Redesigning a Customer Service System for multiple services
A Case Study at NS Klantenservice

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A Case Study at NS Klantenservice

by

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Dear reader,

This thesis is the final work of my almost seven and a half year of study in Delft. For this time, and in particular the graduation time, I want to thank some people. To start with, I am grateful to my parents who gave me the freedom and support to study in Delft and explore parts of the world and student life. My student life is greatly influenced by my membership of the student association Sint Jansbrug. This place gave me the opportunity to laugh, discuss, organise activities and have fun with a lot of friends. I can highly recommend every new student in Delft to join a student association, sports club, cultural society or other student group that makes your live much more busy, but will create friendship and a good time during your student time.

My graduation time at NS started with a non-graduation internship to learn the organisation and find a good subject of study. The staff members of NS Klantenservice treated me as a full employee of their team, which sometimes caused some tensions when I had to focus more on graduation. Still, I want to thank the colleges of the staff. A special word of thanks to my NS supervisor Sulaiman. You always expressed your confidence in me and that it will end well. Also, the talks about what to do after graduation were inspiring. The advices of looking for a starting position with lot of coaching and possibilities to see multiple positions in a company will be adopted.

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I hope you all enjoy reading my thesis and celebrate my graduation with me!

Luuk Mathijs Emiel Weerens
Delft, November 2015
Summary

NS Klantenservice is the customer service department of the Dutch Railways (NS) supporting all services NS provides. Historically, the different services were divided between four contact centres each handling a part of total customer service. NS started to integrate these contact centres in the beginning of 2015 to improve the total service quality and gain efficiency.

Developments in the customer service field like providing support 24/7, new contact channels as live chat and social media that customer can use to access the customer service, and technology improvements that enable business intelligence usages are all added to the existing legacy systems and structures that form the current customer service system. The integration of the four contact centres give the opportunity to redesign the customer service system and realise the goals of a better service quality and improved efficiency. The integration project team started already restructuring processes and integrating systems, but so far has kept the organisational design aside. The focus of this research is therefore on the organisational design, keeping the processes and IT systems in mind. The focus is solely on the NS Klantenservice department, including the most-performed activities of the customer service via all contact channels that are handled by Customer Service Representatives (CSRs). The research question answered is:

Given the existing situation, what would be a service system design for NS Klantenservice that improves the service quality?

To guide the design process, service design literature is reviewed which is assessed unsuitable for the detailed, on operations-oriented, design. Systems engineering literature leads to the Axiomatic Design (AD), which is used as a tool for analysis as it dictates guidelines for an optimal design. Based on empirical evidence of NS Klantenservice, an AD is created and optimised where both the multi channels as the multiple services supported by NS Klantenservice are included in a single functional design. This Axiomatic Design artefact is translated into a process diagram, indicating all required resources that the organisation has to provide. The resources of this system are the skills CSRs need. The organisational design has to structure the skills, so CSRs can be trained and the organisation is flexible, efficient and improves the service quality. An modular system is designed that groups skills into basic knowledge & skills, basic action skills, channel skills and specialised skills modules. The modules can be used to develop training programs for, and career paths of, CSRs. The modular system enables the organisation to allocate and control the CSRs better, so the flexibility, efficiency and service quality goals can be achieved.

Following the AD principles, an AD that satisfies the given conditions does not require additional validation. Although our design meets the AD conditions, we evaluated the AD analysis and design by an expert group workshop. Concluding that our analysis matches the current situation, the expert group created their modular design. The expert design validated our design principles and was largely consistent with our modular design. The workshop substantiates our conclusion of the organisational design according to skill modules. This design creates a structure that is flexible, enables efficient deployment of CSRs and leads to a better service quality by supporting clearly defined responsibilities.

The organisational design has two major practical, open issues that require further study and discussion. One issue is what hierarchical structure of management responsibilities is best to manage the flexible organisation. Second, a large share of the operation is currently outsourced to an external company, mainly for cost benefits. This out-of-scope decision has to be changed to benefit optimal from the modular organisational design. We recommend NS Klantenservice to outsource less activities so the flexibility and efficiency of the own operation benefits from the design.
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<td>ACW</td>
<td>A* metric for handling speed in a contact centre</td>
</tr>
<tr>
<td>AD</td>
<td>Axiomatic Design design method</td>
</tr>
<tr>
<td>ASA</td>
<td>Average Speed of Answering metric for service speed in a contact centre</td>
</tr>
<tr>
<td>AHT</td>
<td>Average Handling Time metric for handling speed in a contact centre</td>
</tr>
<tr>
<td>AVG</td>
<td>Assistentieverlening Gehandicapten assistance disabled persons</td>
</tr>
<tr>
<td>CIC</td>
<td>Customer Interaction Centre telephone system</td>
</tr>
<tr>
<td>CRM</td>
<td>Customer Relationship Management information system</td>
</tr>
<tr>
<td>CA</td>
<td>Customer Attribute attribute in the customer domain of AD</td>
</tr>
<tr>
<td>CS</td>
<td>Customer Service the customer service department in general</td>
</tr>
<tr>
<td>CSR</td>
<td>Customer Service Representative agent in a contact centre</td>
</tr>
<tr>
<td>D2D</td>
<td>Door-to-door auxiliary services of the NS as bike/car rental</td>
</tr>
<tr>
<td>DP</td>
<td>Design Parameter attribute in the physical domain of AD</td>
</tr>
<tr>
<td>DSM</td>
<td>Design Structure Matrix design method</td>
</tr>
<tr>
<td>FR</td>
<td>Functional Requirement attribute in the functional domain of AD</td>
</tr>
<tr>
<td>IVR</td>
<td>Interactive Voice Response telephone system</td>
</tr>
<tr>
<td>MCC</td>
<td>Medewerkers Contact Centrum contact centre for NS employees operating on trains and station</td>
</tr>
<tr>
<td>NS</td>
<td>Nederlandse Spoorwegen Dutch railways company</td>
</tr>
<tr>
<td>NS KS</td>
<td>NS Klantenservice the customer service department of the Dutch railways</td>
</tr>
<tr>
<td>NSD</td>
<td>New Service Development design method</td>
</tr>
<tr>
<td>NSR</td>
<td>Division Reizigers van Nederlandse Spoorwegen operates domestic railways in the Netherlands</td>
</tr>
<tr>
<td>PV</td>
<td>Process Variable attribute of the process domain of AD</td>
</tr>
<tr>
<td>QFD</td>
<td>Quality Deployment Function design method</td>
</tr>
<tr>
<td>SAP BCM</td>
<td>SAP Business Communications Management telephone system</td>
</tr>
<tr>
<td>SL</td>
<td>Service-Level metric for service quality in a contact centre</td>
</tr>
<tr>
<td>UVB</td>
<td>Uitstel van Betaling NS term for fines issued on the train</td>
</tr>
<tr>
<td>WFM</td>
<td>Workforce Management operational management around employees in a contact centre</td>
</tr>
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Introduction

The goal of the introduction chapter is to set the context (sections 1.1 to 1.3), state the problem that we look into (section 1.4), describe the contribution of our thesis to society and science (section 1.5) and scope the thesis (section 1.6). The research approach of design science research (section 1.7) guides us in our graduation thesis, which is used to construct the content of the remaining chapters (section 1.8).

1.1. Nederlandse Spoorwegen

The Dutch railways company (NS) is the largest public transport company in the Netherlands. It operates the main rail services for passengers in the Netherlands and operates some international rail services to neighbouring countries. The company transports on average over a million passengers every day (NS, 2015a). The company became a state-owned enterprise after the First World War. The Dutch state is still the only shareholder of the NS, but the EU directive 91/440 (the separation of rail infrastructure and rail operation) introduced a large reorganization in 1995. This was the start of a cultural change in the organization, partly due to the concession of the NS to exploit the main rail services. Part of this concession is the performance of the NS, like on-time performance and customer satisfaction. The cultural change towards a more service-oriented company, with emphasis on customer satisfaction, is also noticeable in the Customer Service department of the NS: NS Klantenservice. This is the department where our research is to be conducted. We describe five key aspects to understand in main points what impacts the NS operation as a whole. The first is the organisational structure of NS itself, the other four aspects are regarding travelling by train in the Netherlands. All these aspects also influence NS Klantenservice.

NS structure The NS corporation is a holding company with four companies and some shared staff departments. NS Reizigers is the company that performs rail transportation. NS Stations is the owner of the stations in the Netherlands and the operator of the station shops and additional services as bike rental and parking places. NedTrain is the owner and maintainer of the trains and Abellio is the subsidiary that operates bus services in the Netherlands and regional/national train services in other European countries as the main rail tracks in Scotland. NS Klantenservice is placed within NS Reizigers, but also performs customer services for NS Station. We elaborate more on the NS Klantenservice operations in section 1.2. NS Reizigers has eight divisions, three of them are from the shared staff departments of NS Group (the dotted lines in figure 1.1). The other five divisions are International, that operates train services between the Netherlands and neighbouring countries, Network Development and Design for the long term logistic planning, Operations Control for the short term planning and Service & Operations that manages the conductors and machinist. The Commerce division is divided in the departments of Consumer Market, Business Market, project management institute PMI and the Customer Service department.

The organisational structure of NS is important to our thesis because it shows where customer services performed by NS Klantenservice originate from. The other elements of the service, everything except the customer service, are allocated departments that have little interaction with
each other. We call this a pillar structure, these departments are only focussed on the services within their pillar. NS Klantenservice performs customer services mainly for the Commerce division, the Business and Consumer departments, but also for the International division and the company NS Stations. Besides, after the reorganisation of NS Klantenservice in 2015 two contact centre departments that formerly where placed under Operations Control and the Concern Security are now also part of NS Klantenservice.

**Train operators** The passenger rail network in the Netherlands is divided in the main rail services, operated by NS, and regional rail services. The latter are operated by NS, Arriva, Syntus, Connexxion and Veolia. For passengers this implies that they might need multiple operators to complete their journey. This requires alignment between the operator to serve the passenger. Alignment might be reached in the regular time schedule, but in disrupted situations this is harder. For example, while an outgoing train of the same operator will probably wait on a delayed incoming train for a few minutes, this is less likely when these trains are from different operators. Since NS is the largest rail operator and operates all stations, it is perceived by a main part of the public as the rail transportation company and receives often the blame for all rail issues.

**OV-chipcard** To travel by public transport in the Netherlands, one need to have an OV-chipcard. This card consists of an electronic chip, which enables to identify the user. The traveller can use the OV-chipcard for all public transport, operated by several transport operators. The OV-chipcard system is operated by the company TLS, who is also involved in creating the cards. Because NS is the largest public transport operator, it is not always clear for the public who to contact for issues with their OV-chipcard. The chipcard can be coupled to an owner (personal chipcard) or it can be anonymous. However, an anonymous chipcard can in general only be used as prepaid card: the owner has to top up the chipcard so the traveller has enough balance for his journey.

**Refunds** When things go wrong in the train operation, customers are legally entitled to claim a refund. There are two types of refunds. One type of refunds is because of incorrect check-in/check-out with the OV-chipcard. An OV-chipcard needs to be checked-in before it becomes valid. When checking-in an amount is deposited and at the check-out, the actual travel expenses are calculated, and settled with the deposit. Due to malfunction of the OV-chipcard system, disruptions on the rail network or forgetfulness of the traveller to check-out an incorrect amount can be charged for the journey. The traveller can get a refund after contacting the transport operator. A second type of refund is refund due to a delay. For delays that occur during normal operations, so not for the delays due to planned constructions, NS travellers can claim a refund when the delay is more than 30 minutes. However, the threshold of 30 minutes only applies to the delay of the NS itself. A missed change of trains of different train operators is not included, which is inconsistent from the traveller perspective.
Types of tickets
To travel with NS trains, the traveller has to possess a valid ticket. We distinguish two categories of tickets: the single-use ticket and the multi-use ticket. Single-use tickets can be bought on a chipcard in the vending machine on the station, valid for one specific chosen journey. This ticket is often used by tourists who don’t own a chipcard. Besides, the traveller can buy an e-ticket and thereby avoid the need for an OV-chipcard. There are several types of e-tickets, with different terms applicable. E.g. different tickets which are only valid on weekend days have different validity on holidays like Liberation Day or Eastern. Also, special marketing actions with third parties are created with their own type of ticket. The second type of tickets is the multi-use ticket, always on a OV-chipcard. The chipcard can be used anonymously, so the traveller cannot be linked to his journeys. Most travellers have a personal OV-chipcard, with the travel product loaded that allows for travelling with a prepaid credit. Frequent train users often have a season ticket. There are several season tickets, with each their own terms. Some season tickets are valid at specific times in a week, others are valid on specific routes or a combination of both.

We described the NS structure and the four aspects that a train traveller might encounter. The introduction of the OV-chipcard introduced a lot of new possibilities, but also increased the complexity for the traveller. We describe the most performed processes in section 4.3, where we will see a large overlap with the subjects described in this section. The aspects that make the business of NS complex, are also the subjects of which customers contact NS Klantenservice about and make the customer service operation complex. We look deeper into the NS Klantenservice department in the next section.

1.2. The customer service department NS Klantenservice
The 2015 concession of the main rail services in the Netherlands has a larger focus on customer satisfaction for the entire NS organisation. Therefore, NS Klantenservice wants to improve their customer services as the department contributes to the greater NS goal. The current performance on customer satisfaction is below the set target, as illustrated in figure 1.2. This score is measured by the external research firm MarketResponse and is a key performance indicator of the service quality of NS Klantenservice. The blue line displays the percentage of customers who value the service quality with at least a 7 out of 10. The yellow line illustrates the target of 82%, set by NS direction. From this data we can conclude that the service quality of NS Klantenservice is not as desired and has to be improved. The lower score on customer satisfaction is not the only signal at NS Klantenservice that indicates an undesirable service quality. Other operational performance indicators as the service levels for direct contacts (i.e. telephone) are below the desired level and also backlog exists on indirect contacts (i.e. e-mail). NS Klantenservice wants to achieve a better customer service by integrating four organisational units that all take care of some elements of the total customer service experience. This integration should improve the service quality, which is good for NS but especially for the NS customers: the Dutch society. The purpose of all changes is to reach the goal of a better customer satisfaction, reputation and profitability. However, the integration plans are not complete and have gaps. With our thesis, we design a new organisational structure that helps NS in their integration plan.

To understand the situation of NS Klantenservice better, we look to shortly to the position of NS Klantenservice in the whole NS organisation. After, we look to the NS vision on customer satisfaction in wider context and look to the NS Klantenservice plans of improving the customer service quality.

As we illustrated in figure 1.1, NS Klantenservice falls under the division NS Commerce. The division Commerce is responsible for attracting passengers and stimulate the use of train services. In order to increase the customer satisfaction, the management of NS Commerce developed a vision that should support this goal. Multiple components of the Commerce division should interact better and break the old thinking in pillars. This vision is illustrated in figure 1.3. The philosophy of NS Commerce is that the customer can be served via three service formats. Self-service gives the customer the opportunity to take care of his needs all alone, for example via the personal web page. The full-service is the classic customer service: the NS takes care of the customer needs and executes the required action itself. The together-service is somewhere in between: the customer ask for help and NS helps the customer so he can execute the action. An example of this last type service format is a customer who asks a question via social media regarding his season ticket, retrieves additional, personal information
and decides based on the information which season ticket is best for his needs. The service formats are delivered to the customer via one or multiple contact domains. NS defined five contact domains. While the home, en route and station domain are physical locations, the online and customer service are supporting the physical domains. Customer service is the main contact domain for the together-service and full-service format and is performed by NS Klantenservice.

Part of the broader vision of the customer contact domains is the change in the customer contact centres. A customer contact centre is a call centre extended with other contact channels as e-mail, paper mail, social media and live chat. Four contact centres, who all in some way support the customer, have been integrated in 2015 in one department: NSKlantenservice (figure 1.4). Originally the Domestic contact centre was already part of NS Commerce. The whole international operation was a separate company of NS Group, but since 2013 the international operations are placed as a division within NS Reizigers. The contact centre of NS International is also integrated with the Domestic contact

![Figure 1.2: Customer Satisfaction Score on overall service performance of NS Klantenservice (MarketResponse, 2015)](image)

Figure 1.2: Customer Satisfaction Score on overall service performance of NS Klantenservice (MarketResponse, 2015)

![Figure 1.3: House of NS Reizigers / Commerce: five domains of customer contact (adapted from M. van der Heijden, Akkers, & Schmidt, 2015)](image)

Figure 1.3: House of NS Reizigers / Commerce: five domains of customer contact (adapted from M. van der Heijden, Akkers, & Schmidt, 2015)
The customer service department NS Klantenservice

1.2. The Employees Contact Centre (Medewerkers Contact Centrum - MCC) was originally part of the Operations Control division, since it mainly supports employees on the train or station. Customers don’t have contact directly with the MCC, only via NS employees. The Service Centre supports service processes like special care for travellers with disabilities and provides contact via service pillars on unmanned stations. This contact centre was originally part of the Concern Security pillar, an staff department of NS Group (see figure 1.1). The Domestic and International contact centres are divided in two aggregated channels: FrontOffice (mostly inbound telephone) and BackOffice (mostly email and paper mail). Social media is also present, but is not situated in the FrontOffice or BackOffice. This channel is too new to fit the old thinking. We expect at this stage that the old thinking in channels and pillars is one of the problems. An example of the pillar thinking is that if a customer contacts via email, the responds is also by email, while it might be more suitable to be answered by telephone because of the type of question or additional information is required.

Future (phase 2)
Special Care
Service+

Blended channels: All agents allround
Separated channels: Agents either FrontOffice or BackOffice

Figure 1.4: Transformation of NS Klantenservice

The first step towards integration (compared to the situation of pre 2015, see figure 1.4), has been taken at the moment of our research. The four former separated contact centres are placed in one department NS Klantenservice. However, at the moment this department is more functioning as a shell around the three/four former contact centres. The integration is completed in the name and somewhat in the organisational structure, but not in the operations. NS Klantenservice created a plan to achieve integration, in which multiple steps are required which are comprised in two phases (Likumahua, 2015). In the first phase, two major changes have to take place. The FrontOffice and BackOffice activities of the Domestic and International contact centre are to be combined. In this way, the operation agents are able to serve all channels and become allround agents. It should also break the pillars of channels, since all agents are also accustomed the use of other channels. Besides, the operation is more flexible since peak demands can be handled easier. Agents handling email or paper mail contacts are able to take some telephone calls. The second change in phase one is the integration of the Service Centre and Employee Contact Centre in NS Onderweg. There are several processes which are shared in the two contact centres, like the handling of lost&found items and assistance to customers with disabilities.

In the last phase integration is fully completed. The Domestic and International contact centres are merged and some of the processes of NS Onderweg are also merged with these two centres. In the end situation there are only two types of contact centres: one who handles the special care processes and one who handles all other, normal processes. This philosophy is based upon the fact that in essence there are three types of processes: service, sales and special care. The service processes comprises all most frequent processes, around 80% of the customer contacts. In addition, there are sales contacts, for season tickets on the interior train network or tickets for international trips. However, the NS does not want a traditional sales contact centre. In their philosophy, non-aggressive sales like personalised advice which season ticket fits best the customer’s needs, is more service than sales. For this reason, the service and sales are combined into Service+. Processes that are less frequent or deserve special attention due to potential impact on the company image are placed under the Special
Care part. Examples for this are customers with a disability and the NS train and station employees. The NS personnel is a special type of customer for NS Klantenservice, since employees that contact NS Klantenservice, mostly have questions from a customer in front of him. In this way, the employees serve as a mediator between NS Klantenservice and the customer, which is the reason that this group is gathered under Special Care.

The integration of the four contact centres is not one of equals. Domestic is the largest contact centre and while staff has switched, most of the routines are adapted from the Domestic centre. In meanwhile the innovation in service delivery continues: the new channel of live-chat has been added and the Domestic and International services are opened 24/7 (NS, 2015b). The MCC was already open for 24 hours a day. Because customers only indirectly interact with this contact centre, the added value of customer service for the public is higher with the opening times of the International and Domestic contact centre. All changes, in service times but certainly also the integration of the contact centres have an impact on the operation.

The need for improvement driven from NS is not the only reason for change. We examine broader developments in the customer service domain in the next section that contribute to the need for change.

1.3. Developments of the customer service domain

Only looking to the existing contact centres is not enough to understand the mission of NS Klantenservice. General developments in the customer service domain changed the contact centres or pose future changes on the new organisation. We take these developments into account and discuss them in this section.

