators need to be made clear. Then, of each indicator should be studied how personalization affects that indicator, in an unbiased way: done by researchers without conflicts of interest. This will provide companies considering personalization with trustworthy information about the effects of personalization and will reduce the biases discovered in chapter 4.

In chapter 5, methods of personalization were studied. However, the literature search yielded limited results because the current **state of the art in personalization is not present in literature**. The most advanced personalization forms are developed by commercial companies like Google, Facebook and Spotify and this knowledge is not shared with the public, because of competition purposes. Science aims to increase the knowledge about phenomena, but this is not possible when the latest knowledge is not shared but kept secret. This has negative effects for the research field, which then cannot develop as fast as is possible.

Therefore, more **exploratory research** should be done to uncover the state of the art applications and techniques of personalization, currently used by commercial companies. This will increase the knowledge about personalization and will, in turn, lead to more innovative personalization solutions. Research can be done, similar to this thesis, by offering companies to study personalization improvements in their context, in return for knowledge about their current personalization practices. However, companies might not give that permission and will keep their knowledge for themselves. To overcome this, personalization practices can be reverse engineered: studying personalized services to determine what the underlying algorithms and techniques are. An example of this is a study to reverse engineer Google's automatic annotation of Web pages (De Virgilio, Frasinicar, Hop, & Lachner, 2013).

For personalization, an example of state of the art techniques not being shared with the public is Facebook's News Feed algorithm called **EdgeRank**, through which they determine the sequence the news items to display in a user's News Feed. On their own website, Facebook only gives some vague information (Facebook, 2015). Other news websites and authors have begun to unravel the basics of the algorithm (Constine, 2014; Widman, 2015), as can be seen in Figure 53, but still, a lot is unclear about the exact working of the algorithm.

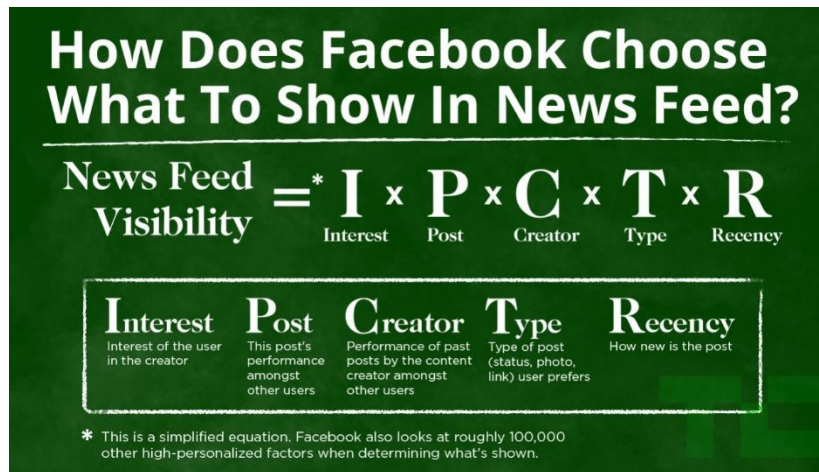


Figure 53 – Basic characteristics of EdgeRank algorithm (Constine, 2014)

Through rigorous testing and experimenting, the EdgeRank algorithm can be (partially) reverse engineered, resulting in knowledge about the latest and best ways of applying personalization. This knowledge can then be applied by other companies that want to know when to offer which personalized content to customers. Furthermore, through extensive experimenting and testing, the algorithm can be improved further, which also benefits Facebook itself.

11.7 RECOMMENDATIONS FOR PRACTICE

This research provides opportunities for NS to further apply personalization in their daily practice, which are further detailed in this section. Also, other companies can use the recommendations described below to implement personalization in different contexts.