Customer service is traditionally delivered via a call centre. Customers can call for support and Customer Service Representatives (CSRs) answer questions, sell products and services or deliver a service of which the customer is not able to perform the self-service. This already identifies different types of call centres: purely service-oriented or also sales-oriented. When a customer has to contact the call centre because he is unable to perform the self-service, this can be because self-service options are not available or it is not clear to the customer how to perform the right action. Nowadays, the call centre evolved into a customer contact centre by adding more contact channels than only the telephone channel. E-mail and paper mail are already old technologies, but still serve as contact channels for interaction with the customer service. Also, new technologies such as live chat and mobile applications are possible contact channels for interaction with the customer service. Contact via social media is increasing in importance and is referred to with the term Webcare. Webcare is interesting for companies because of the (online) reputation and brand management (van Noort & Willemsen, 2012). Contacts via social media are closely related with reputation management, because customers share their experience on social media. Therefore, the reaction of the company is publicly visible. Reactions via other channels are less likely to have a public impact. The increasing number of contact channels increases the accessibility of the customer service department, but it has also downsides. The increase of contact channels creates the possibility of information inconsistency and inconsistent service quality between channels. This technological change creates a more complex customer contact centre to manage.

The information inconsistency is not only an internal problem for customer service. Customer service is embedded in the company service system and has lots of interconnections with other company departments. Interaction with customers is not solely for customer service. Information can also be provided via other service systems. Customers can interact with the company employees in a store, on an airport or in a train and retrieve information from these employees. Besides, other sources as the company website or physical boards provide information and give the opportunity for self-service. Online self-service does not guarantee a lower amount of contacts with the customer contact centre (Kumar & Telang, 2012). Ambiguous information on the website can lead to an increase of telephone contacts. The nature of required information is also important in this case. For complex services, that need specialised knowledge or have several distinct options that are more-or-less similar, the informa-

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1 This is our opinion after three months of observations.
tion provided via telephone contact is superior over web services (Jerath, Kumar, & Netessine, 2012). This implies that not all channels are suitable for all types of services or information.

Modern customer service systems have more complexities than only inconsistent information sent to customers. The customer data that is gathered and stored regarding customer contacts should also be consistent among the channels. Customer interactions are logged via a Customer Relation Management (CRM) system, so the contact history of a customer is visible for a CSR. In theory, this allows to share the contact information between channels. However, integrating the customer data from multiple channels is difficult (Neslin et al., 2006). Integrating the customer data from all channels enables the possibility to create a 360-degree view of a customer and the use of business intelligence techniques in the operation, which is seen as the future operational model of contact centres (Chen & Popovich, 2003; Mitchell, 2007; Gans, Koole, & Mandelbaum, 2003). Well integrated customer data helps the company to perform a better service and can possibly save costs.

The societal desire for a more accessible customer service resulted in an increase in contact channels. A second way to increase accessibility is to extending the opening hours. Traditionally, contact centres have similar opening hours as usual business hours: from nine to five on week days. The changing world lead to different desires and expectations, such as most services to be available 24 hours a day. To increase the service quality and match the customer expectations, companies have extended their CS opening hours to 24 hours a day, 7 days a week (KLM, 2011; KPN, 2012; NS, 2015b). This change has an impact especially on the operation, since it makes the planning and scheduling process of CSRs for the operation more complicated.

Optimizing the contact centre operation is a well studied field. A contact centre can be optimized by a good management of CSRs and their training (Gans & Zhou, 2002; Aksin, Karaeasmen, & Örmeci, 2007), a smart way of routing contacts (Aksin, Armony, & Mehrotra, 2007; Gans et al., 2003), making a precise forecast (Weinberg, Brown, & Stroud, 2007) and provide a differentiated service level for different customers segments (Gurvich, Armony, & Mandelbaum, 2008). To use the knowledge of optimizing a contact centre, the contact centre should first be defined. What is actually done at the contact centre, what processes are performed, which skills are required for this and how do all these elements interact with each other? NS Klantenservice can use the optimising techniques, but when the foundation is not right, optimising the operation will only have a small effect. We need to look to NS Klantenservice from a broader perspective.

1.4. Problem Statement

Now we have set the context of NS Klantenservice, we can make a problem statement. We do this by stating the problem as it is relevant for NS and relate this to the scientific questions. Solving the problem contributes to the academic knowledge as we explain later in section 1.5. After the problem statement, section 1.6 scopes and bounds our thesis.

1.4.1. Needs from NS Klantenservice perspective

From the sections above we have a good understanding of the complexity of NS Klantenservice. The environment of the NS itself comprises many elements that create complexity in running the rail road company (section 1.1). These elements of complexity reflect in NS Klantenservice operations. NS Klantenservice wants to increase their customer satisfaction. Their plan is to integrate multiple units that perform all some kind of customer services, into one department where all customer services are performed, so customers retrieve a more consistent customer service experience. The transformation of the customer contact centres is described in section 1.2. However, the implementation plan of the four contact centres integration and the restructuring in “Service+” and “Special Care” is far from complete.

The integration of the contact centres has an impact on the customer service operation. Processes have to be aligned and streamlined because the larger organisation has different capabilities. Systems and applications that are used to perform the processes have to undergo the same streamlining and aligning procedure. It would be very inefficient when two different applications are used which per-
form the same task. Also, the organisation has to be redefined. One cannot integrate an organisation without restructuring teams, line of command or operational management. A new customer service system design comprises all these elements. NS Klantenservice needs to align all elements in order to complete the integration, but we cannot take all the elements into account. In section 1.6, we scope our thesis to the organisational elements.

The need to change is not only driven by NS. As we described in section 1.3, the customer service domain shows general developments. NS Klantenservice implemented most of these developments themselves, but as we will see later in more detailed descriptions of NS Klantenservice (chapter 4) the implementations of these developments could be improved. New contact channels as webcare are supported, but form almost a separate unit and use own applications. Longer opening hours are realised, but the CSRs need very different skills then during business opening hours. We found in literature (section 1.3) that integrating all customer data is the future, which is a point of improvement to make at NS Klantenservice. The developments in the customer service domain form an additional argument to redesign the customer service system of NS Klantenservice. While integrating the contact centre, we want to use the opportunity to redesign the customer service system that copes with the newest developments.

1.4.2. Problem situation

Transforming the organisation to a new design brings several challenges. As the organisation cannot change in one day, the existing situation is of extreme importance. The system as a whole consists out of several elements and cannot change at once. Legacy systems and behaviour form constraints on what can be changed. The legacy elements place the design in a brownfield situation. The term brownfield and its antonym greenfield are not used often in the Information Systems field. In two other areas these two descriptions are used more often, which forms the base for the meaning of the terms in our study. In architecture and urban planning the term greenfield is used for complete new constructions. Brownfield is used for sites that are abandoned, idle or former industrial areas that need to be redeveloped. A project in a brownfield site faces different challenges then one in a greenfield site, mainly because of the previous function of the site. A similar distinction is made in the area of foreign direct investments. When companies want to expand their business to a new country, they can acquire an existing company in that country that fits in their business or create a new (greenfield) company themselves. The mixture of these two options is the brownfield solution: acquiring an existing company and restructure this company so it fits in the new owner’s business (Cheng, 2006). In the area of Information Technology the term brownfield is used to indicate the presence of legacy systems. Shutting down the operation and replacing all technology is not only expensive, but often also unacceptable. New technologies have interfaces with existing technologies, the system as a whole has to be operative. In this situation we say the new technology is placed in a brownfield situation. Our study has the same characteristics: not only technologies are possibly partly to change but also other elements as processes and organisational elements.

The brownfield situation makes it extreme important to have a full understanding of the operation of NS Klantenservice. Although a new design for processes and systems is not included, we need to know the details of these elements because it influences the organisational design. NS Klantenservice wants to integrate the different customer services, but does not know exactly how to do this. The existing structures, pillars in the organisation and habits form the current organisation, so a customer service system redesign should handle the existing elements well. This is the problem we are going to untangle.

From a systems engineering perspective, the integration of the contact centres would imply that there are not four departments that perform several functions, but only one department. However, this one department becomes very large which makes it difficult to manage. The department needs to be structured in smaller units in order to be efficient. We need to find an approach that helps us in structuring the department, that works in the situation of NS Klantenservice but could possibly be applied to other customer service departments of different organisations. Finding such approach would increase the academic knowledge.
1.4.3. Research Questions

The main goal for our research is to design a new customer service system for NS Klantenservice, taking into account the brownfield where the customer service department is situated in. We see the customer service operation, where NS Klantenservice employees give support to customers that contact the customer service, as the customer service system of NS Klantenservice. This leads to the main research question of our thesis:

**Research Question** Given the existing situation, what would be a service system design for NS Klantenservice that improves the service quality?

In order to answer this question, we first need to dive into the service systems design literature to learn more on possible solutions. Secondly, we need to select an appropriate method that helps us in the redesign of the customer service system and tackles the complexity as described in this chapter.

**Sub Question** What is the state-of-the-art in service system design and how useful is this for our research?

**Sub Question** What method can be used for the design of a customer service system?

After selecting an appropriate method in chapter 2 we can make an improved service system design (chapters 5 and 6). The design should not only encounter an organisational design, but has to deal also with the processes and IT systems. All three elements that create the complex environment of NS Klantenservice should be incorporated in the service system design.

**Sub Question** What could be a customer service system design that incorporates the NS Klantenservice activities?

We need to limit the design so it is feasible in the time that we can spend for a MSc. thesis. The boundaries and exact scope are to be defined in section 1.6. Besides, we need to assess in some way whether the new design solution is an improvement. Evaluation of a design is a mandatory step in design science research.

**Sub Question** How to evaluate the designed customer service system?

The evaluation is discussed in chapter 7. Testing the design would be the best option, but this is not feasible in the scope of our thesis. We use expert validation as input for the design evaluation.

1.4.4. Research Activities and Methods

In order to answer the research questions as described in the previous section, we need to perform a number of different activities. Some activities will use the same method, as the first two sub questions are theory-oriented. We use the next methods in our thesis:

**Literature study** will be used to select an appropriate design method. First we will search for literature regarding service systems design. Second we will select a method that helps us in structuring a complex service system’s design.

**Case study** is to be conducted at NS Klantenservice. The case study enables to learn about the complexity in a very detailed level and provides information towards the analysis and design of the service system.

**Design activity** will lead to the new service system design. The design comprises both analysis as decision-making element. The knowledge from the case study is, together with methods from literature, the input for this activity.

**Workshop** will be used as input for the design evaluation. The most important evaluation criterion we use is the validity of the design. In the workshop, experts will validate our analysis and our design.
1.5. Contribution

Our thesis aims on contributing to the practical issues of NS Klantenservice and on increasing academic knowledge. Our design is aimed on creating a new organisational structure for NS Klantenservice. This structure integrates all activities performed in the Service+ part of NS Klantenservice. The existing coupled organisational design makes it hard to really integrate the four contact centres. A fully integrated customer service department should create more channel synergy, lead to better information consistency and increase customer satisfaction.

The theoretical contribution of this thesis lies in the potential methodological contribution of applying the very analytical Axiomatic Design method on customer service systems. The existing service design methods focus on the customer and marketing perspective and not on the service operations. We take the Axiomatic Design method to reduce the complexity problems by solving the existing coupling between contact channel, core services and service processes in the organisation. Applying the Axiomatic Design method on customer service organisation design is novel, as is to be explained later. The knowledge we gain in this thesis can be applied on other organisations, which is discussed in chapter 8.

1.6. Scope and boundaries of our research

We need to scope our thesis for two reasons. First, we cannot change all elements at once because of the brownfield situation where we operate in. Besides, we cannot make a design that requires to stop the operation, implement changes and then continue. The operation cannot be stopped, so a stepwise approach fits better to this situation. Second, redesigning all processes, organisational structures and redefining requirements for used applications and system for an organisation that handles over 5 million customer contacts a year by more than 500 employees is way too much to complete for a MSc. thesis. Therefore, we limit our scope and will also define precisely what contact channels we include.

1.6.1. Boundary of the customer service system

The customer perception of the NS services is influenced by a wide range of factors. When travelling by train, the on-time performance of the train, the seating capacity in the train, the behaviour of other travellers in the train and the behaviour of the NS personnel on the train influence all how the customer experience the NS service. NS is often topic of news because of disruptions, discussions in the parliament about obligations of building in toilettes in the trains or the 2015 fraud with the regional concessions in the Dutch province of Limburg. Because the NS services are used by over a million passengers every day, people share their NS experience with their friends, colleges and family on regular bases. All these past and shared experiences influence the expected service and image (also see section 2.2).

Customer service is not something that is solely delivered by one department of the NS organisation. A good functioning website will not require customers to call for help, marketing actions with clear terms should not require additional information from a CSR, a clear and well-functioning system for refunds might not need manual processing etcetera. NS Klantenservice has many interactions with other parts of the organisation. When one part makes a mistake, NS Klantenservice usually has to clean up the mess. We could choose to focus on these interactions between parts of the NS organisation. This could lead to interesting observations as it gives insights in what processes NS Klantenservice performs and why they have to perform these processes. However, we will not research the interactions between departments with NS Klantenservice. The position of our internship, at the staff of NS Klantenservice, gives some access to these interactions but are probably hard to observe. Instead, we take the interactions of NS Klantenservice with other NS departments as given. Actions performed by NS Klantenservice because of these interactions are gathered as processes.

1.6.2. Scoping in the department

To continue the scoping within the NS Klantenservice department, we use the division of NS Klantenservice as illustrated in figure 1.4 in “Service+” and “Special Care”. We will only study the “Service+” part of NS Klantenservice. This has three reasons. The “Service+” part handles the majority of customer contacts and contains the largest part of the organisation expressed in employees. Besides, the “Ser-
1.6. **Scope and boundaries of our research**

vice+” part should contain out of a small amount of processes, just the processes that are often used. The smaller number of processes makes the design more feasible for our thesis. Although we are not going to redesign the processes themselves, we need to understand what processes are performed in order to have a matching organisational structure. A last argument to exclude the “Special Care” services is that these services are currently scrutinised by NS itself. They dived into these processes, because the NS Klantenservice organisation has lesser knowledge and insights on these processes. The processes come from the former Service Centre and MCC, which had less support from staff.

1.6.3. **Scoping on contact channels**

The previous two scoping levels helps us in what type of customer contacts we include in the research. We only take contacts where the customer initiated the contact to NS Klantenservice into the scope. In general, this is also the type of work NS Klantenservice handles. Outbound contacts, like pro-active sales, is not in the scope of NS Klantenservice and neither of our scope. We won’t exclude outbound contacts in general, because reactions or additional questions are also outbound contacts. However, the type of contacts in the scope are always related to an inbound contact and the outbound contact are a follow-up action to that contact.

Now we selected inbound, customer initiated contacts, we need to scope on the contact channels. We include the channels telephone, email, paper letters and paper forms, live chat and social media. The social media covered by NS Klantenservice is the Twitter account @NS_online, the Facebook page “Nederlandse Spoorwegen” and the service forum. The largest channel that is excluded is the website itself, due to the self-service aspect. The website contains a lot of information that can be found by an embedded search engine. In addition, a chat bot is present on the website answers frequently asked questions. When the chat bot cannot provide the answer, it composes an email with the customer’s input. This email is send to NS Klantenservice and is then an incoming, thus included, contact. Also excluded are the employees in trains, at stations or at front desks at stations that provide support to the customer. These employees are part of the overall service that NS provides, but are not part of NS Klantenservice. These employees can ask for support from the MCC - which is part of NS Klantenservice, but since this would be a indirect contact from a customer, the contact is not included in our scope.

1.6.4. **Scoping on the organisational domain**

As we described earlier, we can look at the NS Klantenservice operation from three perspectives: the process elements, the IT systems and the organisational structure. We dive deeper into all these elements in chapter 4, but will eventually take the process and IT systems domain as given due to time limitations. We might have to make assumptions or impose constraints on these domains, but we will not make new designs for processes or systems that are used. The organisational structure is the variable element in our design. This includes how employees are grouped, but even more what processes should be handled by which group of CSRs. What knowledge and skills do these CSRs have to possess and how can we combine these skills in sets that can optimal process the customer contacts.

The two most extreme configurations are visualised in figure 1.5. When all processes can be handled by all CSRs, these CSRs have to possess all the skills and knowledge that is necessary at NS Klantenservice. We call these CSRs than allround agents, as they can be deployed for all type of activities. The contrary is the situation where all CSRs are able to perform one task. Every CSR is a specialist in this situation. Both situations are undesirable as we will explain later, so the question is what the optimal configuration is for NS Klantenservice.

![CSR skill set trade-off](image)

*Figure 1.5: Visualisation of the CSR skill set trade-off*
1.7. Research Approach

In appendix A, we collected literature on design science and how to do research in information systems and design science. The literature on design science research shows guidelines for rigorous research, which has implications for our research approach. The literature on information systems is relevant because our topic at NS Klantenservice fits this field of study. From the definitions of various scholars as given in appendix A, we form our definition of information systems as:

**Definition 1.** The field of Information Systems studies the interaction of the technical and the social system in organisations.

The positioning of our research in the field of information systems is important in order to know how to do research. March and Smith (1995) argued that the traditional, natural science, approach does not fit for this field. Instead, the design science approach is used in the information systems field. Multiple scholars have defined design science, of which we base our definition:

**Definition 2.** Design Science is the study and creation of artefacts, which solve identified/practical problems.

If we want to perform design science research, we have to know what the academic view is on doing so. Hevner, March, Park, and Ram (2004) provides seven guidelines, which are listed in table A.1, that helps the academic community on how to conduct design science research. In this thesis, we emphasise all the guidelines. We create an artefact (guideline 1), the customer service system design, that should help NS Klantenservice with their integration problem, which eventually should lead to a better customer service (guideline 2). The design has to be evaluated (guideline 3), which we do as good as possible by an expert validation session. The research has to contribute to the public knowledge (guideline 4), which we will elaborate further on in the next paragraph. Besides, the research has to be rigorous (guideline 5) by relying on well-founded methods. We select a rigorous method in chapter 2, so this guideline is also followed. The design should be a search process (guideline 6), which we will also elaborate on later in this section. Last, the research should be communicated effectively (guideline 7). We plan to do this by writing an article for the communication to the academic audience and by creating visual understandable artefacts for the NS management. Besides, the evaluation with NS Klantenservice experts has also the purpose of communicating our research.

The output of research is the contribution to science. We need to be aware what type of contribution our research produces (guideline 4). Figure A.2 shows what type of knowledge contribution is possible as output of design science. We plan to contribute by exaptation: by taking methods and tools used to tackle other problems, we apply known solutions to new problems. Whether this approach leads to a desirable solution from NS Klantenservice perspective will be clear after we performed the research, but trying will already contribute to the knowledge.

Last, we elaborate on the search process (guideline 6). Our thesis itself is a search process on what we think is a vital piece that has to be changed in order to solve the NS Klantenservice problem. This means that we start with gaining knowledge about the current situation, take a path but often go a step back and continue on a different path. Analyses have to be changed slightly so the analysis emphasises the path we take. This iterative approach corresponds to the guideline that design science is a search process. This approach has its pros and cons, which we reflect on in chapter 10.

1.8. Structure of the thesis

Now the scope is the thesis is set, we ask ourself how we should proceed. The elaboration on the research approach (in section 1.7) and the design science research (in appendix A) provides also suggestions how to structure publications for researches that uses the design science approach. Gregor and Hevner (2013) created a publication scheme for this approach, displayed in table A.2. We adopt this scheme largely as we explain by referring to the section numbers as suggested by Gregor and Hevner (2013).

We already started with the introduction chapter, where we defined the problem, motivate the relevance, give the scope and boundaries and state the research questions (section 1). As we also stated
in the first sub research question, we continue with a review of the literature in service design methods in chapter 2 (section 2) and select a method that guides us in the further design. Chapter 3 contains the research method (section 3) and our empirical data gathered in the case study. The different type of information used is explained and substantiated with references to the consulted sources. The next three chapters correspond to section 4 of the publication scheme. As we mentioned earlier, it is important to know the details of NS Klantenservice before we can make a redesign. Therefore, we describe the processes, systems and applications and organisational setting in chapter 4. Next, in chapter 5 we analyse the current customer service system according to the Axiomatic Design method that we select in the second chapter. In chapter 6, we improve the bottlenecks identified in the current design. The Axiomatic Design gives us artefacts that are useful as a designer, but have to be translated to more understandable artefacts for NS Klantenservice. We deduct design principles from our Axiomatic Design and use this in the organisational design artefact. The organisational design is to be evaluated in an expert workshop. The workshop setting, validation of our analysis and design and feedback on our design are described in chapter 7 (section 5). The design is discussed (section 6) in chapter 8, followed by chapter 9 containing conclusions and recommendations (section 7). Last, we reflect on our personal experiences gained in our thesis process, with, inter alia, the iterative research approach.
Our goal in this chapter is to find an appropriate service system design method that suits our problem. For this, we start with a general introduction of services and define terms that we use throughout our thesis (section 2.1). Next, we explore literature on service quality (section 2.2), the service concept (section 2.3), new service development (section 2.4) and find two service systems design methods from the state-of-the-art literature (section 2.5). Although these service system design methods are used to design service systems, these methods focus mainly on the marketing and user perspective. We look for a method that also includes the processes and organisational perspective, which requires a different method then the traditional service system design methods. Therefore, we look to the systems engineering perspective (section 2.6) and find two methods that include the multiple perspectives (section 2.7 and 2.8). From this, we select the Axiomatic Design method as appropriate method to guide our redesign of the NS Klantenservice organisation. The first part of this chapter emphasises our “design as a search process” for the right method (until section 2.5), while the second part emphasises the usability of the selected method and explains the theoretical substantiation of the method.

### 2.1. A more service-oriented society

The traditionally economic sectors are the agricultural sector, industrial sector and service sector. Where the first sector produces food, the industrial sector produces good or products and the third sector produces the non-physical, intangible services. According to the World Bank (2015), the service sector contributes for more than 70% in the world, 74% in the European Union and 78% in the United States to the Gross Domestic Product in 2013. Services dominate the economy and today’s society. It is a paradigm shift from the exchange of goods in a Goods-Dominant logic to the creation of value in the Service-Dominant logic (Vargo & Lusch, 2004a). However, in business and science the traditional theories are oriented around products and production. A new field has emerged and is called Service Science, which “[..] combines organisation and human understanding with business and technological understanding to categorise and explain the many types of service systems that exist as well as how service systems interact and evolve to co-create value.” (Cardoso, Lopes, & Poels, 2014, p. vii).

So when the field of Service Science focuses on service systems, we need to know the definition of such a service system. Besides, what is the definition of a service? We adapt the definition as given by the authors of the award-winning article of the Service-Dominant logic from Vargo and Lusch (2004a, p. 2):

**Definition 3.** A service is an application of specialised competences (knowledge and skills) through deeds, processes, and performances for the benefit of another entity or the entity itself.

Definitions of service systems that follow the service definition are among others made by Maglio, Vargo, Caswell, and Spohrer (2009) and Cardoso et al. (2014). We adapt the definition of the latter authors from their book about service systems (Cardoso et al., 2014, p. 10):
**Definition 4.** A *service system* is a collection of resources, stakeholders, processes and other service assets that, combined, enable value co-creation between producer and consumer.

Service systems can be part of other service systems or linked with these service systems. We will focus on one particular service system, the one that provides customer service. From previous definitions, all service systems should provide customer service since the systems co-create value between the customer and the system owner. However, sometimes customers need support in the use of the service in order to reach customer satisfaction. This support is then delivered by the customer service system. Customers need the help from customer service when they are not able to complete a service by themselves (self-service).

**Definition 5.** *Customer service* is the service system ensuring customer satisfaction, by delivering supporting services to the customer in addition to the core service.

**Definition 6.** *Self-service* is a way of retrieving a service without in-person interaction with the producer or producer’s employees.

The last term that needs a clear definition is the quality of service. Quality of service, or service quality is a comparison between the customer’s expectation and service performance (Parasuraman, Zeithaml, & Berry, 1985). Increased customer satisfaction implies a higher service quality. Customer service is key to satisfy customers (Innis & La Londe, 1994). Research around service quality resulted in the Servqual framework of Parasuraman, Zeithaml, and Berry (1988). This framework defines five dimensions of the consumer perception service quality: tangibles, reliability, responsiveness, assurance and empathy. The framework also includes a model where five gaps are identified, gaps that can contribute to the difference between the customer expectations and the perceived service performance.

**Definition 7.** *Service quality* is an indicator that compares the service performance as experienced by the customer with the customer expectations.

Now we have defined the basic terms, we continue with the different methods and theories in literature. We start with the Gaps Model of Service Quality, which is one of the foundations in service design. The Gaps Model learns us what the bottlenecks are that cause a poorly perceived service. The Service Concept is vital to define, so it is clear to the designer what we have to design. The literature on New Service Development leads us to what we have to know in order to design a new service, which is called the service prerequisites. The service prerequisites can be gathered by service design methods, of which we highlight service blueprinting and the quality function deployment. We look further to applicable methods for our subject and look also to the systems engineering approach as taught at the TPM faculty. Two methods that fit the systems engineering approach are elaborated, the Axiomatic Design and the Design Structure Matrices of which we choose the Axiomatic Design as our design tool.

### 2.2. Gaps Model of Service Quality

We start our literature study with one of the fundamental models of the service science, the Gaps Model of Service Quality. The Gaps Model is called fundamental (Bitner, Zeithaml, & Gremler, 2010) and is still relevant after more than twenty years (Ladhari, 2009). This model (figure 2.1) is introduced by Parasuraman et al. (1985) to help companies manage their service quality. The model focusses on the customer and the customer’s perception, so the customer expectation can be met. The service quality, as in our definition, primarily depends on the customer expectation and perception. The model focusses on the customer and the customer’s perception, so the customer expectation can be met. The service quality, as in our definition, primarily depends on the customer expectation and perception. Gap 5 as numbered in figure 2.1, between the experienced service and the perceived service, is the centrepiece of the model and is the ultimate goal to be closed (Bitner et al., 2010). The other gaps are from the service provider side and represents failures from the company to deliver the service at the customer expectations. Gap 1 is present when the company does not know what the customer expects, the company does not listen to the customer. Gap 2 is also called the design and standards gap, when the company does not have the right service design and standards. Gap 3 is present when the company does not deliver to the standards, the service performance has a gap. Finally, gap 4 is the communication gap, when the performance do not match the promises as communicated.
Since the development of the Gaps Model of Service Quality in 1985, technology has changed. Bitner et al. (2010) studied the influence of technology on the five gaps. The original Gaps Model studied services as in person interaction of employees with customers. Self-service technologies enabled other type of services and are important in service systems, as it is part of our definition. Self-services make the customer a co-producer, which changes expectations and perception and thus the service quality. This relates very directly to NS, where the customer contacts CS often only when the self-service does not give a satisfying result.

Two specific technological developments made it easier to close gap 1. Internet research make it easier to listen to the customer. Customer satisfaction surveys via the internet give greater responds and are cheaper which allows a larger population to be researched. CRM software make sit easier to build relationships with the customer. The digitalised information of one customer can be retrieved in a split second out of a database of thousand customers. Combining all customer data allows even to create a very personalised relationship with thousands of customers. As already described in section 1.3, this is one of the challenges for customer contact centres. Gap 2 can be closed by creating a service according a service design that include the customer expectations in the design. The design allows for the setting of standards, which makes performance measuring easier. We will continue on design methods in section 2.5.

Closing Gap 3 is increasing the service performance. The non-self-services, the one we focus on, are delivered by employees. Therefore, service performance depends largely on the skills, knowledge and motivation of the employees. Because of the self-service development, as described earlier, the service performance is partly depending on the customers own contribution. The NS acknowledges this in their service formats as described in 1.2. The together service format is the hybrid format between the full service, the classic in-person service, and the self-service. The communicative gap 4 is not only do what you promise, but also give consistent information. New technologies enabled new contact channels, which are not only optional for companies. Customer expect online communication possibilities. Besides, the internet created more transparency about the company information. Customers search online for information and share experiences with other customers, which change customer expectations.
The Gaps Model of Service Quality indicates five gaps that can cause an unsatisfactory service quality. The main customer gap between experience and expectations is to be closed by the four gaps that are inside the business. NS Klantenservice has created a vision that comprises the changing customer expectations. A service design that fits this vision is the next step. Before diving deeper in service design, we explore one more concept in service design research literature: the service concept.

### 2.3. The Service Concept

The service concept is used often in service design, but a definition and the importance is emphasised by Goldstein, Johnston, Duffy, and Rao (2002). The service concept is used as description of the service idea which can be transformed into a service design. The service concept is often described as the what and how to be done for the customer. Goldstein et al. (2002) agree that the what and how need to be defined, but that also the integration between these two aspects have to be included in the service concept. Besides, the service concept can mediate between the customers needs and the strategic intent of the company, closing one of the gaps in the previous described Gaps Model of Service Quality. The service concept as defined by Goldstein et al. (2002, p.131) will also be used as our definition:

**Definition 8.** The *service concept* is the customer’s and provider’s expectation of what a service should be and the customer needs it fulfills.

As the service concept defines the service in multiple dimensions, the what from marketing perspective, the how from operations perspective, the strategic intent from the provider’s expectations and the customer needs from customer’s expectations, it serves as a foundation for service delivery. Therefore, the service concept can be placed as link between these four elements and can be used for service design as illustrated in figure 2.2. The service design planning model as proposed by Goldstein et al. (2002) is an enhancement of earlier models, and add the service strategy as base for the input and the performance measurement after the output to evaluate the service and the service design.

![Figure 2.2: Proposed service design planning model (Goldstein et al., 2002, p. 126)](image-url)

The service strategy of NS Klantenservice is defined in section 1.2. In the context of Goldstein et al. (2002), the service strategy includes items from the marketing domain as the market positioning relative to the competitors. This is already difficult for the NS, since the NS is more a logistic company than a commercial oriented company. NS does not have direct competitors when it's operating business. The competition for NS are other transport modes and companies that bid on public transport concession. The latter does have an impact on the service strategy, but the company is different from companies that operate in the free market and have real competitors.

### 2.4. New Service Development

One of the most popular service development methods is the new service development/design (NSD), which has a lot in common with the new product development method for tangibles. NSD is more of a development process than a specific method. Johann and Storey (1998) conducted an extended literature review regarding NSD, which we will summarise in this section.
NSD is defined as “the development of service products which are new to the supplier” (Johne & Storey, 1998, p.185). Service products are then defined as “the predominant intangible core attributes which customer purchase” (Johne & Storey, 1998, p.185). Service products involve almost always interaction with customers. This implies that in the development of new services not only the form of the service product, but also the interaction with customers. Interaction is often an integral part of a service, which makes services more complex to develop than products.

The main four differences between services and products are intangibility, heterogeneity, inseparability and perishability, introduced as such by Zeithaml, Parasuraman, and Berry (1985) and used as such by almost all scholars (Vargo & Lusch, 2004b). Although these differences between services and tangible products, the NSD literature borrows a lot of terminology of the product development literature. Four types of developments are identified. These are improvements, new lines, extensions and new-to-the-world introductions. Besides, two other developments are identified: cost reduction and repositioning. The latter two are not shared under product (or service) development, but under process development and product augmentation development. The distinction between the three types of developments is made by Johne and Pavlidis (1996). Process developments are improvements in the supply chain that create the product. These improvements often lead to cost reductions, but can comprise more such as changing working practises and the use of new technologies. Improved customer service can also be a process development (Johne & Storey, 1998). Product augmentation development is improving the way products are presented and made available to the customers (Johne & Storey, 1998). It offers a way to offer different variations of the same basic product attributes to different customer segments. Adding support to the product can create a premium product.

To know and serve the customer needs, user involvement is inevitable in the development process. Alam (2002) divided the development process of new services in ten stages, each where users can be

<table>
<thead>
<tr>
<th>Development Stage</th>
<th>Activity Performed by the Producers</th>
<th>Activity Performed by the Users</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Strategic planning</td>
<td>Chart the direction; corporate objectives; mission of the business; identify users for involvement to leverage users’ expertise.</td>
<td>Limited feedback on proposed plan for new service development.</td>
</tr>
<tr>
<td>2. Idea generation</td>
<td>Internal and external search for the ideas. Probe customers’ needs, wants, and preferences; and their choice criteria, likes, and dislikes; seek competitive product ratings.</td>
<td>State needs, problems, and their solution; criticize existing service; identify gaps in the market; provide a wish list (service requirements); state new service adoption criteria.</td>
</tr>
<tr>
<td>3. Idea screening</td>
<td>Feasibility analysis; attribute analysis; gather users’ problems and their solutions; elimination of weak concepts by analyzing how these meet users’ needs; assess customers’ purchase intent; look for patent legal and regulatory issues.</td>
<td>Suggest rough guide to sales and market size; suggest desirable features, benefits, and attributes; provide reactions to the concepts; liking, preference, and purchase intent of all the concepts. Help the producer in go-go decision.</td>
</tr>
<tr>
<td>4. Business analysis</td>
<td>Economic analysis to justify the project, that is, payback analysis and net present value; market assessment, profitability analysis; drafting of budget for each concept; commitment of resources by top management; detailed competitive analysis.</td>
<td>Limited feedback on financial data, including profitability of the concepts, competitors’ data.</td>
</tr>
<tr>
<td>5. Formation of cross-functional team</td>
<td>Adopt a team approach and select a team leader; induct new users into the team; ask each team member to adopt a role he or she would prefer to play in the development process.</td>
<td>Join top management in selecting team members.</td>
</tr>
<tr>
<td>6. Service design and process/system design</td>
<td>Combine the service attributes identified earlier with their delivery process, including service delivery personnel; map this process jointly with the users; develop documentation and final service design blueprinting; find out service delivery time; install, refine, and debug the service delivery mechanism.</td>
<td>Review and jointly develop the blueprints; suggest improvements by identifying fail points; observe the service delivery trial by the firm personnel. Compare their wish list with the proposed blueprints of the service.</td>
</tr>
<tr>
<td>7. Personnel training</td>
<td>Train the service delivery workforce; prepare them for encounters; manners and attentiveness are the key criteria; ensure consistent service quality.</td>
<td>Observe and participate in stock service delivery process; suggest improvements.</td>
</tr>
<tr>
<td>8. Service testing and pilot run</td>
<td>Test the blueprint; implement design change and refinement; test to prove the service under real-life conditions; determine users’ acceptance of the service.</td>
<td>Participate in a simulated service delivery process; suggest final improvements and design change.</td>
</tr>
<tr>
<td>9. Test marketing</td>
<td>Develop marketing plan and test with the users; examine the salability of the new service; examine the marketing mix options in different markets; limited rollout in the selected market.</td>
<td>Comment and feedback on various aspects of the marketing plan; detail comments about their satisfaction with marketing mixes; suggest desired improvements.</td>
</tr>
<tr>
<td>10. Commercialization</td>
<td>Plan promotional campaign; appoint distributors and brokers; roll out in the market; look for potholes; modify according to the market conditions.</td>
<td>Adopt the service as a trial; feedback about overall performance of the service along with desired improvements, if any; word-of-mouth communications to other potential users.</td>
</tr>
</tbody>
</table>

Figure 2.3: Activities at Various Stages of the Development Process (Alam, 2002, p. 258)
involved. In this development process, users are both customers as CSRs and other company employees. The ten stages are illustrated in figure 2.3. The stage development starts with the initialisation phases of strategic planning, idea generation, idea screening and business analysis to the development phases of formation of cross-functional teams and service design and process/system design to the testing phases of personnel training, service testing and pilot run and test marketing to the launch of the commercialisation phase. In particular the idea generation, service/process system design and service testing/pilot run phases, the user involvement is important to create a better understanding of the customer, convert this understanding in ideas and requirements. The actual customer interaction in the pilot run shows where final modifications are necessary (Alam, 2002).

Four levels of user involvement are identified in the Alam (2002) study: passive acquisition of input, information and feedback on specific issues, extensive consultation with users and representation. Passive acquisition of input is when the user takes initiative to provide input, e.g. by expressing new service ideas of improved service deliveries. The manager acquires the information passively, so the intensity of user involvement is low. The second level is the information and feedback on specific issues. Here, the developers approach users to obtain feedback and information on specific issues at various stages of the development process. The user involvement intensity is a somewhat high in this level. Extensive consultation with users is the next level of user involvement, which is relative high. Here, the developers plan for user input in e.g. focus groups or interviews. User input is governed in the objectives. The last level of user involvement is extremely high. By representation, users are invited to be part of the new service development team.

Edvardsson and Olsson (1996) created a frame of reference for strategic service development, presented in figure 2.4. This frame of reference shares the importance of user involvement. In order to deliver a quality service, the scholars define three types of service prerequisites. These are the service concept, the service processes and the service system. In this frame the service prerequisites are part of the service outcome, as experienced by the customer. In order to generate a good customer outcome, or a high service quality, the prerequisites have to be optimal. Smith, Fischbacher, and Wilson (2007) take this model to extend it with two methods that could develop these prerequisites. The scholars use the service prerequisites model because “[it] provides a framework for analysing large scale NSD as well as the impact of smaller changes on the service prerequisites [..]. It allows developers/designers to adopt a holistic, or panoramic, approach to NSD [..].” (Smith et al., 2007, p. 371). Two methods to design service prerequisites are described in the next section.
2.5. Service Design methods

Now we know about what gaps influence the service quality (section 2.2), that a good service design can close one of the gaps and that the service concept (section 2.3) is important in the service design, we can continue with methods to design service systems. From the NSD literature we selected the service prerequisites model to guide us in a good design. The service prerequisites can be developed by methods, which we call service design methods. The two methods that are to be elaborated in this section are Service Blueprinting and Quality Function Deployment.

2.5.1. Service Blueprinting

Service blueprinting is a design process that results in a systematic design, quantifiable and non-subjective (Smith et al., 2007). The service blueprinting design process consist out of four processes (Shostack, 1984). First, the service processes have to be identified. The service processes are the steps a customer takes or can take. Services that consist out of a large number of steps, decision point and alternative option can create a large diagram of processes. By breaking up the processes in subprocesses, service steps can be grouped. The service steps that a customer does not see should also be included, for example backoffice activities or supporting services.

The second design process is the isolation of fail points. The diagrammed processes from the previous design step are to be analysed, so possible fail point can be identified. The service blueprint can than be enhanced with (sub)processes that work as fail-safe. The design of fail-safe processes is critical for preventing service failures. Involvement of management and users in the design phase can lead to the identification of potential problems. The third design process is the establishment of a time frame. The time frame comprises the order of execution and the execution time, with the allowance of deviations of the standard time. Here, the customer acceptance is important as a longer than acceptable time can decrease the service quality. The last design process is the analysis of profitability. The service execution time can be within the boundaries of what the customer accepts, but the profitability can decrease if the execution time is too long. Smith et al. (2007) add to this that for non-profit organisations other performance indicators can be included, like waiting time, throughput and efficiency.

Fliess and Kleinaltenkamp (2004) added two further design processes to the model of Shostack. The visualisation of the organisational structure is included to show which departments and employees execute which tasks and actions. This should improve internal coordination and cooperation. Secondly, Fliess and Kleinaltenkamp (2004) introduced lines of interaction, internal interaction and implementation. These lines are added in the blueprint diagram to better visualise the differences what processes directly or indirectly interact with the customer.

For service delivering different alternatives might be available. Some processes are human-intensive and require training and recruitment of employees, other processes can partly or entirely be replaced by technological solutions. The service delivering means can influence the profitability and other performance indicators. The blueprint facilitates analysis and supports decision making by visualising the possible trade-offs.

2.5.2. Quality Function Deployment

The Quality Deployment Function (QFD) method is originally developed to improve the quality of product design and the design process (Smith et al., 2007). Key of QFD are the customer needs. The analysis of the customer needs lead developers to focus on the voice of the customer. The customer needs are one perspective that generate functional requirements. Requirements and specifications from the company, product or service are included in the QFD and form a different perspective. The QFD method is also applied on service design and planning (Stuart & Tax, 1996). The House of Quality displays the relations between the requirements from multiple perspectives with themselves and with the specifications. Although the House of Quality alone is not QFD, the House of Quality is often used as tool to guide the QFD process.

The House of Quality (see figure 2.5 for an example) can be generated in six stages (Smith et al., 2007). In the first stage the service concept is defined in terms of customer attributes and require-
ments. The service attributes or criteria should be determined for each service by research. Important to notice is that different stakeholders will generate a different set of criteria. In the second stage, the customer attributes are refined and decomposed in more specific requirements. This is necessary because the customer attributes are often broader evaluation criteria for the customer, which are too broad to serve as requirements. In the third stage the customer attributes are assessed to the level of importance. This might require additional research to find out how the consumers assess the attributes. In addition, the performance of competitive services on the customer attributes are added. In this way, the customer’s possible choices are included in the analysis.

The resources required to deliver the customer attributes are added in the fourth stage. These resources are the service system prerequisites, as mentioned in section 2.4. The resources (the columns) form together with the customer attributes (the rows) a matrix. On the intersection of each resource/customer attribute, the type of relationship is highlighted as illustrated by the boxes and circles in figure 2.5. Besides, interaction between resources are also included in the House of Quality in the so-called roof. The fifth stage exists out of further analysis of the competitive position and resource requirements. The competitive alternatives are evaluated on the resources, and this evaluation is added to the house. In the last stage the control measures must be established. The elements of the service system that contribute highly on customer satisfaction should have more attention.

The QFD method, including the House of Quality tool, provides a way of communication, shows interactions between resources and customer attributes, and brings the voice of the customer into the design (Smith et al., 2007). The systematic way-of-work facilitates the identification of possible conflicting requirements, showing the trade-off so informed choices can be made by the company (Stuart & Tax, 1996).