Companies wanting to personalize their customer contacts should not take a project approach, but a **program approach**. A project is defined as “a temporary endeavour undertaken to create a unique product, service or result” (Project Management Institute, 2004). It has concrete results and a specific focus (Arto, Martinsuo, Gemünden, & Murtoaro, 2009). However, when a company wants to personalize its customer interactions, there should be a broad focus: not on a single channel but on all channels, not on a single service but on all relevant services. The goal should not be to temporarily improve customer contacts but to permanently personalize the way customers interact with the company. This was also experienced by NS International (based on internal documents of NS International), which wanted to personalize their customer interactions. After some trying out, NS International eventually created several smaller interrelated projects instead of a single large project. Therefore, a program should be created to focus on personalizing customer interactions. A program can be defined as “a group of related projects managed in a coordinated way to obtain benefits and control not available from managing them individually” (Project Management Institute, 2004).

Thiry (2012) defines a **program life cycle** which consists of five phases: Formulation, Organization, Deployment, Appraisal and Dissolution. In the Formulation phase, a high-level overview is constructed of the program’s benefits and costs, stakeholders involved and the main program objectives. This can, for example, be done by filling in the Business Model Canvas (Osterwalder & Pigneur, 2010). The Organization phase consists of creating a more detailed blueprint of the program. The different projects are actually carried out in the Deployment phase: this is where the added value of the program is created. The Appraisal phase then consists of collecting project results and benefits, to assess how the program has realized the predicted benefits. Finally, the projects are closed down and long-term benefits measurement processes are set up in the Dissolution phase. Companies wanting to implement personalization should follow this program life cycle in order to make their personalization efforts as effective as possible.

The need for service personalization at NS is high: customers currently have high expectations and the satisfaction regarding services of NS is below average. However, the projects in which personalization plays a role are often

not related to each other and carried out by different departments: there is no overarching vision. Also, projects with the highest profitability are given the highest priority. This causes projects which are only indirectly profitable, like the layered authentication proposal from this thesis, and smaller personalization projects to be delayed because of a lower priority. Therefore, **NS needs to establish a personalization program**, in which all personalization-related projects are carried out. Relevant departments from NS Commercie need to be participating, such as Marketing, PMI and Business Systemen but also the M-lab which develops the smartphone application Reisplanner Xtra and the Business Intelligence Competence Center, in which NS's data analytics capabilities are centralized. Establishing a personalization program prevents having to request funding for every project individually and reduces the need for every project to be profitable in itself. Having an overarching program vision makes sure projects are related and knowledge is re-used.

NS should set up the personalization program according to the phases defined by Thiry (2012) as follows. In the first quarter of 2016, the program **Formulation phase** should be carried out. A program board should be established in which all concerned departments are represented, which coordinates the program. The main opportunities and costs of personalization should be listed, together with a number of directions in which projects are going to be started up. An overarching vision and common goals should be defined, which are agreed on by all involved departments, as well as indicators to accurately measure the achievement of those goals. This could be summarized in the Business Model Canvas, which lists the nine core elements of a business model (Osterwalder & Pigneur, 2010). All this should be used to convince higher management to fund further development of the program.

In the second quarter of 2016, NS should carry out the **Organization phase** of the personalization program. This means detailing observations and plans from the Formulation phase. An extensive description of future projects and related goals should be developed, as well as costs and benefits with regard to those projects. A timeline should be made which shows when and in which order projects will be executed. This should lead to higher management approval of the detailed program blueprint and funding for the first year in which the program will run.

From the third quarter of 2016, the program will enter the **Deployment phase**, in which projects will run and the program plan will be carried out. Those projects should be run in an iterative way, constantly receiving feedback from customer surveys, usage statistics and sales figures and using that feedback for further optimization. The first phase of such a project should be to start small by running a pilot phase, which can be deployed and tested quickly. When the pilot success has been proven, it can be rolled out into the production domain.

A suitable project to carry out at the beginning of the program would be **implementing layered authentication**, as was defined in this thesis. It is suitable because the project idea, together with the IT impact, is worked out in detail in this thesis and it provides a lot of opportunities for other personalization projects that can be realized because customers can authenticate themselves at multiple levels. In order to do this, the redesign should be further revised based on the feedback described in section 8.3. Also, costs and benefits of layered authentication should be worked out in more detail, so that a business case can be established which can convince higher management to approve funding. Project costs should be defined in more detail by estimating the IT impact on all online services and channels, as well as the impact of layered authentication on the organization of NS, as an expert stated in section 9.3. Project benefits can be detailed by implementing a pilot version of layered authentication and measuring what its effects are. When this is positive, the project can be rolled out in the production domain.