2.5.3. Usability of the service design methods for our research
The service systems and design literature provided insight on what service quality might compromise and how to close gaps in the service quality. The importance of a good service system design is emphasised and the NSD gives a process to develop new services. However, our thesis is not focussed on...
2.6. Systems Engineering

the design of a new service. The core services of the NS are out of scope, only the customer service part of these services is our subject. Here, a second problem arises that is not dealt with in literature. NS Klantenservice performs the customer service of a range of services. There is no one customer service, NS Klantenservice provides customer services, for several core services. The service design methods focus on more elements of a service than only the customer service elements. The detailed working of a the contact centre cannot be caught in a House of Quality or Service Blueprint, in addition the organisational questions are not likely to be answered with these methods. Therefore, we do not use one of these service design methods for our approach.

The described literature does emphasise on the systematic inclusion of customer requirements. Besides, the House of Quality uses decomposition to create more specific and tangible elements. This technique provides a lot of benefits for system design and fits within the SEPAM master school of thought. We need to understand the system as a whole, a systems approach to service design. Therefore, we shift our literature focus on systems engineering which does provide this insight.

2.6. Systems Engineering

Systems Engineering is the discipline focusing on the design, development and deployment of large scale engineering systems. In this context, engineering is in line with artificial as in the meaning of Simon (1996): man-made to solve practical problems. In Systems Engineering, the system can be a product or service, but always has a technological component and an interaction between humans and machines. In addition, in Systems Engineering there are always multiple disciplines present and the elements in the system have interactions with each other. All aspects of the system are to be considered in this approach (Sage & Armstrong, 2000). The core services of NS are complex, large-scaled systems that have many interactions with other stakeholders and different systems. Specific for the Customer Service department, the services are still complex due to many core services it serves.

Figure 2.6: The three basic phases of Systems Engineering (Sage & Armstrong, 2000, p. 12)

Sage and Armstrong (2000) structured the Systems Engineering approach in three basic steps, as illustrated in figure 2.6. The steps of systems definition, development and deployment are not solely linear. The secondary information flows illustrate the feedback from a later phase back to an earlier phase. Feedback loops are an essential part of Systems Engineering, due to the many interactions of the elements. However, the whole Systems Engineering approach also involves development and deployment of the system. For our study, the deployment is out of scope and the development is only partial in our scope. We are not going to develop a working prototype of a new service system. Conceptualization is also part of the systems development, which is to be a part of this thesis. Therefore, we can use the Systems Engineering approach for basic guidelines. More specific design methods should be in line with Systems Engineering. In the design approach for mobile service systems by Kar and Verbraeck (2007), this basic is also used. Kar and Verbraeck distinguishes two types of Systems Engineering: the hard and the soft perspective. In the hard perspective the methods used are quantitative, like methods from Operations Research, Systems Dynamics and Systems Engineering and Analysis. The soft perspective involve more Process Management elements, so agreement among stakeholders can be reached.

Systems Engineering can be seen as a school of thought where general elements are described. One of these elements is focused on structuring complex problems and is the decomposition tech-
nique. Decomposition can be applied on breaking down system’s functions, objectives, activities and processes. For all types of decomposition, the purpose of breaking down elements is to better understand the system as a whole. Before one can break down a problem, the system definition needs to be complete. In Systems Engineering, this is done by defining the needs, objectives, criteria and functions of the system. Also important are the things that can be changed in the system or the alterables, in order to reach the goals.

Purely a Systems Engineering approach would not be tailored enough for our problem. We do not pursue all activities that are incorporated in Systems Engineering. However, two important elements of Systems Engineering are very suitable for our problem. The structural thinking in objectives, requirements and functions make sure that the problem is integral reviewed. To create a better understanding of the problem, the decomposition technique is helpful for all parts of the problem. We found two tools that fit within the mindset of Systems Engineering. First we look to Design Structure Matrices and second to the Axiomatic Design method. We first introduce these methods, before we make analogies to Systems Engineering and chose the best approach for our study.

2.7. Design Structure Matrix

The Design Structure Matrix (DSM) is a method from complex systems engineering that visualize dependencies (Steward, 1981). In the engineering design, many variables need to be specified, which together define a product and it’s behaviour. Often, one variable is the input or predecessor for the other variable. In the context of DSM, the term variable is used for all kind of relations, whether they are activities, product elements, organizations or design parameters (Browning, 2001). Displaying the interactions between product elements or components, is like the roof of the House of Quality of the QFD method. In total, all types of DSMs can be applied to a wide area. The general idea stays the same in all applications: DSMs can be used to visualize the relations of complex systems. The DSM is built by systems decomposition and analysis, which enables the integration of the parts. DSMs contribute to understanding of the system and thereby enables improvements in these systems (Browning, 2001).

Eppinger and Browning (2012) enriched the original DSM method founded by Steward. Static architectures were added to the type of DSM models. The latest addition is the mixture of multiple DSM models, so cross-domain mapping is possible. In figure 2.7a the type of models as defined by Eppinger and Browning are displayed. DSM models illustrates the elements comprising a system and their interaction. In the static architecture models, the interaction between similar elements are displayed. The matrix consist out of $n \times n$ elements. Interactions between elements are highlighted by values, colours or just crosses, depending on what system it represents. The advantages of the DSM

![Diagram of DSM Models](image_url)

(a) Distinction of different models of the DSM family (b) Connecting multiple DSM domains

Figure 2.7: Application of different DSM models and domains (Eppinger & Browning, 2012, p.11 (left) & p. 237 (right))
method are the conciseness of the system it represents, the visualisation aspect by the matrix, it is to be found intuitive in understanding the method, the matrix representation enables other mathematical techniques for analysis and the method is highly flexible to different applications because of its loosely form (Eppinger & Browning, 2012).

The multi domain matrices are a combination of multiple DSM models. The DSM matrices are connected by a commonly not $n \times n$ matrix, because of the different sizes of the two DSM matrices (see figure 2.7b). An example of the use of this mapping between two domains is given by Eppinger. In that example, the product structure and organisational structure are compared, to make sure that the organisational units matched with the product structure. We see great advantages in applying DSM to our problem. The decomposition of elements can be helpful for us to understand the NS Klantenservice situation. Besides, the matrices give a good visual insight in what interactions are present in the observed system. However, we see two downsides of applying DSM. First, DSM is a method to gain understanding of a system which is very useful in the analysis phase, but it does not provide any guidelines in how to conduct the design phase. We might see complex interactions in the DSM artefacts, but the next step of solving the complex interactions is not guided in this method. Second, the DSM focuses primarily on one domain. The mappings are of the elements within the domain, e.g. what organisational units do interact with what other units. We do not see lots of added value for such a mapping, the multi domain mappings are much more interesting for our problem. Therefore, we look to a second method called the Axiomatic Design, where dividing the system in multiple domains are one of the foundations of the method.

2.8. Axiomatic Design

The Axiomatic Design (AD) method is based on the hypothesis of fundamental principles that lead to a good design practice (Guenov & Barker, 2005). The goal of AD is "to establish a science base for design and improve design activities by providing the designer with a theoretical foundation" (MIT, 2004, p. 45). The name AD comes from the word axiom, which is used for phenomena that are true, are not derived from some natural law and are not disproved by counter-examples (Suh, 2005). The AD theory exists of two of these axioms. The first axiom is that the functional requirements (FRs) of the design should always maintain independence and is called the Independence Axiom. A FR should be satisfied, without affecting a different FR. This leads to a uncoupled design and creates less complex designs. Trade-offs between requirements as discussed in the QFD should not be necessary when the Independent Axiom is satisfied. The second axiom states that the information content of the design should be minimized and is called the Information Axiom. If there are two designs which both satisfy the requirements, the design with the least information is best. In this context, information is defined "in terms of the logarithmic probability of satisfying the functional requirements" (Suh, 1998, p. 192). For products, hard requirements ranges can be drawn, e.g. the space between two seats in an aircraft should be between 70cm and 80cm. The design then gives a space range between 67cm and 75cm. A perfect match between the two ranges gives zero information, in the definition of Suh. Minimizing information thus implies better fulfilled requirements. Besides the axioms, the theory exists of four domains: the Customer, Functional, Physical and Process domains. These domains are connected with each other by a mapping from one to the other, as illustrated in figure 2.8.

![Figure 2.8: Axiomatic Design framework with four domains and three mappings (Suh, 1998, p. 204)](image-url)
The domain on the left represents what the designer wants to achieve in relation to the domain on the right. Subsequently, the domain on the right represents the solution, or how the designer wants to satisfy the requirements of the left domain. The most-left domain, the customer domain, has Customer Attributes (CAs) which represent the attributes the customer is looking for in the process, product or system. The CAs can be translated in requirements of the customer, which are the FRs. The design requirements form the boundary of the design, as some requirements also work as constraint. For the design as a whole, the CAs and FRs are the what. The step towards how should be done by the mapping to the third domain, the physical domain. The physical domain exists of Design Parameters (DPs). A DP fulfils a functions of the system. Each FR should be satisfied by at least one DP. Eventually, each FR has to be satisfied and in the chosen DP should not affect other FRs, which is defined by the Independence Axiom. In the last domain, Process Variables (PVs) are designed that produce the DPs. The process of Axiomatic Design is an iterative process: by zigzagging through the domains, each domain can be decomposed further. Because of the mapping, decomposition in the one domain offers possible further decomposition in the other domain.

One more thing to emphasise of the Axiomatic Design is the type of possible designs. The mapping of the FRs on the DPs characterises the type of design. Figure 2.9 shows the three different types of possible designs. When the Independence Axiom is fully satisfied, each FR can be determined in the design by DPs. When each FR maps on only one DP, the FRs are independent and the design is uncoupled. Each FR can be satisfied without influencing another FR. The order of determining the DPs is not important in an uncoupled design, since each DP determines only one FR. An uncoupled design results in a predictable design. When the design is decoupled, the Independence Axiom can still be satisfied, but the order of determining the DPs is important. A decoupled design is a path-dependent design. In the example in figure 2.9, we should first determine DP2 as it both affects FR1 and FR2 (Cochran, 2012). When the design is implemented in the right sequence, it still satisfies the Independence Axiom. The last type of design does not satisfy the Independence Axiom. The coupled design requires trial-and-error to end in the desired situation for both FR1 and FR2, since changes in the two DPs affects both FRs. Even when the desired situation can be reached via trial-and-error, which is already questionable, the deterministic part of the design is not present. The dependency between the FRs makes a coupled design not satisfying the axioms of the AD and is unacceptable as AD solution.

To illustrate the problem of a coupled design, we take the example as given by Helander (2007). For the design of a workstation, we have three FRs: FR1 support the feet; FR2 support the elbows; FR3 top of display one eye height. Figure 2.10 shows two possible designs. The left design has a fixed desk, but can adjust the chair, has a separate footrest and can adjust the monitor. The right design
does not have a foot rest, but can adjust the chair, desk and monitor. The chair height influences the foot support (FR1), the elbow support (FR2) and the monitor on eye height (FR3). Both designs are decoupled and can successfully make an acceptable design, as long the chair is set on the right height first. The coupling becomes a problem when both the desk is fixed and there is no separate footrest: the elbow and foot support FRs are coupled and can not be satisfied independent for all people. This example illustrates the problem of a coupled design and the need of a decoupled or uncoupled design.

![Figure 2.10: Illustration of a decoupled workstation design (Helander, 2007, Figure 1 on p. 126)](image)

2.8.1. In relation to Systems Engineering
In Systems Engineering we described the use of system definition. In AD the system is defined by the four domains and the mapping between them. In the customer domain, the goals and objectives are present, although the goals and objectives are not necessarily from the customer’s perspective. In Systems Engineering the objectives have to be measured in order to assess the function of it in the deployment phase. The importance of measurement of the system performance is undeniable, however the system analysis is our scope and for this reason we neglect the objectives measurement.

In Systems Engineering the requirements are part of the problem formulation or system definition. The requirements follow from the goals and objectives. In AD the FRs are also coupled with the objectives or CAs via a mapping, but the FRs are in more detail than in the Systems Engineering approach. This is desirable for our study, since we want to analyse the system in more depth. The physical domain is less present in Systems Engineering. Where in AD each FR needs to be mapped on a DP, in Systems Engineering there are alterables. The alterables are more or less the same as DPs, but serve to generate alternative solutions to the problem. In AD we do not seek for alternatives, since the axioms tell us when a solution is viable (the first axiom) and what viable solution is best (the second axiom). The process domain can be seen as the system activities in Systems Engineering, where the activities provide the functions of the system.

The analogy with Systems Engineering learns us that the AD theory uses the same elements as Systems Engineering. However, Systems Engineering is in our opinion usable on a much higher level. To ensure the integral system approach on a lower level, the Systems Engineering school of thought is useful to apply on a detailed systems analysis. This is the case in AD, which substantiate the choice of the AD method.

2.8.2. In relation to Quality Function Deployment
In section 2.5.2 we described the QFD method. QFD shares similar techniques and principles that are applied in AD. QFD is also a method used in Systems Engineering to move from systems definition to design and deployment (Sage & Armstrong, 2000). QFD focuses on the cross- or multi-functional requirements of a service and displays these requirements in the House of Quality, where the relation between the requirements (what) and the specifications (how) is shown in a matrix. In the AD theory, the mapping of the FRs and the DPs has a similar function. The requirement of the Independence Axiom, ensuring the independence of FRs, is not embedded in QFD. The QFD does show the interac-
tion of the specifications in the House of Quality’s roof, so trade-offs have to be made, but does not prescribe how the trade-offs should be made.

AD en QFD are compared as design methods by Goncalves-Coelho, Mourao, and Pereira (2005). The objective of Goncalves-Coelho et al.’s study is to improve the use of QFD with AD principles. This is necessary, because some experts in QFD say that the method is not useful for creation of new products. QFD does not capture the architecture of the design object and focuses less on alternative design solutions. Assessing the design in QFD is done by benchmarking the design with similar products or prototypes. This makes the method better for improving a design than creating a new design. The zigzagging technique of AD is a useful addition in the QFD method, because the decomposition makes the design objective’s architecture more clear. The fixed structure of AD also makes it easier to assess design decisions, which in QFD is harder because of the different criteria in different stages of the QFD process. The additional functionalities of the AD theory in comparison to QFD are valuable for our study. QFD is applied extensively, also in the area of service design, and the similarities with AD would suggest that AD can be useful for service design in addition to product design.

2.8.3. Applications of Axiomatic Design

Suh, as founder of AD, is a mechanical engineer which explains the major focus of AD on product engineering and (manufacturing) systems engineering. However, the theory is applicable on different fields according to his own description (Suh, 2005). Software design, hardware design and organizational design are all named as fields where the four domains can be used to describe the designs. In our study, we take the NS as object of study which operates services. A service design by the use of AD theory is novel as far as we can find.

To learn about applications of Axiomatic Design in literature, we take an extensive literature review by Kulak, Cebi, and Kahraman (2010) as basis for this section. Kulak et al. performed a literature review of 63 papers in the period of 1990-2009. The studies are classified in four groups: the type of axiom, the application area, the method used and the type of evaluation. We elaborate on all four groups, but the application area is to be discussed in more detail. This group shows best what has been done in the area of AD and what will be novel.

As described earlier, the AD theory is based on two axioms: the Independence Axiom and the Information Axiom. Studies that apply AD principles, do not always use both axioms. The majority of the 63 studies (84%) applies the Independence Axiom, and only 11 % applies both axioms. The type of evaluation relates to the Information Axiom. The original AD theory takes crisp values for the information content in the design. The information content is associated with a probability that a FR satisfies a DP (Suh, 1998). When the probability is not quantitative known, one can take less crisp and more fuzzy probabilities to simulate qualitative information. This distinction is used in the classifier type of evaluation. The fuzzy element is only present in 19 % of the studies. The group classifier method is used to describe how AD principles are utilized. This is either an integrated method, a combination of AD and one or multiple other methods like the combination with QFD. Other type of methods are theory development and AD application.

The application area is the best described classifier. There are several studies in the area of product design and software design. These types of applications are too different from customer services. The system design applications are better comparable to customer services. Especially the large scale system description, with possible changes over time, does fit NS Klantenservice. A large system is defined by Suh (1995, p.207) as "A system is a large system if the total number of the highest level FRs that the system must satisfy during its lifetime is large and if at different times the system is required to satisfy many different subsets of FRs.". The complexity of NS is expected to lead to a large number of functional requirements, possibly changing over time. Suh (1995) also mentioned how to deal with such complexity. The large number of FRs can be handled by creating modules. The modules should be aligned with the organizational structure: when the organization consists out of subunits, these subunits are a likely candidate to serve as module. The subunits must either be functional subunits or product subunits, because a mixture of both types would generate a coupled design without independence of the FRs. At NS, there exist subunits within the Customer Service Department. Whether they
are solely functional or product (service) based, is to be analysed, but it might be an indicator for our problem. Suh (1995) did not apply his AD theory on a case in his paper, but stayed in the theoretic description.

Application of AD theory in service design is not found in the study of Kulak et al. (2010). Applying the AD theory on the case of NS Klantenservice, the area of customer service, is to be expected to contribute to science. Services are not equal to products, but if AD can be applied on system design for various systems, why not on customer service systems?

2.9. Conclusions for service system design methods

Design Structure Matrix and Axiomatic Design are methods that share multiple components, but there are also differences. In DSM the main goal is to analyse and visualise the interactions of elements within a domain. In AD the main goal is to make a good design by analysing and structuring the elements between the domains. Besides, the domains of DSM and AD are not entirely the same. The organisational structure of NS Klantenservice can be described in DSM, but the units within NS Klantenservice have little interaction with each other. The activities of the organisation require a different domain, so a multiple domain matrix is necessary to map the interactions between the two domains. This is possible, but the AD provides the same features of a multiple domain matrix and even more in dictating how we can create a good design. Therefore, we do not use DSM for our approach. The AD does provide guidelines for our design, but as the literature review of Kulak et al. (2010) shows, the method is not applied before on service organisations. We think this is not an issue, but does requires some creativity to make the method fit for our need.

Concluding for the search of a service system design method as a whole, we reject the traditional service design methods. The method two we identified, Service Blueprinting and Quality Service Deployment, are not suited for the operations directed scope of our research. These service design methods are focused on the entire service experience and looks more from the user perspective. This would require to include other departments of NS in our research. We want to include NS Klantenservice processes and organisational elements. Therefore, we searched more general design methods within the field of systems engineering, not focussing on services on the first place. The Axiomatic Design method is going to guide us towards the organisational design for NS Klantenservice.
Empirical evidence

The goal of this chapter is to describe and discuss the research methods we used to gather data and the type of evidence we found. In our research, the data is gathered in the form of empirical evidence which is common in qualitative research in information systems. The empirical evidence includes ethnographic experiences, interviews and archival information. We start with a short piece of literature on how to use evidence in qualitative research in the area of information systems (section 3.1). We discuss shortly the type of evidence used in this research (section 3.2) and the use of ethnography (section 3.3). Then, we give the interview protocol of the semi-structured interviews and discuss shortly the findings from this (section 3.4). The names of the employees are listed with who we conducted informal interviews in section 3.5. Data sources that we used are divided in archival information (section 3.6) and database information (section 3.7). We described three user cases in great detail (section 3.8), to gain insight in what evidence we can retrieve via the data sources and to show some of the problems customer have with NS Klantenservice. Last, we conclude on the main patterns we find in all the empirical sources (section 3.9).

3.1. Qualitative Research in Information Systems

Our study at NS Klantenservice is qualitative research. We already described the case study as a research method in section A.7. The techniques to collect data, or empirical evidence as it's often called in qualitative research, are different in qualitative research than in quantitative research. Techniques that can be used are interviews, observational techniques and archival research (Myers, 1997). Archival information can contain published and public information, but also internal documents like reports, presentations and e-mails.

Interviews and documented materials are used foremost, without using participant observation. Interviews can be performed in groups or individually, and the type of interview can either be structured or unstructured (Fontana & Frey, 2000). In a structured interview there is a fixed, prepared script that is to follow. There is no room for improvisation in a structured interview. This type of interview has a lot in common with surveys. Instead of fixed answer possibilities in surveys, which allows quantitative techniques, the answers in a structured interview are open, but the questions are closed. Because of this, structured interviews can also be held without the interviewing asking the questions directly. Formulating the questions is therefore extremely important, which requires that the interviewer needs to know exactly what he wants to ask. We do not know exactly what to ask and rather want to start from a particular subject and converge to a direction. Therefore, the structured interview method is not optimal for our research.

There is room for improvisation in the unstructured, or semi-structured, interview. The interviewer prepares questions, but these are not exclusive and thus incomplete. The interviewer is also the researcher, able to navigate the interview to a certain direction. Myers and Newman (2007) studied the use of this type of qualitative interviews in information systems and named a few pitfalls that can potentially occur in qualitative interviews. Because the semi-structured interview is interesting for our
research, we highlight four of these potential pitfalls: ambiguity of language; the entry level in the corporation and the bias this creates; lack of trust; and lack of time.