In addition to layered authentication, mechanisms should also be put in place on all online channels to track customers that are not logged in, for example by using cookies and integrating cookie data with other data sources. As a result of this, all customers interacting with NS via digital channels can be identified and authenticated and this data is being shared across all online channels.

When this is the case, NS should experiment with other personalization scenarios. Using pilot projects, different types of personalization can be tested to see whether they work or not. The varying goals and methods described in chapters 4 and 5 can be used as a guide as to what scenarios are possible. For each scenario, different data sources will be used to base personalized experience on. To ensure that projects can build on previous efforts and

results, it is important to centralize data from different sources and the analyses done on that data. Every time a project needs data from multiple sources, that centralized data can be used and new data sources can be added if needed. This makes sure that new pilot projects can be launched in less time and with less effort. More information about data integration and analysis solutions and technologies can be found in section 10.1.

Organizing personalization through a program enables an integrated approach, in which knowledge is shared and common vision and goals are pursued. This will cause NS to personalize its services step-by-step and will lead to permanent improvements which benefit NS as well as its customers.

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APPENDIX A GLOSSARY

A/B-testing	Comparing and testing two versions of a website to see which one performs better
BI&A	“Business Intelligence & Analytics” (H. Chen et al., 2012)
Central service	Service which is centrally hosted and does not take place in specific locations like railway stations
Context-awareness	Using “context to provide relevant information and/or services to the user, where relevancy depends on the user’s task” (Dey & Abowd, 1999)
CTTS	Back-end system of <i>NS</i> containing travel transactions of <i>Paper tickets</i>
Customer Effort Score	Rating which measures the effort a customer has to make to complete a certain task (Dixon et al., 2010)
Customization	Sub-form of <i>personalization</i> in which explicit input from the customer is used to tailor interactions between a business and the customer
DSRM	Design Science Research Methodology (Peppers et al., 2008)
E-ticket	An electronic (train) ticket, often generated in the form of a PDF-document, which can be bought online
IAM	Identity and Access Management: capabilities to manage user identification, authentication and authorization
KYC	Know Your Customer: the process in which a company verifies the identities of its clients. Often used in the financial sector
Mijn NS	Online personal customer portal of <i>NS</i>
NS	Nederlandse Spoorwegen
NS Extra	<i>NS</i> ’s customer loyalty programme
Online channel	Channel which interacts over the Internet
Online service	Service provided via <i>online channels</i>
OV-chipkaart	The smartcard for all public transport in the Netherlands
Paper ticket	Paper train ticket containing an RFID chip, which can be bought at vending machines at railway stations
Persona	‘Fictitious, specific, concrete representation of target users’ (Pruitt & Adlin, 2006)
Personalization	the combined use of technology and customer information to tailor interactions between a business and each individual customer
RTS	“ReisTransactieSysteem”: Back-end system of <i>NS</i> containing travel transactions of the <i>OV-chipkaart</i>
SAP PI	SAP Process Integration: Middleware system of <i>NS</i> responsible for process orchestration and message forwarding

APPENDIX B PERSONA DESCRIPTIONS

In this chapter, extended persona descriptions are given that were used when brainstorming for the redesign of online services, as described in section 6.2. The persona descriptions were originally in Dutch in the redesign and brainstorm sessions. They were translated to English for consistency and understandability purposes.

APPENDIX B.1 UNEXPERIENCED TRAVELLER

"I do not know much about travelling by train, but it suits me well!"

Peter Koopman – 71 years old – pensionado – married, three children and two grandchildren – lives in Haarlem

Travels by train on average four times a year – does not have a season ticket but buys paper tickets – travels from and to family and other social events – has no regular train route but does have a regular departure station: Haarlem – approximately half of his travels are alone, the other half are in company of others

Low to average knowledge of internet and computers, preference for analog channels like telephone and mail.

Is looking for clear information about his journey and possible delays and changes – currently knows little about NS and travelling by train



APPENDIX B.2 THE SOCIAL TRAVELLER

"I use train travelling to socialize with my friends and relax!"

Margriet Veneman – 28 years old – works 32 hours per week at the Municipality of Barendrecht – Single – lives in Barendrecht

Travel by train on average two times per week – has a Dal Voordeel season ticket – travels for social and recreation purposes – has no regular train route but does have a regular departure station: Barendrecht – travels mostly together with others

High knowledge of internet and computers, preference with digital contact channels like computer and smartphone

Would like to get in touch with others online, would like to receive information about day trips, special offers. Would occasionally like to order e-tickets for multiple people



APPENDIX B.3 THE CERTAINTY SEEKER

"Travelling by train is quite tense for me. I would like to know up front all information about my journey"

Corry ten Boer – 52 years old – works 24 hours per week as a veterinary assistant – married, four children – lives in Tilburg

Travels by train on average three times per month – has a Dal Voordeel season ticket – travels from and to her work – always travels alone – has a regular travel route

Low knowledge of internet and computers, preference for analog channels like telephone, service center and mail.

Would like to plan her journey and print travel information up front. Plans her journeys as early as possible, would like to have all relevant information and control over her journey.



APPENDIX B.4 THE COMMUTER

"Travelling by train is my daily routine."

Dennis van Houten – 36 years old – Project Manager in Amsterdam – in a relationship – lives in Utrecht

Travels by train on average five days per week – almost exclusively travels during rush hour – has a travel route season ticket – travels solely for business purposes – has a fixed train route and travel time – travels almost exclusively alone

Is a digital native, prefers digital channels like the computer and the smartphone

Wants to have information about his fixed route and would like possibilities to make use of claim and travel information services with as low efforts as possible. Would like to easily generate an overview of his travel history



APPENDIX C OVERVIEW CENTRAL SERVICES NS

An overview of the central services provided by NS is given below. There are three categories in which those services can be placed: information, sales and service. Of each service is stated through which channels the service can be delivered and which personas generally use the service.

Service name	Category	Channels	Used by personas <i>Based on expert session</i>
Refund in case of delay	Service	Mail, Mijn NS	2,4
Refund in case of forgotten check-in/out	Service	Mail, Website NS (web form), Mijn NS, telephone	2,3,4
View travel history	Information	Mijn NS, Reisplanner Xtra (partly)	2,4
View card information	Information	Reisplanner Xtra, service desk, vending machine	
Generate travel history overview	Service	Mijn NS	2,4
Overview recent personal messages and notifications	Service	Mijn NS	2,4
View and edit personal data	Service	Mijn NS, telephone	1,2,3,4
Stop or change season ticket	Service	Telephone, mail, Mijn NS (partly)	2,3,4
Buy tickets	Sales	Webshop, vending machine, service desk	1,3,4
Buy special offer tickets	Sales	Spoordeelwinkel	1,3
Buy season ticket	Sales	Telephone, webshop	2,3,4
Issue complaint	Service	E-mail, mail, telephone	1,2,3,4
Lost and found objects	Service	Website, telephone	1,2,3,4
Receive special offers and information	Information	E-mail (newsletter)	2,3,4
View invoices	Service	Mijn NS	2,4
View previous claims	Service	Mijn NS	2,4
Plan train journey, view prices, view disturbances and delays	Information, Service	Website, Reisplanner Xtra, telephone	1,3,4
View information about railway stations and other background information	Information, Service	Website, Reisplanner Xtra, telephone	1,4
Request temporary chipcard	Service	Mijn NS, Telephone	2,3,4
Check status OV-chipkaart (e.g. checked in/out, current balance)	Information	Reisplanner Xtra	2,3,4

APPENDIX D CONSULTED EXPERTS

Experts are consulted in this research for three purposes. Firstly, three experts from NS were involved in the development of the redesign. Secondly, twelve other experts from NS validated the redesign. Thirdly, two experts from inside NS and two experts from enterprise architecture company BiZZdesign were consulted to review the impact analysis of the redesign.