The ambiguity of language is probably the hardest pitfall in our research. The meaning of words is not always clear. Besides, in large corporations like NS, specific terms are used that might be named differently in other companies. Due to the time spent on location, between the same people we interview, we observed the behaviour and are more used to the specific terms. In this way, we think we can bypass this pitfall. The second pitfall is the level of entry and the potential bias this creates. We entered NS Klantenservice in the staff team, which supports the operation. The connection to the operation are short, but also the connection to the management of NS Klantenservice is good. Besides, the staff members are intensively involved in the integration of NS Klantenservice. We think that we can incorporate a holistic view in our research and that this pitfall will not impose issues. However, the entry level and status as MSc. student does makes it harder to interview top management, for example of NS Reizigers of NS Commerce. We do not see an immediate need to interview top managers of the NS concern and are confident the pitfall will not cause issues. Lack of trust in the researcher is not probable to become problematic. The culture, at least the values as propagated by the management, is characterised by openness and transparency. This matches our own observation of the behaviour of the employees. Besides the transparency as a value, we also believe that a bond of trust is created by the time we spent at NS Klantenservice. We do not see the lack of trust as pitfall for our research. The last pitfall is a lack of time in the interview. This can either lead to incomplete data, due to too little time, or incorrect data, due to simplifications or forced answers. This problem is to be taken seriously, but we think that we can prevent this issue by good time management of ourself. The possibility to continue an interview, or to ask additional questions, on a later time gives enough room to prevent lack of time pitfalls.

Myers and Newman (2007) identified seven guidelines that should stimulate a general way of reporting about qualitative interviews. From these guidelines, we focus on describing the relation with the interviewee and how much improvisation is used in our interviews. This is done in section 3.4, where per semi-structured interview the relationship and use of improvisation is described.

3.2. Types of evidence in our research
We use all types of evidence that we identified in section 3.1, but in different amounts. We classify the types of evidence in five categories. These categories are described in more detail in the next five sections.

Ethnography is used as method to gather observations of the NS Klantenservice organisation.

Semi-structured interviews are performed with three employees with different knowledge and roles in the organisation.

Informal interviews with employees increased a large part of our knowledge about the organisation.

Archival information in the form of presentations are used to gain knowledge about current policies, decisions made and organisational guidelines.

Database information is takes as separate type of archival information, as this data source contains information about the customer contacts.

3.3. Ethnographic research
During our thesis time, we were often present at the staff team of NS Klantenservice. In the first part of our time at NS, we performed regular activities as a member of the data analysts team of the NS Klantenservice staff. This enabled us to learn a lot of different systems that are used and gave us a good insight in how the department worked. Being part of the team made it easier to create a bonding with the staff members. We describe these experiences as ethnographic research, since we collaborated with a lot of NS employees and experienced the feeling of being a staff employee. A lot of conversations with a wide range of people are therefore not recorded or noted as interviews. Often, these conversations were only very short or were part of a conversation being held at the department.
Longer conversations with a premeditated goal are classified as interviews and are described in the next section.

Our experiences as ethnographic researcher were very little in the beginning of the thesis. The importance of a complete record of the ethnographic work became clear to us in a later stage. Although we have taken notes at important events, lot of smaller observations were not noted down. This is an improvement we would make a next time, probably reducing the total time required for the study. We think that all important information is gathered and the quality of our work is sufficient for a first time as ethnographic researcher.

3.4. Interviews

We conducted three semi-structured interviews with three employees having a different expertise. We first describe the interview protocol and the area of expertise of each interviewee. Because each interviewee has different knowledge, the interview protocol is different per interviewee. The content of the interviews is discussed in the synthesis section.

3.4.1. Interview with integration contact centre project manager

Paul Likuhamua is an external project manager who is hired to assist the integration of the four contact centres of NS Klantenservice. Paul has gained experiences of designing customer contact centres at several other organisations in the Netherlands. We interviewed him on July 6th in a semi-structured interview. We send him some questions in advance, but since the questions were very open there was a lot of room for improvisation. The complete transcription of interview (in Dutch) can be found in appendix D.1. The interview protocol we used at this interview is:

1. What is your role at NS Klantenservice?
2. What is the project integration of contact centres and when did the project start?
3. What are the intended goals of this project?
4. What is the intended design of the organisation?
   • What problems did you encounter in the beginning?
   • What approach have you used until now?
5. What is the roadmap of the new customer service system design?
   • What has to change to reach the end situation?
   • What are the largest blockers that can hinder the integration?
6. Wrap-up and thanks.

3.4.2. Interview with improvement manager staff

Jonne Balster is staff member of NS Klantenservice and operates as improvement manager. His job is to improve internal processes so customers receive a better service: this includes faster service delivery, less ambiguous information or less steps in the process. In this role he has gained expertise on the processes of NS Klantenservice. Besides his knowledge, we also selected Jonne for an interview because he expressed ideas of improvement to us and other employees in an informal setting. We interviewed Jonne at August 12th in a semi-structured interview. We did send him context and questions beforehand, but less formal as we did by Corina. We primarily wanted to know what the relation between the NS Consumer, NS Business, NS International and door-to-door services is. There was a lot of room for improvisation, but we still had a script with questions we asked. As with Corina, the interview is not recorded but only noted down. The transcription based on the notes can be found (in Dutch) in appendix D.2. The interview protocol we used at this interview is:

1. What is your role at NS Klantenservice?
2. What are the differences between the Consumer, Business and Door-to-door services of NS?
3. What are the similarities between Consumer and Business services?
4. What do you think is a better way to serve the customer?
5. Wrap-up and thanks.
3.4.3. Interview with CSR training program advisor
Corina van der Heiden is advisor for and director of NS Klantenservice training courses. Corina is an expert in creating training programmes for CSRs and is involved in the creation of an integrated training program for all NS Klantenservice operations. We interviewed her on August 8th in a semi-structured interview. Beforehand we send her a context description and our formulated questions. During the interview we improvised a little, because we noticed that our original questions or word choice were not optimal. In this way, we had a natural conversation, but the subject and questions were set in advance. The interview is not recorded, however based on the notes taken we transcribed the interview. The complete transcription of interview (in Dutch) can be found in appendix D.3. The interview protocol we used at this interview is:

1. What is your role at NS Klantenservice?
2. On what projects do you work regarding to the integration of the contact centres?
3. NS Klantenservice is currently divided into several silos. To what extent are there similarities between the required knowledge and skills of the specific processes?
4. CSRs are currently often trained in direct contact channels or in indirect contact channels. How realistic is it to demand an allround skilled CSR in terms of contact channels?
5. The changes in required knowledge seems to demand much more from CSRs.
   • In what extent do you think the current competence profile of the CSR is fit for this task?
   • What should change in order to deliver more services by a single CSR?
6. What do you think of the role of the outsourced contact centre (Webhelp) in relation to training? What are the pros and cons when all contacts are handled in-house?
7. How should you, in your opinion, design the Service+ department of NS Klantenservice, focussed on skills and training of CSRs?
8. Wrap-up and thanks.

3.4.4. Synthesis of semi-structured interviews
The three semi-structured interviews provided a wide range of information. The interview with Paul revealed a lot about the contact centre integration project, what is done so far and why NS Klantenservice initiated this project. Most of this information is used in 1.2. The interview with Paul also used for the scoping of our thesis, so we could focus on the remaining questions of the integration project. From this interview, we see that a lot of process management issues have to be dealt with. Harmonisation between the four contact centres is necessary, but this takes a lot of time and requires changes in people’s behaviour and changes in IT systems. Part of why the end situation is not entirely clear is because there is no complete insight in what is exactly done at the contact centres and how the performance is of the operation. Part of this is caused by the fragmentation of the activities, the historical way activities are organised and sometimes the lack of investment in IT systems. The latter causes that a part of the activities are handled manually, which makes it harder to retrieve insight in what is done.

The interview with Jonne is mostly used in section 4.1. This interview revealed a large part of the history of the organisation for us and explained why the things are how they are now. The division of labour between a first line (front office) and second line (back office) as described in contact centre literature gained real meaning with the examples Jonne gave. We are certain that the division into front- and back office activities is necessary, which does not imply that the back office activities always have to be performed by the same employees like the current situation. Jonne also shared ideas about how to divide the activities of the contact centre. Because a large part of the customer contacts are about logistics, like delays of trains, these general question should be handled more efficient when they are combined for all core services. As we will see in our design solution, this idea is largely consistent with our own analysis and design.

The interview with Corina is used in section 5.2. Her insights on what is realistic to ask from employees in terms of knowledge, skills and training abilities contributed to our design. The assumption regarding one knowledge management system (further discussed in section 6.3.1) came to our attention the first time in this interview. Her explanation of the to built training program showed the unanswered questions regarding the organisational design of NS Klantenservice. The current training
programs are constant changing because of the graduate organisational change. Due to operational reasons as retirements and leave of employees, situations occur where CSRs have to be trained old training programs. This *running the business* versus *building the business* makes it hard for Corina to lead the change of training programs. We think that her involvement in the design of new training programs is inevitable, but due to the daily work this task should not be solely placed by her.

### 3.5. Informal interviews

Besides the semi-structured interviews, we performed several informal interviews with different employees about different subjects. Here under, we state a list of employees and the subject area we discussed once or more often during our research.

For conforming the functions per contact channel, we spoke with Barbara Gerritsen (CSR) about the e-mail and paper mail functions. Angela de Mari (team coach) performed the same task for the live chat and telephone channel. Vera van Hulst (CSR) explained the social media functions to us. Esther Schonhage (CSR) explained the several functions of the MCC to us and gave us the opportunity to watch her while handling contacts. Annelies Moerings (CSR) gave us the opportunity to listen to her, while handling customer questions on the telephone, and ask questions about why she performed certain actions. Jozef van der Sluis (traffic controller) answered our questions about the refund process in the back office. Joost Nagtzaam (operations manager) provided information of the bigger picture between the relation of customer service and the rail services of NS. Willem van Olst (operations manager) discussed possible improvements of the contact centre with us. We discussed possible telephone system related issues with Boudewijn Vermeulen (IT consultant). Maarten Repkes and Henk van Olderen (information analysts) provided information about what data is available in the IT systems, explained the meaning of the data and discussed what is missing. Annemarie Prins and Gerard Offerman (forecasters) helped us understanding the detailed operation of the contact centre, with all specific activities performed.

The informal interviews are part of the ethnographic research. It is hard to make precise conclusions on what we learned via informal interviews, because the information gained via this method is fragmented and used in all parts our research. The functions of NS Klantenservice as described in section 5.3 are confirmed via informal interviews, which is the most tangible result of the method. We see confirmation and explanation as good activity to be performed via informal interviews, because it is very accessible. When the impact of the to be confirmed subject is very high for the research, more formal methods are recommended because these formal methods enhance the research quality.

### 3.6. Archival information

The archival information that we used are mainly presentations. One group of presentations are the ones used for training purposes. The training manual for CSRs that are used to learn the NS Business skill explains what type of products are applicable for NS Business customers and highlights the difference between the contract holder (often the company) and the card holder (the company’s employee). A different training presentation explains about issued fines on the train for travelling without a valid ticket. Customers can contact NS Klantenservice and ask questions about these fines, but the CSRs are allowed to perform only a limited number of actions. Other actions are organised at other NS departments. The training material give us insight in the details of the operation, which is useful because there are a lot of detailed and specific processes at NS Klantenservice. Two other documents are used to learn more about the strategy NS Klantenservice is developing and how the vision is translated in goals and performance indicators for NS Klantenservice. These two documents are described in detail in the next sections.

#### 3.6.1. Presentation Vision on Service & Customer experience

The presentation by M. van der Heijden et al. (2015) is created for the management of NS Commerce, to inform the management and to get approval to continue the vision as described in the document. The writers of the document are part of different NS Commerce division, besides NS Klantenservice the writers are manager at the Multichannel management department and manager of the Consumer Marketing department. The text is therefore written as an overarching vision from these departments.
The document explains the current situation, where customers experience the different subsidiaries of NS as incoherent. The document is a roadmap towards an improved situation where the customer has a more consistent experience of the different NS parts that produce all a piece of the total operation. This makes the presentation very valuable for our research, although most of the information is outside our scope. The wider context is still important for our knowledge. A large part of section 1.2 is written based on this document.

3.6.2. Presentation WerkWijzer Klantenservice
WerkWijzer Klantenservice is a presentation of the work group WerkWijzer that translated the NS vision put the customer on place 1, 2 and 3 to procedures for NS Klantenservice. The work group developed a structure that should lead to achieving the goals of NS Klantenservice and makes it clear how NS Klantenservice can adjust the operation when needed. Section 5.1, which describes the customer needs, is based on this presentation. Besides the customer needs, goals of NS Klantenservice are also present in this presentation. The document describes the performance indicators for NS Klantenservice on strategic, tactical and operational level. The strategic performance indicators are in general the responsibility for the management. The tactical performance indicators are the responsibility for multiple employees with different job functions. The operational performance indicators are in general the responsibility for individual employees, both staff as CSRs. The document is very up-to-date and the content tells us a lot about the NS Klantenservice perception on their own goals and how they see their customer goals. This makes the document valuelable (NS Klantenservice, 2015).

3.6.3. Synthesis of the archival information
The archival information is highly valuable to retrieve insight in the company policies and the (proposed) decisions. The vision on service and customer experience shows that the core services move to more integration. This is good new for NS Klantenservice, as it aligns the internal stakeholders that interact with customer service. When the business is used to think out of the silos, it is probably much easier for NS Klantenservice to integrate activities from the multiple services. The presentation regarding the procedures give insight on what NS Klantenservice focuses. The values described in this information source are both from customer as from business perspective. This mixture of including the customer needs into overarching goals of NS Klantenservice is important, as it brings customer service to a higher level. Our design should embrace these values so the design has a better change to be adopted.

3.7. Database information
At NS Klantenservice a lot of different electronic information is stored in databases. The primary database source for our research is the Customer Relationship Management (CRM) system, part of a larger enterprise software suite of the company SAP. There are two interfaces for the SAP CRM system: the interface the CSR uses and the business intelligence interface for the data analysts. We explain both interfaces as it gives insight in how we retrieved data for analysis (the data analyst interface) as it reveals what information is entered into the system by CSRs (the CSR interface).

The CSR interface is displayed in figure 3.1a. The interface in the illustration is the one for a creation of a customer contact record. Label A are the data fields that categorise the customer contact. Label B is the field for a short description, this description is visible in the interface of the customer record where all historical interactions are linked. Label C is the data field for the contact channel. In the free text field of label D there is room for notes. Label E contains the possibility to attach other contacts, e.g. when a customer contacts NS Klantenservice in response of an earlier contact. The data fields in label F make it possible to create a follow-up action. This can be either an action performed by the CSR directly, like the creation of a refund payment, or a notification for a specialist group. The SAP CRM application is connected with other interfaces, like the customer account details, the OV chipcard transaction details and the contracts interface. These interfaces make it possible for a CSR to lookup information about a customer and perform brief actions.

The data analyst interface is displayed in figure 3.1b. Here, the data as inserted by the CSR is displayed in a table format. A wide range of variables is available, i.a. the categorisation, the date, week, month and year, the contact channel and the CSR. The business intelligence interface makes
3.7. Database information

it possible to analyse a large number of customer contact records and see what categories are most used. The SAP business intelligence interface can also interact with other data cubes within the SAP data warehouse. In our research the customer contacts cube is the most used data source. In section B.2.1 the most used processes are analysed based on the CRM database information.

Other electronic data are used similar. The data analyst interface, or back entrance, provides access to the data stored in the database of that application. The social media application has an option to generate summaries on the amount of interactions and data fields similar to the SAP CRM system. This data is used by the data analysts of NS Klantenservice to create management information. We use this same data as it provides a lot of insight in what type of questions the customer service department answers and thus what the customer service system should deliver.

The selected cases from table 5.1 are reverse engineered. Based from the top processes as described in section 4.3, a customer contact transaction is randomly chosen from the SAP data analyst interface. In the CSR interface of SAP CRM, the case is looked up based on the case ID. Other information like earlier contacts of that customer or follow-up actions based on that contact are also visible in SAP CRM, so a complete picture of that case is made. The example cases in the next section are identified differently. The first two examples are identified from the overview interface of the customer satisfaction survey interface. Here, customers that give a low score on the customer satisfaction survey can be filtered. When NS Klantenservice performed an additional action in reaction to the customer satisfaction score, this is also visible in the interface. The two cases with a low score and a follow-up action are chosen from this selection. The SAP CRM id number is also included in the customer satisfaction survey data, which allows to lookup the entire cases and the contact history of that customer. In this way, the example cases are re-engineered. The last example case in section 3.8 crossed our path when we were observing and informal interviewing CSRs at the MCC. One CSR was handling this case and talking about it. We wrote down notes, because in our view the case illustrated the room of improvisation that CSRs have at the MCC.
3. Empirical evidence

Figure 3.1: The two interfaces of the SAP CRM system

(a) CSR interface of the SAP CRM system

(b) Data analyst interface of the SAP system
3.8. Three example cases

The detailed description of the cases in this section has two purposes. First, it offers insight in how much details we are able to gather from a customer contact. The possibility to use very detailed evidence is nice, but it hard to generalise from this much details. Therefore, we want to illustrate what kind of information is collected in the SAP CRM system, as explained in the previous section, since this data source provides a lot of data to our research. Second, we want to share what customers experience at NS Klantenservice. We selected two examples where the first responds of NS Klantenservice shows a large room for improvement. As the examples will show, the case is picked up later to repair the initial bad service experience. While the latter action is great, we would like that the service is performed right the first time.

Case: Customer has lost his OV Chipcard with a season ticket on it

The customer has a season ticket "Traject Vrij", which is a ticket for a specific route between two cities, paid in advance for a lump sum. This type of season ticket is often used by commuters to travel between their home town and work town. Over time, the following events happen in chronological order:

- On day -6, the customer blocks her OV chipcard after loosing it. The customer cannot use his season ticket and needs to buy separate tickets.
- On day 0, the customer sends a printed form requesting a duplicate of her NS season ticket to NS. The form is not a NS form, but a form of TLS - the company that issues the OV Chipcards.
- On day 24, NS CS replies with a letter that NS CS is not able to help the customer. Instead, the customer needs to contact the CS of TLS. NS CS closes the case based on the suggested alternative solution.
- On day 29, the customer contacts the front desk at station Amsterdam Zuid. The customer wants information about how to use her season ticket on a temporary chipcard, so he can travel by train without paying for additional tickets.
- On day 29, the customer responds on survey for customer satisfaction that is performed standard after contact with NS CS. The customer expresses his dissatisfaction by giving a score of 1 (out of 10).
- On day 35, the score on the customer satisfaction survey results in a follow-up action by NS CS. CS tries to contact the customer by phone, but does not succeed and sends an email to the customer. In the mail additional information is provided about procedures and CS makes excuses for incorrect redirection to TLS. The procedure is that the old season ticket needs to be terminated and the customer has to buy a new subscription. The termination before the end of the contract term requires a special action by NS, because customer can normally not end their contract before the term has expired. However, in this case the customer needs to order a new personal OV chipcard with the season ticket on it and the money of the unused part of the old season ticket will be returned by NS.
- On day 35, the customer replies by mail. The customer has already received a new, personal OV chipcard and wishes to activate his current (old) season ticket on his new, personal chipcard.
- On day 36, customer receives an evaluation survey on her bad experience (the survey answered on day 30), but answers that she only receives mail for evaluation and receives only the same information about her problem, without a real conversation.
- On day 36, customer calls NS CS for additional information and receives the same answer as earlier provided by email. It can be assumed that the customer makes a call because of no reaction on her email.
- On day 38, CS processes the customer’s email (from day 36) and returns a custom made email. Also, the customer’s subscription is terminated and customer receives a standard process email. This standard email contains the message “we are sorry to see you go”, because of the termination.
On day 39, the customer reacts on the standard email of termination and expresses her displeasure on this mail, since the customer does not want to terminate the contract, but is forced to do because of NS procedures. The customer thinks the standard mail is inappropriate.

On day 41, the previous mail is processed without giving a reaction.

On day 46, the customer buys a new temporary subscription which replaces the terminated season ticket. Finally, the case is resolved.

This case illustrates several issues in the current working of NS CS. The response time on the paper form is 24 days. Besides, the responds on email is also not very fast, which makes the customer impatient so he also takes other actions, like contacting NS CS by telephone and ordering a duplicate of his original OV Chipcard. In addition, the customer receives an answer via the same channel as he contacted NS CS, while it might be better to have a dialogue via the telephone so more details can be exchanged and procedures can be elaborated. The procedure that the season ticket contract has to be ended, is also not optimal. Presumed that this is inevitable, the standard process email in this case makes the situation extra inconvenient.