APPENDIX D.1 REDESIGN BRAINSTORM AND DEVELOPMENT

The following three experts were involved in the development and brainstorm of the redesign, described in chapters 6 and 7:

1. Tom van Bruggen: Productmanager at PMI
2. Han Mooiman: Multichannelmanager Internet at PMI
3. Jonne Balster: Improvement Manager at Customer Service

APPENDIX D.2 REDESIGN VALIDATION

The following twelve experts were interviewed, face-to-face as well as via an online questionnaire, regarding the evaluation of the redesign:

1. Joost Kaart: Online Marketeer at Marketing
2. Willemine Steller: Project Manager at Marketing
3. Herma de Leeuw: Project Manager at NS International
4. Jan Willem Grift: Channelmanager Online and Project Manager Redesign at PMI
5. Joep Hombergen: Analist at Customer Insight
6. Hanneke van der Boog: Analist at Customer Insight
7. Ron Peereboom: Business Consultant at IT Operations
8. Jan Broos: Change Manager at Business Systemen
9. Erhan Macaltay: Change Manager at Business Systemen
10. Nathalie van Eck: Multichannelmanager Online at PMI
11. Wouter Jansen: IT trainee at Business Systemen
12. Karen Slijkhuis: Information Architect at Finance Center

APPENDIX D.3 REDESIGN IMPACT ANALYSIS VALIDATION

The following two experts from NS were interviewed to review the impact analysis of the redesign:

1. Henk Manuel, Architect at Business Systemen
2. Harro de Gouw, Architect at NS International

The following two experts from BiZZdesign were interviewed as external experts to review the impact analysis of the redesign:

1. Harmen van den Berg, partner and co-founder of BiZZdesign, speaker and consultant in Enterprise Architecture and Business Process Engineering
2. Bas van Gils, lecturer, consultant and researcher in Enterprise Architecture, Business Process Management and Data Management

APPENDIX E HTML MOCKUPS

APPENDIX E.1 CARD INFORMATION FORM FOR USERS WITHOUT A CONNECTED CARD



[Consumenten](#) | [Zakelijk](#) | [NS International](#) | [Over NS](#) | [Welkom A.W. van den Berg!](#) | [English](#) | [Contrast](#) | [A A A](#)

[Overzicht](#) | [Plan een reis](#) | [Mijn Reishistorie](#) | [Mijn Producten en Kaarten](#) | [Webshop](#) | [Contact](#)

Op deze pagina kunt u:

- Bekijken of u momenteel in- of uitgecheckt bent met uw OV-chipkaart
- Bekijken of u in de afgelopen 30 dagen bent vergeten uit te checken, en versneld geld terugclaimen
- Geanonimiseerde reisgegevens van de afgelopen 30 dagen bekijken

*Dit is een formulier met gelimiteerde opties.
Wilt u het overzicht van uw reishistorie bekijken, automatisch uw reishistorie in uw mailbox ontvangen, uitgebreid zoeken en eerder gemaakte reishistorieoverzichten bekijken?*

[Maak gratis een account aan en koppel uw OV-chipkaart.](#)

OV-chipkaartnummer:

Naam kaarthouder:

Geldigheid kaart:

Controle vraag: In welk station bent u als laatste ingecheckt?

Toon kaartinformatie

Terug

APPENDIX E.2 CLAIMING REFUND WITH DELAY FOR USERS WITHOUT A CONNECTED CARD



ConsumentenZakelijkNS InternationalOver NSWelkom A.W. van den BergEnglishContrastA A A

Zoeken

OverzichtPlan een reisMijn ReishistorieMijn Producten en KaartenWebshopContact

Geld Terug bij Vertraging

Heeft u onlangs vertraging gehad bij het reizen met NS? Vul dan onderstaand formulier in. Als uw verzoek wordt goedgekeurd, kunt u uw restitutie als extra saldo ophalen bij een automaat.

Dit is een formulier met gelimiteerde opties. Wilt u de restitutie op uw bankrekening ontvangen en automatisch notificatie als u mogelijk vertraging heeft gehad?

Maak gratis een account aan en koppel uw OV-chipkaart voor extra gemak.

Persoonlijke gegevens

Voornaam:

Tussenv. en achternaam:

Soort vervoersbewijs:

Kaartnummer:

Emailadres:

Reisgegevens

Aantal minuten vertraging:

Reisdatum:

Tijdstip van vertrek:

Tijdstip van aankomst:

Beginstation:

Eindstation:

APPENDIX E.3 OVERVIEW OF TRAVEL HISTORY AND POSSIBILITY TO FILE CLAIMS FOR USERS WITH A CONNECTED CARD

[Consumenten](#)
[Zakelijk](#)
[NS International](#)
[Over NS](#)

Welkom A.W. van den Berg!
 [English](#)
[Contrast](#)
[A A A](#)

[Overzicht](#)
[Plan een reis](#)
[Mijn Reishistorie](#)
[Mijn Producten en Kaarten](#)
[Webshop](#)
[Contact](#)

Overzicht reishistorie

Overzicht reishistorie

Declaratieoverzichten

Kaartnummer

3528 0200 1234 5678

Maak overzicht (PDF)

Sorteren

Nieuwste eerst

Filteren

<selecteer een snelfilter>

Aankomststation:

Vertrekstation:

Soort transacties:

Alle transacties

Reistype:

Alle categorieën

Datum van:

1 Jan 2013

Datum tot:

25 Sep 2015

☐ Toon alleen afwijkende reizen

Hoogte prijs reis:

€ 0 - € 100

Weekdagen:

☒ Zondag
 ☒ Maandag
 ☒ Dinsdag
 ☒ Woensdag
 ☒ Donderdag
 ☒ Vrijdag
 ☒ Zaterdag

Saldo €8,53, Uitgecheckt (laatst gecontroleerd op 18/09/2015 16:22)

	Datum	Reis (van, naar)	Product, prijs	KI	Categorie	Dien claim in
☒	16-09-2015	10:55 Rotterdam Centraal 12:01 Groningen	Dal Voordeel €14,60	2	Geen categorie	Claim
☒	12-09-2015	08:35 Haarlem 08:51 Almere Centrum	Dal Voordeel €6,60	2	Geen categorie	Claim
☒	28-08-2015	16:33 Rotterdam Centraal 16:38 Rotterdam Alexander	Dal Voordeel €2,50	2	Geen categorie	Claim

APPENDIX F DETAILS OF REDESIGN EVALUATION

First, the questions asked during the semi-structured interviews are listed. Then, the online questionnaire and its results are shown. Both the interviews and the questionnaire were conducted in Dutch. For the purpose of consistency, they are translated into English in this thesis.

APPENDIX F.1 SEMI-STRUCTURED INTERVIEW

At the start of the questionnaire, the setup of the research and the problem definition leading to the redesign are explained. Then, the redesign was demonstrated by showing the HTML mockups made to the experts and explaining their usage.

After this, the experts were asked questions, which correspond to the hypotheses defined in section 8.1:

- A. Do you estimate that the customer effort to receive both redesigned services is reduced by the redesign? (Corresponds to HYP1)
 - a. From your own viewpoint
 - b. For other people, for example the personas defined
- B. Do you estimate the number of people that use NS services online compared to offline increases, decreases or stays the same? (Corresponds to HYP2)
- C. Do you estimate the number of people that create an account and connects their OV-chipkaart increases, decreases or stays the same? (Corresponds to HYP3)

Finally, general feedback questions were asked in order to ask about other aspects relating to the redesign that might be relevant:

- D. What are the advantages of this redesign?
- E. What are the disadvantages of this redesign?
- F. What are the risks of this redesign?
- G. Is the redesign an improvement of the current situation? If yes, why?