Case: Customer has a delay of 1,5 hour and requests a refund

A customer takes the train to travel to Schiphol Airport to catch his flight. To speed up, the customer takes the Intercity Direct, between Rotterdam Central station and Schiphop, which requires a surcharge on the normal ticket. Unfortunately there the Schipholtunnel, the entrance into the Schiphol station, is closed due to fire. The Intercity Direct train diverts to the station Amsterdam Bijlmer. The customer takes a bus to Schiphol and has a total delay of 1,5 hour. In chronological order, the events that took place are:

- On day -19, the customer makes the trip to Schiphol with a delay of 1,5 hour.
- On day 0, the customer mails NS CS and requests a refund due to the delay.
- On day 1, CS replies on the email that refunds cannot be processed via email. Instead, the customer has to fill in a paper form or has to use the online self-service to make the request for refund.
- On day 1, the customer sends a request for refund.
- On day 9, the system receives the claim.
- On day 12, the system notifies that the claim cannot be processed automatically. The claim is put in the manual processing stack.
- On day 30, a CSR rejects the claim because the assessment is that the train did not have a delay of over 30 minutes, but only a delay between 15 and 30 minutes. The latter is a lower category of refund for Intercity Direct trains, so the claim is rejected.
- On day 124, the customer calls CS to make an objection. The CS replies that the Domestic CS cannot handle the objection (because the trip was by Intercity Direct) and is referred to the International CS. The customer calls the International CS, but is unfortunately redirected to Domestic CS. The customer calls again the Domestic CS and now the objection is registered.
- On day 132, CS processed the claim and gives a full refund. This is registered in the system, but not yet communicated to the customer.
- On day 132, the customer receives a customer satisfaction survey. He answers with a 5 (out of 10) because of the redirecting.
- On day 135, the customer receives an automatic, process, email that the refund is granted.
- On day 135, the low grade is noticed by CS and CS calls the customer to ask about the received service. The situation is explained on the telephone by both sides.
• On day 136, an evaluation of the follow-up action of the customer satisfaction survey is send. The customer responds that he is pleased by the follow-up action.

This case illustrates mainly the confusion caused by the separation of the two CS centres of Domestic and International. The wrong assessment of the CSR is always possible, so we won’t judge on this. However, it is not convenient that the customer satisfaction survey is send before the email that the claim is granted. Besides, the redirection to another contact channel is also not optimal since it does not fix the problem the first time.

Case: Customer has not activated his e-ticket
The customer has bought an action ticket via the third-party Hema. The ticket is valid for a whole day, compared to a normal ticket that is valid for one trip. The special terms are created by the marketing department, so more customers use the train especially in the off-peak hours. However, the ticket sold via Hema is not direct valid: the customer buys a voucher code that need to be activated online at NS.nl. The customer did not performed the activation and is unaware of this required action. When the conductor asks the customer for ticket validation, the conductor noticed the invalidity. The customer tells his story and hands the voucher code. The conductor has three options in that situation: give the customer a fine for travelling without a valid ticket, give the customer a warning without a fine or ask help at the MCC. The conductor chooses the latter and explains the situation at the MCC employee. The MCC employee activates the voucher code so the e-ticket is activated. However, it is not possible to send the e-ticket to the customer because only printed e-tickets are valid. The conductor writes out a ticket that is valid for the whole day and hand this manual ticket to the customer. The customer can thereby travel the whole day without having a problem later on the day, in case his ticket is validated a second time.

This case illustrates that the the different type of travel products and terms create confusion by the customers. Besides, the conductor is not able to handle the issue themselves. The support of CS in this case resulted positive for the customer, but the question is whether this action should be necessary. The entanglement of CS with other NS departments and systems is shown by this case.

3.9. Conclusions on the empirical evidence
The empirical evidence we use in our study shows three main patterns. First, the silos of the whole NS organisation influence the several structures within NS Klantenservice. The OV chipcard, used for travelling with the train, has fundamental different travel products on it depending on having a Consumer or Business product (two of the silos) (Balster, 2015). Current training programs are divided along the silos, giving already problems for the training of CSRs for the 24/7 service, because these CSRs have to provide customer service for all the NS services (C. van der Heijden, 2015). The interfaces that are used to store customer contacts in the CRM system are arranged separately for each contact centre, making doing analysis for the customer service as a whole difficult. The separated silos are also a source of unsatisfactory customer service, as given as example in the second case.

Second, the integration plan for the four contact centres show directions of what the new situation should be. This is visible in the archival information, where the presentation of the working procedures show unitary performance indicators for all contact centre activities. How the new situation looks like exactly is not described in documents, nor known as we learned via interviews (Likumahua, 2015). This information substantiates the need from NS Klantenservice for a service redesign, as the existing plans do not form a complete picture of the future situation.

Last, the empirical sources do reveal shared thoughts on what the future organisation should look like. Balster (2015) shared his ideas for separating all logistic related questions and the specific (consumer, business or international) ticket type of questions. This idea is compatible with the explained direction that is planned by the integration project group (Likumahua, 2015). Form training perspective this idea is feasible, but poses some requirements in order to let CSRs handle a wide range of customer questions. One concrete requirements is one knowledge management system where all information regarding the services is integrated (C. van der Heijden, 2015). CSRs then need to be trained to use
their skills to search for information rather than knowing it by heart.

With the knowledge learned from the interviews and a general design direction, we dive deeper into the details of processes, IT systems and human factors as policies and organisation structures in the next chapter.
The goal of this chapter is to retrieve a full and detailed understanding of the NS Klantenservice operations. For this, we dive deeper into the organisation and divide the elements into people, process and IT system related elements. Before we can split the organisation into these three elements, we need to understand the fundamental differences between the NS core services (section 4.1). NS Klantenservice supports all the core services in terms of customer service. Some parts of the core services are similar and have generic needs, while other parts of the core services are unique that make the service different. After the description of the core services, we look to the people, process and IT system elements (section 4.2, 4.3 and 4.4). Last, we synthesise the elements and summarise our findings in section 4.5.

In order to explain why the NS Klantenservice operation is complex, we divide the operation in three parts: People, Processes and IT Systems. The operation takes place in the middle of these three elements, the grey area in figure 4.1. The operation offers customers service to the NS core services. The core services are combined in different segments, which are recognised as such by customers. The segments have a large influence on how NS Klantenservice operates. Therefore, we first start with an description of the NS core services.
4.1. NS core services

NS offers three core services, which consist out of several components (Balster, 2015). Service components are customer registration for usage of the service, the billing of the service, the payment for the service and after usages services like refunding a payment by service non-delivery. The three core services are:

**National train service** This is the train service in the Netherlands as it brings customers from station A to station B.

**Door-to-door services** These services are auxiliary services to the national train service. These services bring a customer from the station to his home, work or wherever he want to go. In addition, there are services as car parking near stations or conference room rental at stations.

**International train service** This train service operates between international destinations and the Netherlands.

The three core services are marketed in four segments. The mapping of the core service to segments is given in figure 4.2. NS International does solely cover the international train service. The Door-to-Door brands are combined in this analysis because they are auxiliary services and not the core business of NS Reizigers. Since the D2D services are serviced by NS Klantenservice, we combine them in the analysis. There are multiple D2D brands, of which OV Bike (bike rental on the station) is the largest. In order to use one of the D2D services, the customer is required to have a NS personal OV Chipcard. In this way, the customer is also either a Business customer or a Consumer customer. Because of this required combination with the Consumer/Business segment, the D2D services are auxiliary.

The national train services is divided in two segments: NS Consumer and NS Business. All customers who use the national train service that are not a Business customer, are considered Consumer customers. This also implies that not all NS Consumer customers are known, because it is possible to use the train with an anonymous OV Chipcard. However, NS Consumer customers can also have a season ticket. Season tickets are always paid in advance, for the whole term of one year or one month. Customers without a season ticket can activate their debit card so train trips are paid when used. NS Consumer customers who also want to use D2D services have to pay separately for the D2D services, which is illustrated by a dotted box in figure 4.2.

NS Business customers have additional options to the NS Consumers customers. All NS services are billed on one invoice after service delivery, instead of before service delivery. Besides for NS Business customers, it is possible to make a distinction between the card user and the contract contact person. Invoices and contractual communication is send to the contract contact person, often the administrative department of a company. The card user is not bothered with payments to NS, but has the ability to easily use the public transport for business purposes. Declarations of trip costs are then not necessary, since the NS bills all used services to the company and the card owner only has to justify his use to his company. D2D services are integrated with the national train services in terms of billing and contracting. In addition, the payment of international train services can also be performed via the NS Business account.

For all three core service, NS Klantenservice provides customer service. In general, only when customers request additional help or when the regular process has a flaw, the customer contacts NS Klantenservice. Depending on what service is used with a specific option of that customer, which is partly depending on the segment, NS Klantenservice needs to provide different customer service. This makes the NS Klantenservice operation complex and explains why so many different systems and processes are used, by several organisational units. These elements, people, processes and IT systems, are described in the next sections.
4.2. People

The people elements of NSKlantenservice that we describe are the organisational diagram, the presents and function of the outsourced contact centre, the physical locations of the teams, how the organisation is divided in management hierarchy, the opening times of the customer services and some description of the culture in the organisation. These topics influence the organisational arrangement and are the more soft side of the operation.

4.2.1. Organisational diagram

In section 1.2 the context of NS Klantenservice is described. The organisational change that is implemented until now, the current situation as illustrated in figure 1.4, is rather a new shell for the organisational units than real integration. In appendix B the organogram of NS Klantenservice is illustrated in figure B.2. This organogram is focussed on NS Klantenservice and can be attached to the organogram of NS Group, as described in figure 1.1. NS Klantenservice is a department of the division NS Commerce. The department is managed by a team of ten people, of which three are operations managers. The operations managers are responsible for the four contact centres, the Domestic and International contact centre are both managed by one manager and the MCC and Service Centre are - in line with the future integration, together named NS Onderweg - managed by one manager. The operations managers are supported by three traffickers. The role of traffic is to adjust the personnel schedule to the actual demand. Does a CSR has to switch from email work to a telephone line? What type of paper letters should be handled: complaints or refunds? These type of operational decisions are made by the traffickers, depending on backlog, current work load and service levels so eventual a balance is chosen between the different performance indicators. Traffickers do not have substantive knowledge of the different type of questions and processes the CSRs, for this task there are team coaches. Team coaches help CSRs with difficult questions and take the more special, non-standard cases. Team coaches are the first level of escalation. Only in the most exceptional cases the Operations Manager or the staff operates as the second level of escalation.

4.2.2. Outsourced contact centre

The outsourced contact centre (Webhelp) is illustrated in the organogram of figure B.2 as semi unit of the Domestic operation. The Operations Manager Domestic is not the manager or contact partner of Webhelp, this is performed by the staff. However, most of the telephone calls and e-mails of consumer customers - which falls under Domestic - are handled by this outsourced contact centre, run by the company Webhelp. Webhelp is specialised in contact centres and runs outsourced contact centres for several large companies as mail order companies Otto, Bonprix and Heine, telecom companies KPN and Ziggo, bank and insurance companies SNS, Aegon and Menzis and many others. For NS, Webhelp has three locations: Groningen and Tilburg are located in the Netherlands and Paramaribo in Surinam serves as the offshore contact centre. The offshore contact centre is opened in April 2015 for NS, other companies already use this offshore location, and is currently in development. NS Klantenservice & Webhelp monitor this development closely and decide together what processes can be handled in Surinam. For this study, all operations of Webhelp are treated as one contact centre. How Webhelp is managed is not the concern of NS, this is the business of Webhelp. The input for Webhelp are the processes and the volumes that they handle. Some customer contacts turn out to be more complicated than Webhelp can handle. These contacts are rerouted to NS Klantenservice. The other way around does also occur: particular consumer customers who want to end or renew their season ticket contract are rerouted to Webhelp. The routing is based on agreements between the two companies. Webhelp handles around 74% of the customers in terms of contact volume that is in our scope.

4.2.3. Locations

We just described the physical location of Webhelp. The in-house contact centres also have multiple physical locations. The Domestic, International and Service Centre contact centre are all three located in Utrecht, divided over two floors of the head office building. The staff team and the boards of the different organisational levels are also located in this building. Only the MCC is located in Eindhoven, roughly one hour away by train from Utrecht. This physical distance can become a issue in the integration of all contact centres, but is left out of scope for this thesis.
4.2.4. Skills in the operation
The four contact centres map on the three units, each headed by a Operations Manager. As described earlier, the MCC and Service Centre are combined into one organisational unit NS Onderweg. However, most units are further divided in skills. The Front Office and Back Office as illustrated in figure B.2 are a combination of skills. The Domestic contact centre Front Office has the skills consumer, business and NS/OV bike, while the Back Office of this contact centre has the skills refund, complaint, custom work, contracts and business. The International contact centre is already divided in three units, group travel and Back Office are similar as one skill. The Front Office has skills in languages: there is a separate line for French and German customers. There is also a skill for social media, which contains both the live chat channel and the Twitter and Facebook channel. The MCC also works with skills, these skills are related to the processes. They also have to use a division of the allocation of processes, because not all work places have access to all systems. For some systems are a limited amount of licences available.

4.2.5. Opening times
The changed opening hours of NS Klantenservice to 24 hours, 7 days a week, have a large impact on the operation. Before, the MCC was already open 24/7, but all other contact centres were not. The Service Centre was open from 6.30h until 23.30h, only closed in the night. Some of the Service Centre processes are take over by the security division, that is outside NS Klantenservice and outside our scope. The Domestic contact centre was closed from 23.00h till 7.00h, besides on weekend days, than the contact centre was closed from 17.00h till 9.00h, all for consumer contacts. The business phone line closed at 18.00h on week days and was not open in the weekend. The International contact centre closed at 21.00h on week days and was open on Saturdays, besides one line which was also open on Sundays. The change to a overall 24/7 open customer service introduced a new, hybrid unit: the 24/7 unit. The prior closing times are still maintained, but when the line would normally be closed, the call is now routed to the 24/7 unit. This introduced the problem that CSRs in the 24/7 unit have to know everything, they should be multi-skilled for all services. The CSRs of the 24/7 unit do not form their own unit, but are all part of one of the unit as illustrated in the organogram in figure B.2. Some of these CSRs work only night shifts and some are deployed on day and night shifts. Working in night shifts is also restricted by health and safety regulations, which increases the difficulty of making a tight planning and decreases flexibility in scheduling shifts for CSRs.

4.2.6. Culture
The work culture is not part of the complexity of NS Klantenservice, but does describe how the business is done. At NS Klantenservice, two sets of work rules are displayed. The ten agreements (see table B.1) are applicable for all NS Klantenservice employees, including staff. Specific for CSRs, the operative personnel, a separate poster with work rules is displayed (see figure B.1). The work rules for the operation are very directive. This tone matches the traditional tone in a contact centre, where (operation) management usually very command and control like. CSRs are evaluated on production, handling time, customer satisfaction and other performance indicators and are monitored closely. The tone and management style for the operation conflicts with the propagated values as transparency and a pro-active work attitude. We think this is partly because of the graduate culture change. Originally NS is a public servant organisation, which is gradually changing to a more commercial organisation. The new values are propagated, but the old culture is still present in some people’s behaviour, as many employees work for decades at NS.

4.3. Processes
Contact centres use a CRM system to record all customer interactions. In this way, the company can gather information on the content of the interaction (what type of questions are asked) and is stored per customer when and about what the customer contacted before. NS Klantenservice uses SAP CRM for most, but not all, of their customer interactions. The interactions are categorised based on a layered tree, e.g. when a customer asks information about a travel product, the type of product is also recorded. The analysis of the processes is based on this categorisation of customer contacts. For all recorded customer contacts in the first half year of 2015 (01/01 - 30/06), we took the first two layers of the categorisation tree. This produces 97 combinations, which we see as processes. Not all processes
are equally used, in fact the top 10 processes comprises between 72 % and 78 % of the interactions for the different contact centres. Because not all interactions are registered in SAP CRM, the processes are only for the Domestic Contact Centre (including the outsourced centre by Webhelp) and the Back Office activities of the International Contact Centre. Besides, the social media channel is not included. In principle the social media interactions are not recorded in SAP CRM, only the interactions that require a follow-up action are inserted into the CRM system. This can be complaints regarding NS, mutations in season tickets or refunds. How the top 10 is created, is described in appendix B.2.

### 4.3.1. Processes analysed based on CRM records

The top 10 processes are summarised in figure 4.3. To understand better what each process contains, the top 10 processes are explained in the remaining part of this section.

<table>
<thead>
<tr>
<th>Process / Unit</th>
<th>Domestic</th>
<th>Webhelp</th>
<th>International B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Information - Travel products</td>
<td>20,4%</td>
<td>19,0%</td>
<td>5,3%</td>
</tr>
<tr>
<td>Refund - Request for restitution</td>
<td>9,8%</td>
<td>3,9%</td>
<td>15,6%</td>
</tr>
<tr>
<td>Terminate/Cancel - Travel products</td>
<td>8,9%</td>
<td>17,0%</td>
<td></td>
</tr>
<tr>
<td>Refund - Correction for Check-In / Check-Out</td>
<td>8,7%</td>
<td>16,0%</td>
<td></td>
</tr>
<tr>
<td>Information - NS general</td>
<td>3,5%</td>
<td>8,8%</td>
<td>9,0%</td>
</tr>
<tr>
<td>Refund - Compensation for delay</td>
<td>6,6%</td>
<td>0,9%</td>
<td>45,2%</td>
</tr>
<tr>
<td>Information - Usage website</td>
<td>3,5%</td>
<td>4,7%</td>
<td>1,5%</td>
</tr>
<tr>
<td>Check status - Payment</td>
<td>5,0%</td>
<td>2,9%</td>
<td></td>
</tr>
<tr>
<td>Refund - Fine on train</td>
<td>2,6%</td>
<td>2,6%</td>
<td>1,4%</td>
</tr>
<tr>
<td>Modify - Customer account information</td>
<td>3,2%</td>
<td>2,0%</td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>72,3%</strong></td>
<td><strong>77,6%</strong></td>
<td><strong>78,0%</strong></td>
</tr>
<tr>
<td><strong>Volumes per week</strong></td>
<td>6,865</td>
<td>32,547</td>
<td>723</td>
</tr>
</tbody>
</table>

**Figure 4.3: Top 10 processes as registered in the CRM system**

**Information - Travel Products** is the process where information regarding the different season tickets and other travel products of NS is provided. The largest type of products where customers contact NS Klantenservice for, are the NS Business Card, the different season tickets, e-tickets and action products. Action products come from marketing actions that have specific terms, e.g. only valid outside rush hours or in weekends. Often, these action products are not a valid ticket and have to be activated via the website, so the customer receives an e-ticket. This causes extra questions from the customers. For all travel products, the specific, product dependant information is provided in this process.

**Refund - Request for restitution** is the process where customer who bought a ticket in advance, can get a restitution when they did not use the ticket. This is only applicable in specific situation, when a train is cancelled due to snow or other disruptions. The customer gets a refund or receives a voucher for an e-ticket. The CSR is authorised to assess whether a restitution is applicable.

**Terminate/Cancel - Travel products** is the process that handles customers who’s season ticket term has ended. When customers contact NS Klantenservice, CSRs have the task to find out whether the customer can be saved: perhaps the customer is not content with his current season ticket and a different type of season ticket fits better the customer’s needs. Other changes with season tickets are also handled by this process, e.g. the type change of a season ticket during the term duration. Due to the ticket terms, a change of season ticket type requires the termination of the old season ticket and an order of a new season ticket. Normally it is not allowed to end a contract before the duration term has expired, but when a customer wants to upgrade to a more expensive season ticket, an exception is made. Other reasons for a premature termination can be the death of the contract holder.
Refund - Correction for Check-In/Check-Out is the process that handles customers who contact NS Klantenservice to correct their check-in or check-out at the station. The correction can also be performed online, in the self-service page of NS.nl, but there are several reasons that require a manual action, e.g. a rejection by the automatic system, or customers who don't have an online account or customers who just prefer a personal interaction. Customers who do not perform a correct check-in or check-out, pay the entry fee - which is a deposit - instead of the real travel price. The customer receives the difference of the deposit and the real travel price as a refund.

Information - NS general is a collective term of processes where in general a CSR does not have to actually perform anything, other than process the contact. E.g. a customer responds by mail on a final answer of NS, the mail itself has to be processed so it is red. A different example can be a question whether it is possible to get a refund in a specific situation. The responds just provides an answer to the customer, but no action is undertaken.

Refund - Compensation for delay is processed mostly automatically, but just as the correction some compensations require manual action. This can be because customers add additional attachments to the standard form or not all required information is filled in on the form. Depending on the delay the customer had and whether the delay is caused by NS, the customer get a (partial) refund of his ticket. Season ticket holders get a partial refund of the annual fee. Compensations for delay can either be made via the self-service internet page, or a paper form. Only the latter is included as contact channel is this research. However, objections on the denial of compensation can be done via multiple contact channels, which explains why this process is used so often.