The interviews were semi-structured, which meant that there was room for deviation from the questions set up. However, the central goal of the interviews was to get an answer to the prepared questions. All relevant answers are stated in section 8.3.

APPENDIX F.2 ONLINE QUESTIONNAIRE

After the interviews, there was a need to quantify some aspects of the redesign effects. In order to do this, an online questionnaire was set up using Google Forms, which all twelve experts filled in. The online questionnaire consisted of the questions and yielded the results shown below. A summary of these results can be found in section 8.3.

1. The redesign causes a reduction of customer effort for a certain group of customers. How big do you estimate that group to be?

The total number of customers of NS is just below 10 million. This includes people travelling per train only once a year.

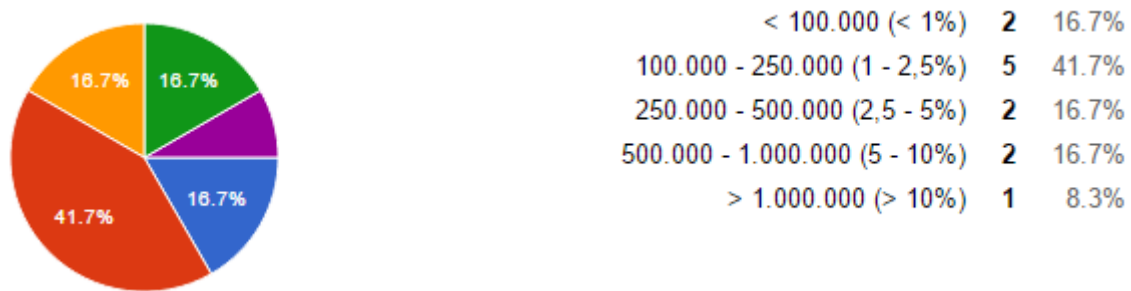


Figure 54 – Summary of answers to question 1 of online questionnaire

2. The redesign causes a certain group of customers that currently use offline services of NS, to change to online service usage. How big do you estimate that group to be?

The total number of customers of NS is just below 10 million. This includes people travelling per train only once a year.

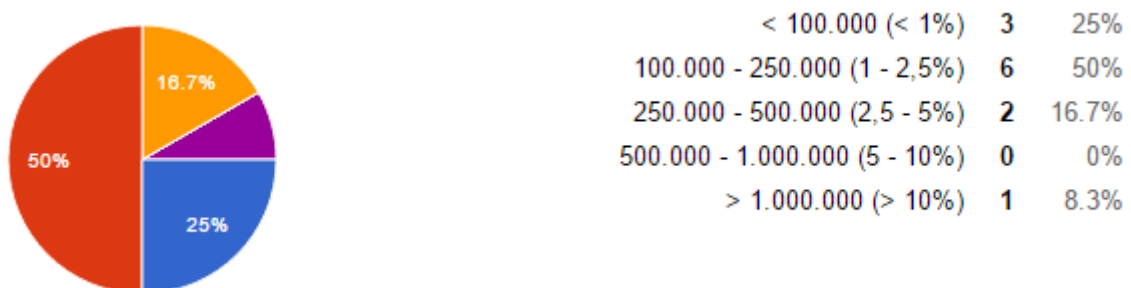


Figure 55 – Summary of answers to question 2 of online questionnaire

3. How does the redesign affect the number of monthly created accounts on the website of NS?

In the current situation, 1.4 million accounts are activated. The current figure of monthly created accounts is 25.000.

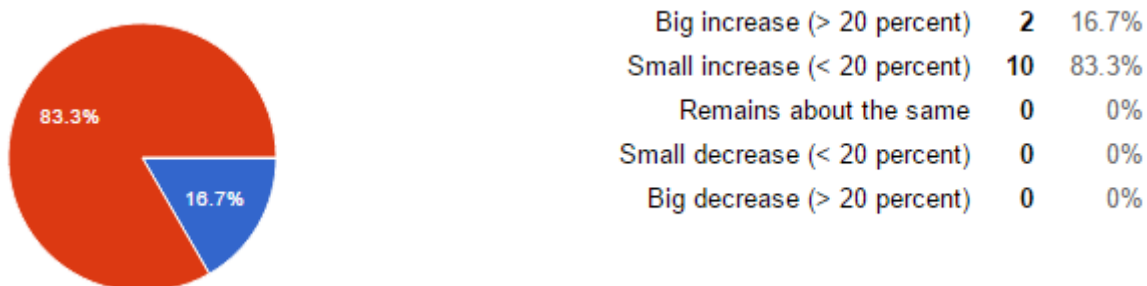
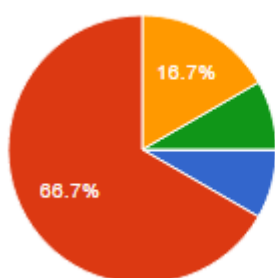


Figure 56 – Summary of answers to question 3 of online questionnaire

4. How does the redesign affect the number of monthly connected cards to user accounts at the website of NS?

In the current situation, 764.000 cards are connected in total and 16.000 cards are connected each month.

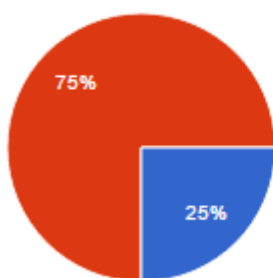


Big increase (> 20 percent)	1	8.3%
Small increase (< 20 percent)	8	66.7%
Remains about the same	2	16.7%
Small decrease (< 20 percent)	1	8.3%
Big decrease (> 20 percent)	0	0%

Figure 57 – Summary of answers to question 4 of online questionnaire

5. How does the redesign affect the number of filed and accepted claims in case of delay?

In 2014, there were 330.000 accepted claims for experienced delay, of which 244.000 were filed via the website of NS.

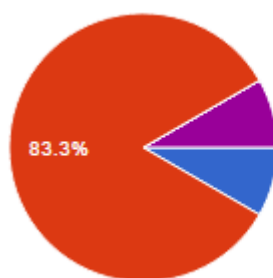


Big increase (> 20 percent)	3	25%
Small increase (< 20 percent)	9	75%
Remains about the same	0	0%
Small decrease (< 20 percent)	0	0%
Big decrease (> 20 percent)	0	0%

Figure 58 – Summary of answers to question 5 of online questionnaire

6. How does the redesign affect the total costs incurred with the process and paying out of claims in case of delay?

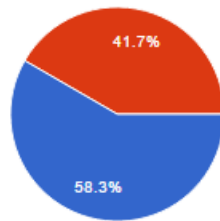
In 2014, the total costs incurred with claims in case of delay were €3.6 million, which consists of €2.3 million being paid out to customers and €1.3 million being process costs.



Big increase (> 20 percent)	1	8.3%
Small increase (< 20 percent)	10	83.3%
Remains about the same	0	0%
Small decrease (< 20 percent)	0	0%
Big decrease (> 20 percent)	1	8.3%

Figure 59 – Summary of answers to question 6 of online questionnaire

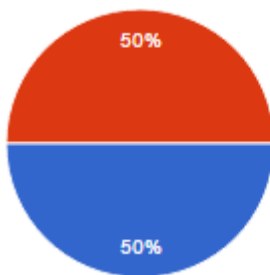
7. If the costs regarding claims in case of delay would increase because of the redesign, what would be your opinion about that?



Customers have the right to those refunds: the extra costs are justified	7	58.3%
We'd rather not make those extra costs, but they are justified if the customer satisfaction increases significantly	5	41.7%
Extra costs are not desirable, therefore this redesign should not make the refund services too accessible	0	0%
Other	0	0%

Figure 60 – Summary of answers to question 7 of online questionnaire

8. Does a smartphone application with which customers can use services of NS on their smartphone, have added value?



Adds a lot of value	6	50%
Adds a bit of value	6	50%
Does not add value	0	0%
Other	0	0%

Figure 61 – Summary of answers to question 8 of online questionnaire



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