Information - Usage website is the process where customers contact NS when they require help for the usage of the website. In particular assistance is provided for the personal account, when the customer cannot use the self-services of NS.

Check status - Payment are processes where customers contact NS Klantenservice regarding financial transactions. This can be payments for season tickets that have to be paid, or refunded tickets or cancelled season tickets that have to be paid back.

Refund - Fine on train is the process where customers who did not have a valid ticket, contact NS Klantenservice to object against the fine. This can be because the customer did forget his season ticket at home: a customer can forget his season ticket a few times a year without having to pay a fine. This policy is pure out of goodwill reasons to their loyal season ticket holders. Customers can also contact NS Klantenservice to object for other reasons. The CSR can decide whether to annul the fine.

Modify - Customer account information is a process where the customer data is altered. Changes in customer data have to be initiated by the customer. A service notification is created by the CSR that has contact with the customer, so the request for changed can be checked and processed.

4.3.2. Other major processes
The processes described in the previous subsection are all selected based on the customer contact registrations in SAP CRM. By this method we miss four major units of NS Klantenservice: the Front Office of NS International, the work of the Service Centre and the work of the MCC. The last missing information is the work done by the social media team.

NS International - Front Office has a weekly 4.095 incoming phone call registrations. These calls are not recorded in SAP CRM, but more simplistic in the phone system CIC. There are three main categories of choice to place a call under: providing information about international train trips, making reservations for these trips or providing service after a customer already bought a ticket. This after sales service comprises in general of making modifications at a booked ticket. The distribution of these categories can be found in table B.2. There are two special kind of groups served by NS International. These are the business customers (owner of a NS Business Card) that want to book an international train ticket and the support for travel agencies. Travel agencies offer international train tickets as the middleman, which makes them also a customer of NS.
Service Centre has on average 5.967 weekly calls. The contact centre handles requests for customers with a disability, handles lost and found items for customers who call the NS Klantenservice and handles direct services for customers who press the help button on the station. The help button is located on some devices, like ticket machines and service pillars on the station. The call distribution of the Service Centre is described in appendix B.

Employer Contact Centre (MCC) has on average 3.364 calls per week. These calls are recorded in SAP CRM, but not in the exact same SAP CRM. Some databases are shared with NS Consumer and NS Business, but others like the one that handles the registration of lost and found items are not. The main business of the MCC is to support the employees on the trains and stations. There are four top processes. The largest is tracing lost and found items on the train. Instead of the Service Centre where the customer calls the NS Klantenservice, the MCC is contacted by train or station employees because a customer has contacted that employee. An other large process is the last minute organising of taxi rides, mainly for train employees. Taxis are needed to close the train employee’s work schedule: to transport the machinist from the station to the switch yard and the other way around. Sometimes the scheduling went wrong and the MCC arranges a taxi for the employee. Customers can receive a taxi ride when the trains are disrupted which causes that the customer can not travel to his home. A third large process is the support of train employees with ticket validation, e.g. a customer with a season ticket who has forgotten his OV Chipcard can be verified by the MCC that the customer has a valid season ticket. The last process is very broad and is providing assistance during disruptions on the tracks. The assistance is mainly providing real time travel information and giving status updates about the disruptions to the train personnel.

Social media team has on average 6.909 cases every week. Because a conversation via social media can consist out of several messages, the conversations are combined into a case. The social media cases are mostly not recorded in SAP CRM, only in case additional action is needed the case is forwarded and the customer contact is recorded in SAP CRM. The cases are categorised by automatic labels based on keywords in the application that handles social media. The most used categories are tweets about punctuality, travel information and travel products. Besides, customers tweet about whether they could find a seat on the train and other observations in the train or at the station. The complete list can be found in table B.3.

4.3.3. Conclusions on the processes
We described the ten most performed processes based on the SAP CRM system. From the other major processes, they Service Centre and MCC are out of our scope with together ca. 9.300 contacts per week. The social media contacts are partly similar in terms of content and partly unique because of the topicality of the contacts. This categorisation of the social media contacts is also visible in our analysis and design in section 6.1. The International FO contacts are also not registered in SAP CRM and therefore described separately. Part of the content of International FO contacts is different from the domestic services, like the selling of tickets on international trains. Actions like selling of tickets is unique, but is a same type of action as the sale of season tickets and can therefore be included in our analysis. In the analysis in chapter 5, we include all of International FrontOffice activities because of this reasoning. To conclude, a lot of the processes do look alike but have small varieties and are treated at NS Klantenservice as unique. From the analytical point of view as we do, these small varieties can be smoothened which increases the generality and decreases complexity.

4.4. IT Systems
NS Klantenservice uses a lot of different applications and systems to operate the customer service. Some of these systems are very specific for one process, others are broad and used for several processes or for supporting the operation. We describe the most used IT systems in appendix B.3 to give an impression what kind of systems are used and where they are used for. The IT systems are categorised in five type of features that they provide. What systems provides what feature is summarised in table 4.1. The five categories of features are elaborated shortly.

Operations management/performance is the feature that collects information that is necessary to manage the operation effectively. Lots of systems collect a part of the performance information.
Table 4.1: IT Systems used at NS Klantenservice for different features. When the systems provides the feature, a short description is provided of what the system contributes to the feature.

<table>
<thead>
<tr>
<th>IT System / Feature</th>
<th>Operations management / performance</th>
<th>Contact NS Klantenservice</th>
<th>Register contact details</th>
<th>Information source</th>
<th>Out of our scope (self-service, special care services)</th>
</tr>
</thead>
<tbody>
<tr>
<td>MarketResponse</td>
<td>Customer satisfaction</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Invision</td>
<td>CSR rostering</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Timerecorder</td>
<td>CSR activity monitoring</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Phone systems</td>
<td>Performance telephone contacts (all services)</td>
<td>Route telephone calls</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Oracle RightNow</td>
<td>Performance live chat contacts (all services)</td>
<td>Handle chats</td>
<td>Collect complaints</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>External complaints websites</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Service Forum</td>
<td>-</td>
<td>Exchange information on Forum</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Coosto</td>
<td>Performance social media contacts (all services)</td>
<td>Route social messages</td>
<td>Registers social media contacts</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>SAP CRM</td>
<td>Performance e-mail/paper mail contacts (all services)</td>
<td>Route e-mails</td>
<td>Register all channels contacts</td>
<td>Account details, previous contacts</td>
<td>-</td>
</tr>
<tr>
<td>SalesForce CRM</td>
<td>Performance D2D services</td>
<td>-</td>
<td>Register D2D services contacts</td>
<td>Account details D2D services</td>
<td>-</td>
</tr>
<tr>
<td>Refund</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>Status refunds</td>
<td>-</td>
</tr>
<tr>
<td>UVB system</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>Status fines</td>
<td>-</td>
</tr>
<tr>
<td>Intershop</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>Status e-tickets</td>
<td>-</td>
</tr>
<tr>
<td>AVG</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>Status special care requests</td>
<td>Handling special care requests</td>
</tr>
<tr>
<td>EVA Live Presence</td>
<td>-</td>
<td>Automated chat bot / route emails</td>
<td>-</td>
<td>-</td>
<td>Handling automated chats</td>
</tr>
<tr>
<td>Reisregie</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>Live information trains</td>
<td>Travel advice</td>
</tr>
<tr>
<td>ISVL</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>Live information disruptions</td>
<td>Information disruptions with trains</td>
</tr>
<tr>
<td>BAP</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>Train and conductor schedules</td>
<td>Lost&amp;found items</td>
</tr>
<tr>
<td>Search engine</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>Routing FAQ website Order a taxi</td>
</tr>
<tr>
<td>Taxi Munckhoff</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

The data from all these systems are currently not extracted, translated and loaded into a central data warehouse or other kind of interface. Operational management has to collect information from all the systems to be able to have a complete oversight of the operation.

**Contact NS Klantenservice** is the feature that makes sure the customer contact arrives at NS Klantenservice. The systems that provide this feature are the interface between the customer and customer service. Each contact channel requires a separate system.

**Register customer details** is the feature of storing the notes, the categorisation and the customer details of each contact in a database. In general, this feature is provided by a CRM system, but as we see at NS Klantenservice three systems are used.

**Information source** is the feature of a system that provides some customer specific information. Several systems store specific information, when a customer contacts NS Klantenservice the CSR might have to access the information in order to help the customer. Lot of information sources are connected to the SAP CRM system, like the information regarding all contracts of customers, travel history of customers and customer account details.

**Out of scope (self-service, special care services)** is not a normal feature, but is used to distinguish other features that are out of this thesis scope. The MCC contact centre uses some specialised systems for information gathering. To illustrate the existence of more systems than our scope, some systems are included in the table. The systems that automatically answer customer questions or route them to the correct information on the website are not in our scope. The EVA
4.5. Synthesis of the current operation

Live Presence system is one of such systems, but this system is also used as classification system for customer who send an e-mail to NS Klantenservice.

4.5. Synthesis of the current operation

We described in this chapter the three core services (domestic, international and door-to-door) that are marketed as four segments of NS (Consumer, Business, International and Door-to-Door). NS Klantenservice provides customer service for all these core services. The customer service operation is described according to three fields: the people elements, processes and IT systems.

The people elements show a complicated organisational structure, with units handling specific customer contacts because of different core services and contact channels. Included in this structure is that 74% of all customer contacts are outsourced to the company Webhelp. We include these contacts and activities in our analysis and design, but reflect on this choice section 9.4. Besides, we see that the 24/7 opening hours started in April 2015 has an impact on the organisation. The existing structure influences by core services and contact channels is not able to handle the night hours. In the night, questions of all core services are asked and due to the low volume the limited number of CSRs that are present have to possess the knowledge of all services. As we will see in the design solution, the current division of skills could be organised more efficient so the fluctuation contact volume can be handled better.

The analysis of the processes show that over 70% of the customer contacts are handled by one of the ten processes we included in the analysis. This makes it possible to focus the redesign on the activities performed in these ten processes. These processes are also taken as selection criteria to select cases, which is to be done in section 5.4. The cases form the basis of the Axiomatic Design in chapter 5.

The analysed IT systems show that there are a large number of systems present at NS Klantenservice. Most of these systems perform a unique feature, but some of them do not. We see three issues with the IT systems. First, there are several systems that store some kind of information that is used to help customers with their personal questions. When these information sources would be connected to one information system, the complexity for CSRs would reduce. Second, we also see three systems present that store contact details (CRM functionality). This is one feature that should be integrated in one system, as we found in contact centre literature in section 1.3. Last, the systems that provide information for operational management purposes are not standardised making gathering operational performance measurement difficult and hard to standardise. Although standardised performance measurement could increase the operational performance, this is out of our scope as it is not necessary for an organisational redesign.

With the detailed knowledge of NS Klantenservice, we start with the Axiomatic Design method. The method requires to abstract the real situation, but we include as much of the details as possible. The analysis that leads to a new design of the customer service system uses the information from chapter 3 and this chapter. We defined our scope to include the organisational elements of the customer service system and take the process and IT system elements as granted. This means that we do not design IT systems or processes, but we do state assumptions and constraints on these elements. We start the analysis in the next chapter by looking to the requirements posed on the system, from NS Klantenservice perspective and from the customer perspective.
5

Analysis of the as-is situation of NS Klantenservice

The goal of this chapter is to analyse the customer service system at NS Klantenservice by applying the Axiomatic Design method (explained in section 2.8). The AD method zigzags through the domains and is an iterative method. We include two iterations in this analysis chapter. First, we start with self-stated goals of NS Klantenservice regarding customer needs (section 5.1) and complement these with needs from business perspective and needs found in literature (section 5.2). The high-level customer attributes are translated to high-level functional requirements, which are decomposed into lower-level functions (section 5.3). The top processes as analysed in the previous chapter are used as selection criteria for real customer cases, which are seen as process variables (section 5.4). From the cases, the required resources and skills to handle the cases are distilled (section 5.5). These resources form the design parameters of the AD. This initial AD is analysed in sections 5.6 and 5.7. We restructure the first iteration of the AD and create a modified second version. This second iteration is analysed in section 5.8. Finally, we conclude our findings from the analysis of the as-is situation (section 5.9). Here, we see a coupled design which is to be solved in the new customer service system design in chapter 6. We adjusted the standard Axiomatic Design framework in figure 5.1 and added our relations between all the sections in this illustration.

Figure 5.1: Axiomatic Design framework with four domains and three mappings as used in our research

5.1. Customer needs of the customer services

The Axiomatic Design method starts with the customer attributes that the system as a whole has to provide. For this, we discuss the self-stated goals of NS on what the customer needs. We compare these customer needs with literature on service quality, which leads to the customer attributes from the customer perspective as used in our design. In section 5.2, we supplement these customer needs.
with the needs from business perspective.

In 2015 NS launched a new, company wide, slogan called put the customer on 1, 2 & 3 which emphasises that the new priority of NS is the customer. NS Klantenservice translated this slogan to a vision for the customer service. For this, they used the Lean philosophy to look at the organisation from the customer perspective. The vision and goals are shown in the diagram in figure 5.2. From this diagram and the explanation given by NS, we identify the following three customer attributes:

**Personal attention** implies that the customer’s voice is heard and that this is also experienced as such. Depending on the customer needs, so personalised on the situation of that customer, the customer should be taken care of his problem, surprised and inspired by NS.

**First time right** means that the customer only has to contact NS Klantenservice one time. NS Klantenservice will take care of all actions that lead to a (satisfying) answer. Information consistency is important, because the customer should receive the same answer regardless of the contact channel he chooses.

**Easy accessible** implies that the customer can contact NS Klantenservice always (24/7 opening hours) by the contact channel of his choice.

The authors that developed the GAPS Model of Service Quality, determined five distinct dimensions that together can measure the consumer perception of service quality. These dimensions are tangibles, reliability, responsiveness, assurance and empathy (Parasuraman et al., 1988). Tangibles include the physical evidence of the service. For customer service this evidence is rare, since all contacts are not face-to-face. Only emails and paper letters generate physical evidence, which are standardised in layout. Therefore, we do not include this dimension as customer attribute. Reliability involves consistency in performance and dependability. First time right is incorporated in a reliable services. Reliability also means that the company does what it promise, like bill the things right and answer within the promised responds time. This dimension is incorporated under the name first time right by NS Klantenservice.

Responsiveness concerns the willingness or readiness of employees to provide service. This dimension includes a quick response on customer actions, including calling back the customer if necessary. Assurance is a dimension that consists out of several determinants, like the competence, credibility and courtesy of the employees, and the security feeling. The latter would be privacy related for NS, as the company deals with confidential information like personal information but also the solvency of

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**Figure 5.2: Goals of NS Klantenservice (NS Klantenservice, 2015, p. 4)**

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consumers and companies. Empathy consists out of accessibility, communication and understanding the customer. Accessibility deals with opening times, waiting times before the customer gets a responds and a convenient way of accessing the service. For NS Klantenservice the latter would be the contact channels the customer can choose from to contact the customer service. Communication is about listening to customers and reacting according the personal customer needs. Different groups might expect a different kind of language. Communication is also about explanation of the service and the trade-offs that are made in the service. Understanding the customer is regarding individualised attention, so that customer’s problem and needs are heard. The dimension of empathy is translated in two attributes by NS: both personal attention and easy accessible fall under empathy as defined by (Parasuraman et al., 1988).

The analysis for customer attributes compared the needs as identified by NS Klantenservice with the needs from Parasuraman et al. (1988). In this comparison NS Klantenservice split the empathy dimension in two attributes. Further, the literature suggests to use three more attributes. For our analysis we exclude the tangible dimension, since the tangible evidence of NS Klantenservice work is so little, it is not of that importance in our design. The four dimensions of customer attributes from the customer perspective we include are reliability, responsiveness, assurance and empathy (figure 5.3). These dimensions can be decomposed if necessary, e.g. ease accessible and personal attention for the empathy dimension.

\[
\begin{align*}
CA_1 &: \text{Reliability} \\
CA_2 &: \text{Responsiveness} \\
CA_3 &: \text{Assurance} \\
CA_4 &: \text{Empathy}
\end{align*}
\]

Figure 5.3: High-level Customer Attributes from the customer perspective

5.2. Needs from NS Klantenservice

We do not want to include solely the customer attributes from customer perspective on the service. Business values as efficiency and the operational performance might eventually be of importance for the customer, but we want these values to be included directly for the service system as a whole. Therefore, we look to what NS and NS Klantenservice wants from the customer service system, besides a high quality service for customers. For this, we look to the reasons that drive the integration the four contact centres.

In section 1.2 we already introduced the NS Klantenservice and it’s current transformation as illustrated in figure 1.4. The reason of the integration of the four contact centre are twofold: increasing customer satisfaction and increasing efficiency (Likumahu, 2015). Economies of scale is the primary efficiency gain. In the contact centre, the demand via direct contact channels fluctuates during the day and week, but also due to external events. External events can be caused by NS, like a marketing action or the mailing of invoices, but also by unforeseen circumstances like disruptions on the rails, majors events in the Netherlands and even strikes by train personnel in other countries. The structural fluctuations of the demand are primarily a problem for the planners. By scheduling more shifts during the peak hours, the structural fluctuation can be coped with. The real economies of scale gain is during external events. Quick responds and action is needed, for example increasing the telephone capacity. Changing the capacity at such a short notice is not easily possible, since a part of the work force is off duty. With a larger base of CSRs at duty, it is much easier to allocate more CSRs at that moment to a specific task.

We now talked only about economies of scale benefits for direct contacts. In figure 5.4 the volumes of the Domestic and International contact centre are displayed over 2014. These volumes include volumes of the outsourced contact centre by Webhelp. Live chat was not available as channel in 2014, this channel is added in 2015. The channels that are considered as direct contact are telephone and
live chat. E-mail and paper letters are indirect contact channels, since the time between an incoming contact and the responds can be several hours, or even several days. Social media is in between direct and indirect: the service level for Twitter contact is 15 minutes for example. Contacts via social media are not handled immediately, they can be stored in a waiting queue. However, the expected responds time is so short, social media can better be categorised as direct contact than indirect contact.

The division between direct and indirect contact is importance for economies of scale benefits. Because of the probabilistic arrival distribution of all contact, and the direct contact need to be answered immediately, there will be time slots where a lot of CSRs are required to handle the capacity and there will be time slots when the required capacity is low. CSRs need to work continuous shifts of around 8 hours a day, so in the off-peak hours the productivity of the CSRs will be low, if the number of incoming, direct contacts is low. A general used solution for this productivity problem is that the CSRs process indirect, low-priority, contacts in the off-peak hours (Gans et al., 2003). Therefore, there is a group of CSRs needed that possess both the skills for direct as for indirect contacts. This will increase the flexibility to absorb peak demand, increasing the accessibility and thus the customer satisfaction. From figure 5.4 we see that 85% of the contacts in 2014 were from direct contact channels and only 15% were via indirect contact channels. However, this does not show the division of the real work load between direct and indirect contacts.

Direct contacts can be completely handled if the customer asks for information or an action that can be processed easily. The first line CSR, the CSR that answers the direct contacts, is not always capable to complete the required action, since some actions require more time, education or authorisation to process. The solution for this at NS is that the first line CSRs create a service notification, which notifies the second line team that further action is required. The second line team, sometimes also referred to as Back Office, divides the work under the CSRs that possess the right skills. Second line work is another form of low-priority work, assumed that answering direct contacts has priority. In a new service system design, a second line that picks up more advanced actions is inevitable.

The future phases of the NS Klantenservice integration as illustrated in figure 1.4 show a blending of contact channels and front- and back office activities. All CSRs should be all-round in the end situation. It is not entirely clear whether all-round means able to serve all contact channels or able to perform all activities. Both are probably not feasible since some channels require different skills, e.g. social media requires fundamental different skills and attitude than telephone, and the number of activities are too many to educate them all to one CSR (C. van der Heijden, 2015). One could say that all-round CSRs should then only possess the frequently asked skills, but this conflicts with the earlier described productivity issues. We could agree that all CSRs are all-round when we define all-round as possessing skills for both high-priority contacts, like direct contacts, and low-priority contacts, like indirect contacts or second line work. In the design, we can vary how all-round a CSR should be, so this is one design parameter. In section 5.5 we elaborate further on this.

The second reason for integrating the contact centres was increasing customer satisfaction. As illustrated in the example cases in section 3.8, customers now sometimes are sent between CS departments. This is caused by the existing structure of NS in pillars: the employees see different parts of NS
really as different while the customer just sees the company NS. The current pillared situation limits first time right. Besides, information consistency can also be improved when the contact centres are really integrating in one contact centre. The same applies to opening hours, were in the old situation the different contact centres had different opening times, which can confuse the customer. Integrating the contact centres is likely to increase the customer satisfaction. The only danger is that by enlarging the number of activities handled in one contact centre, the operation becomes more complex and harder to manage. When the operation becomes a mess, the customer satisfaction will not increase. The service system design should structure the operation right, so it stays manageable and the mentioned customer satisfaction increase can be realised.

If we translate the two reasons that are given for integrating the contact centres into customer needs, customer satisfaction is already included in our needs. Customer service’s ultimate goal, as defined in definition 5, is to ensure customer satisfaction. In section 5.1, we gathered the needs customers search for in customer service. Therefore, fulfilling these needs should lead to customer satisfaction.

The second reason for integrating the contact centres is to gain efficiency. Efficiency is also part of the goals of NS Klantenservice, as illustrated in figure 5.2 by the higher goal We have cost awareness consisting of Efficient designed processes and Balanced costs and revenues. Therefore, we add efficiency as the customer need for the design from NS perspective. Looking at the goals of NS Klantenservice, we observe one more goal that should be translated into a customer need. NS Klantenservice defines Continuous improvement by customer response as goal of NS Klantenservice. In section 1.3, we identified a complete and consistent customer view as one of the means and challenges to improve service quality. When the NS wants to improves continuous, the customer can only be interpreted right if there is a complete and consistent customer view. Therefore, we add a consistent customer view as customer attribute to our design. The complete set of CAs is listed in figure 5.5.

\[
\begin{align*}
CA1 &: \text{Reliability} \\
CA2 &: \text{Responsiveness} \\
CA3 &: \text{Assurance} \\
CA4 &: \text{Empathy} \\
CA5 &: \text{Efficiency} \\
CA6 &: \text{Consistent customer view}
\end{align*}
\]

Figure 5.5: High-level Customer Attributes from both the customer as NS perspective

We now have analysed the needs from the customers and NS Klantenservice perspective. As given in Axiomatic Design, these customer needs form the what of the design. How the customer needs will be fulfilled is to be described in the next section, where the functions of the customer service system are discussed.

5.3. Functions of the customer service system

According to the Axiomatic Design, the functional requirements (FRs) and constraints (Cs) should satisfy the customer attributes (CAs). When we look to NS Klantenservice at the highest level, we could model the activities as illustrated in figure 5.6. The core business is to help customers with their individual need and turn them into handled customers without a need. As we defined in our scope, a customer can contact NS Klantenservice via five channels. In the current organisational structure, the contact channels are more or less a separate team. For this reason, we decompose the highest level function into five high-level functions: one for each contact channel. Each of these high-level functions should handle a customer contact. We define the FRs as illustrated in figure 5.7.

Each FR will be further decomposed in a separate subsection of this section. The decomposition is based on the ethnographic experiences of ourself. We checked these decompositions via informal
5. Analysis of the as-is situation of NS Klantenservice

![Diagram of highest-level IDEF0 model of NS Klantenservice](image)

**Figure 5.6**: Highest-level IDEF0 model of NS Klantenservice

| CA1 : Reliability          | FR1 : Handling of telephone contacts |
| CA2 : Responsiveness       | FR2 : Handling of live chat contacts |
| CA3 : Assurance            | FR3 : Handling of social media contacts |
| CA4 : Empathy              | FR4 : Handling of e-mail contacts |
| CA5 : Efficiency           | FR5 : Handling of paper mail contacts |

**Figure 5.7**: Definition of the high-level functions

The whole decomposition of the functional domain is given in figure C.3 on page C-2, where all lowest level FRs are underlined.

### 5.3.1. FR1: Handling of telephone contacts

We decompose the handling of telephone contacts into four FRs. When a customer calls, a CSR has to answer the call (FR11). Second, the customer has to be heard (FR12). The hearing of the customer contains of two sub functions: the identification of the customer question (FR121) and when the question requires the customer account details, the customer himself also has to identified (FR122). After the CSR knows what the customer needs, he can process the customer question (FR13). The processing contains of five sub functions. For information questions, the CSR can direct process the question (FR131) without any action. It might be the case that the customer question requires an action, this action could be direct executed by the CSR himself (FR132). It is also possible that the CSR cannot help the customer himself, in case he asks for help from a mentor who has more knowledge (FR133). When the customer should be processed directly, e.g. in case of retention of season ticket contract but the CSR has not the right skills, the customer can be transferred to a colleague who is a specialist (FR134). It might also turn out that such a specialist action is required, that the question cannot be processed direct. In that case, the CSR can create a notification to the second line where the question is processed later by specialists (FR135). The last step in handling a telephone contact is recording the contact details (FR14). We constructed a tree where all functions are displayed in a hierarchy in figure 5.8.

![Functional decomposition of handling telephone contacts](image)

**Figure 5.8**: Functional decomposition of handling telephone contacts

### 5.3.2. FR2: Handling of live chat contacts

We decompose the handling of live chat contacts into four FRs. When a customer opens the live chat via the webpage of NS, a CSR has to accept the conversation (FR21). After this, the CSR has to hear to customer (FR22), identify the customer question (FR221) and in some cases identify the
5.3. Functions of the customer service system

customer (FR222) to lookup his customer account details. Then, the question is processed (FR23) by
direct processing without any action (FR231) or by executing an action (FR232). In case the CSR has
not enough knowledge to help the customer, the CSR can ask a mentor for help (FR233). In some
cases, an action cannot be executed directly and a notification is created for the second line (FR234).
The team of specialist will process the question than on a later time. Eventually, the customer has an
option to receive a transcript of the conversation by e-mail (FR235). As a last step, the CSR records all
contact details (FR24). We constructed a tree where all functions are displayed in a hierarchy in figure
5.9.

In comparison with the handling of telephone contacts, a live chat conversation cannot be trans-
ferred to a different CSR. Because the conversation is written, it is possible to send a transcript of the
conversation to the customer by e-mail.

5.3.3. FR3: Handling of social media contacts
We decompose the handling of social media contacts into four FRs. The functions of social media are
similar to the functions of the other contact channels, but not all functions are used equally often in
social media. First, a social media message is accepted and opened (FR31). Then, the message is read
and the customer is heard (FR2). At social media, the customer question is posted very directly which
makes the identification of the question fast (FR321). Only in some cases, when the customer account
data is required, additional messages are needed to identify the customer (FR322). The question is
processed (FR33), which can be that only a reply is send where empathy is expressed, information is
provided (FR332) or an action is performed (FR333). In case of a more difficult question, the contact
can be handled with help from a mentor (FR334). When an additional action is required that cannot be
performed directly, a notification can be created (FR335). Only in case the customer contact information
is important to process the contact, the contact details are recorded (FR34). We constructed a tree
where all functions are displayed in a hierarchy in figure 5.10.

5.3.4. FR4: Handling of e-mail contacts
We decompose the handling of e-mail contacts into four FRs. E-mails are not entirely pre-sorted on the
content, some e-mails enter NS klantenservice in a generic box. These e-mails have to be classified
on subject so the right skilled CSRs can handle the e-mails (FR41). The handling of e-mails starts by
hearing the customer, which in this case is the same as reading the e-mail (FR42). With e-mails, both
the customer question (FR421) as the customer identity (FR422) are always identified. The processing
(FR43) of the question can be either performed by the CSR himself, with or without an action (FR431)
or with help from a mentor (FR432). In case of special action required, the CSR can create a notification
for the second line (FR433), where specialists pick up the conversation later. It might also be possible
that the initial classification of the e-mail occured incorrectly, in which case the e-mail is transferred
back to the classification process (FR434). When the question is processed, a reply is composed and
send to the customer (FR435). Finally, the contact details are recorded (FR45). We constructed a tree where all functions are displayed in a hierarchy in figure 5.11.

5.3.5. FR5: Handling of paper mail contacts
We decompose the handling of paper mail contacts into five FRs. The first step is that paper mail has to be sorted on letters that should be handled by NS Klantenservice and those who should be handled by other NS departments (FR51). Second, all paper mails that have to be handled by NS Klantenservice are classified on subject (FR52) so the right skilled CSR can handle the contact. The letter is read so the customer is heard (FR53). The customer question is identified (FR531). Like e-mail contacts, the identity of the customer is identified for all paper mail contacts (FR532). The customer question is processed (FR54), by direct handling the question with or without a required action (FR541). When needed, the question can be handled directly with help from a mentor (FR542). Actions that require specialists can be transferred to the second line via the creation of a notification (FR543). Eventually, a reply is composed and send to the customer (FR544). The last step is to record all contact details (FR55). We constructed a tree where all functions are displayed in a hierarchy in figure 5.12.

5.3.6. Synthesis of the functions
The decomposition of the customer contact centre functions in five contact channels show five sub-functions that have a lot of similar elements. Since we started the analysis this way, we first look to the required resources and skills in the same channel divided structure. However, as we will discuss in the last three sections of this chapter, the similar elements are to be combined so the channel dimension is reduced in the customer service system.

5.4. Customer cases as input for the Process Variables
A sequential following of the Axiomatic Design domains would continue with the physical domain. In the redesign phase, the process domain would be designed as last, since the domain follows from the functional and physical domain. We choose to continue the analysis with the process domain, because we want to include the evidence of the current situation to generate the PVs. We analyse the current system based on empirical evidence, which are customer cases gathered from the top processes. Therefore, we first discuss these cases, since the cases identify the resources and skills that are necessary to handle customer contacts. These resources and skills are the Design Parameters of the physical domain and are discussed in section 5.5.

The selection of the cases is based on top processes that we identified in section 4.3.1 and appendix B.2. For each contact channel, we selected a case for every top category. The selection of the cases is performed with the information stored in the databases, as described in section 3.7. To narrow our search, we selected only cases from one day, on Wednesday 17th of June. The date is chosen semi-random with three selection criteria. The date is within our earlier date range of the process description
(first half year of 2015), is on a weekday and is a day where no extreme external events occurred.

Table 5.1: Selected cases as Process Variables

<table>
<thead>
<tr>
<th>PV</th>
<th>Case ID</th>
<th>Channel</th>
<th>Process Description</th>
<th>Resources</th>
<th>Followup</th>
</tr>
</thead>
<tbody>
<tr>
<td>PV11</td>
<td>5013225889</td>
<td>Telephone</td>
<td>Information - Travel products</td>
<td>Self-service for customer</td>
<td></td>
</tr>
<tr>
<td>PV12</td>
<td>5013228909</td>
<td>Telephone</td>
<td>Information - Travel information</td>
<td>None</td>
<td>Self-service for customer</td>
</tr>
<tr>
<td>PV13</td>
<td>5013226004</td>
<td>Telephone</td>
<td>Information - Usage website</td>
<td>None</td>
<td>Self-service for customer</td>
</tr>
<tr>
<td>PV14</td>
<td>5013226648</td>
<td>Telephone</td>
<td>Information - OV Chipcard</td>
<td>SAP CRM</td>
<td>Together-service at station</td>
</tr>
<tr>
<td>PV15</td>
<td>5013226392</td>
<td>Telephone</td>
<td>Information - DDZ</td>
<td>Saleforce CRM</td>
<td>Notification for DDZ services</td>
</tr>
<tr>
<td>PV16</td>
<td>5013240806</td>
<td>Telephone</td>
<td>Terminal/Canc - Travel products</td>
<td>Save-skill</td>
<td>Self-service for customer</td>
</tr>
<tr>
<td>PV17</td>
<td>5013228148</td>
<td>Telephone</td>
<td>Refund - Request for restitution</td>
<td>SAP CRM</td>
<td>Creation of payment order</td>
</tr>
<tr>
<td>PV18</td>
<td>5013219102</td>
<td>Telephone</td>
<td>Refund - Correction for Check-In / Check-Out</td>
<td>None</td>
<td>Creation of payment order</td>
</tr>
<tr>
<td>PV19</td>
<td>5013227764</td>
<td>Telephone</td>
<td>Modify - Customer account information</td>
<td>SAP CRM</td>
<td>None</td>
</tr>
<tr>
<td>PV20</td>
<td>5013231278</td>
<td>Telephone</td>
<td>Check status - Termination</td>
<td>SAP CRM</td>
<td>None</td>
</tr>
<tr>
<td>PV21</td>
<td>5013236218</td>
<td>Telephone</td>
<td>Check status - Payment</td>
<td>SAP CRM</td>
<td>None</td>
</tr>
<tr>
<td>PV22</td>
<td>5013227571</td>
<td>Live chat</td>
<td>Information - Travel products</td>
<td>Change of bank account &amp; termination</td>
<td></td>
</tr>
<tr>
<td>PV23</td>
<td>5013230080</td>
<td>Live chat</td>
<td>Information - NS General</td>
<td>SAP CRM</td>
<td>None</td>
</tr>
<tr>
<td>PV24</td>
<td>5013231553</td>
<td>Live chat</td>
<td>Information - Travel information</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>PV25</td>
<td>5013231585</td>
<td>Live chat</td>
<td>Terminate/Canc - Travel products</td>
<td>SAP CRM</td>
<td>None</td>
</tr>
<tr>
<td>PV26</td>
<td>5013238802</td>
<td>Live chat</td>
<td>Refund - Correction for Check-In / Check-Out</td>
<td>SAP CRM</td>
<td>Creation of payment order</td>
</tr>
<tr>
<td>PV27</td>
<td>5013237333</td>
<td>Live chat</td>
<td>Refund - Request for restitution</td>
<td>SAP CRM</td>
<td>Creation of payment order</td>
</tr>
<tr>
<td>PV31</td>
<td>-</td>
<td>Social media</td>
<td>Punctuality</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>PV32</td>
<td>-</td>
<td>Social media</td>
<td>Travel information</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>PV33</td>
<td>-</td>
<td>Social media</td>
<td>Information - Travel products</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>PV34</td>
<td>-</td>
<td>Social media</td>
<td>Complaints - In train</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>PV35</td>
<td>-</td>
<td>Social media</td>
<td>Compliments - In train</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>PV41</td>
<td>5013229743</td>
<td>E-mail</td>
<td>Information - Travel products</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>PV42</td>
<td>5013230304</td>
<td>E-mail</td>
<td>Information - Usage website</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>PV43</td>
<td>5013227853</td>
<td>E-mail</td>
<td>Information - NS General</td>
<td>SAP CRM</td>
<td>More details from customer</td>
</tr>
<tr>
<td>PV44</td>
<td>5013227866</td>
<td>E-mail</td>
<td>Refund - Compensation for delay</td>
<td>SAP CRM</td>
<td>Creation of payment order</td>
</tr>
<tr>
<td>PV45</td>
<td>5013239382</td>
<td>E-mail</td>
<td>Refund - Request for restitution</td>
<td>SAP CRM</td>
<td>Creation of payment order</td>
</tr>
<tr>
<td>PV46</td>
<td>5013232993</td>
<td>E-mail</td>
<td>Refund - Correction for Check-In / Check-Out</td>
<td>SAP CRM</td>
<td>Creation of payment order</td>
</tr>
<tr>
<td>PV47</td>
<td>5013239402</td>
<td>E-mail</td>
<td>Refund - Cancel/Cancel - Travel products</td>
<td>SAP CRM</td>
<td>Cancel of OV</td>
</tr>
<tr>
<td>PV51</td>
<td>5013226901</td>
<td>Paper mail</td>
<td>Terminated/Cancel - Travel products</td>
<td>SAP CRM</td>
<td>Creation of payment order</td>
</tr>
<tr>
<td>PV52</td>
<td>5013218653</td>
<td>Paper mail</td>
<td>Refund - Correction for Check-In / Check-Out</td>
<td>SAP CRM</td>
<td>Creation of payment order</td>
</tr>
<tr>
<td>PV53</td>
<td>5013220338</td>
<td>Paper mail</td>
<td>Refund - Request for restitution</td>
<td>SAP CRM</td>
<td>Creation of payment order</td>
</tr>
<tr>
<td>PV54</td>
<td>5013226969</td>
<td>Paper mail</td>
<td>Check status - Payment</td>
<td>SAP CRM</td>
<td>None</td>
</tr>
</tbody>
</table>

Table 5.1 summarises all 38 cases we selected. Some channels handle more processes from the identified top processes of section 4.3 than others, which explains why there are more cases present from the telephone channel than from the paper mail channel. We will not discuss the cases themselves, but rather discuss the columns of the table. Since we choose the contact channels as a first decomposition level in the functional requirements, we also selected cases according to the different contact channels. The process column contain the categories within each contact channel as discussed earlier in section 4.3. All cases that we selected based on the SAP CRM system have a case ID number, this number is added in the table. Each selected case is analysed on content which is described briefly in the column description. The column resources is filled based on our ethnographic experiences. For the follow-up action, the larger context of each case is analysed. Some customers have multiple contacts recorded that regard one case, as we can read from the content of the customer contacts. After having selected all cases, we created a hierarchy tree. Since we already have all lowest nodes of the hierarchy tree (labelled in the column PV), the higher nodes are constructed by grouping cases with similar content. The entire PV structure is illustrated in figure C.3 (on page C-2), in which all cases are underlined as they form the lowest level of the process domain.

The required resources and follow-up actions of all cases are used as input for the physical domain. The 38 cases represent the most performed processes in each contact channel and are therefore taken as basis for the DPs. We continue with the DPs in the next section.
5.5. Skills and resources as Design Parameters

The cases in the process domain reveal resources and follow-up actions that were performed to process that case. Based on this, we constructed DPs which are divided into the five contact channels. Although we describe in our thesis two iterations of the Axiomatic Design method, we performed more iterations. In a smaller iteration we found that not all FRs could map on a DP, which indicates that there are DPs missing. We defined additional DPs to close this gap. Due to the added DPs, not all DPs map any more on the cases. This is no problem in the analysis phase, as the Axiomatic Design method focusses on the mapping of the functional and physical domain. We describe the DPs per contact level in the next sections. The complete hierarchy tree with DPs is illustrated in figure C.2 on page C-2, where all lowest level DPs are underlined.

5.5.1. DP1: Handling of telephone contacts

We constructed the DPs that handle the telephone contacts in a first-level hierarchy containing of five elements. The first DP is the basic set of skills and knowledge to serve the telephone channel. This contains the ability to use the telephone system, but also the basic knowledge of of NS services and the skill to search for knowledge (DP11). Next, we identified a special DP from the cases. This is the specific knowledge of door-to-door services and the corresponding Salesforce CRM system (DP12). The skills related to the SAP CRM system (DP13) are decomposed into four elements. A basic elements of the SAP CRM system is the skill to lookup customer account data and to register a customer contact (DP131). For processing contacts that require a refund, the skills and authorisation to use the payment system is required (DP132). For more difficult contacts that cannot be processes immediately, a notification is created in SAP CRM (DP133). Customers who want to end their season tickets are handled by CSRs with a sales/save skill (DP134). We identified this action as a separate DP, since customers can be transferred to a special pool of CSRs. A different type of special action is processing questions regarding to the UVB system (DP14). Here, fines for travelling on train without a valid ticket are registered. This application requires special training before one can use it. The last identified DP is the mentor duty, which is conducted by CSRs with an advance knowledge of the processes (DP15). We constructed a tree where all DPs are displayed in a hierarchy in figure 5.13.

![](figure5.13.png)

Figure 5.13: Decomposition of the physical domain that handles telephone contacts

5.5.2. DP2: Handling of live chat contacts

We decomposed the DP to handle live chat contacts into three elements. The first DP is the skill set and basic knowledge to handle live chat contacts (DP21). This contains the skill of handling the live chat application, but also the skill of chatting with customers and sending the conversation by e-mail to the customer. The basic knowledge of of NS services is also included in this DP. The DPs related to SAP CRM are decomposed into four elements (DP22). The basic functions of looking up information in the CRM system and registering a customer contact is captured in DP 221. A frequent performed action is to terminate season ticket contracts (DP222). Also, creating a payment order for refunding money is performed in the SAP CRM system (DP223). Questions that require more difficult action or
special authorisations can be forwarded to the second line via a notification (DP224). The creation of
a notification is done in SAP CRM. The last identified DP is the mentor duty (DP23). When the CSR
wants extra confirmation or is not entirely sure about his actions, the mentor can be asked for help.
We constructed a tree where all DPs are displayed in a hierarchy in figure 5.14.

5.5.3. DP3: Handling of social media contacts
We decomposed the DP to handle social media contacts into four elements. The first DP is the basic
knowledge and skill set to handle social media contacts (DP31). This includes the skill to use the
Coosto application, that is used for handling social contacts. Besides, the basic knowledge of NS
services and the skill to find additional information is included in this DP. Social media is different from
other channels because the responds are very visible. Therefore, CSRs have to possess the skill to
manage the reputation of NS and respond appropriately to the customer (DP32). DP321 is specified
as this reputation skill. We also identified three additional actions from the cases. Because social
media has an easier accessibility, more notions are reported by customers. When a follow up action is
needed, the CSRs have to create a notification to the responsible team. This can be notifications for
urgent cleaning (DP322), for a shortage on seating capacity (DP323) and for maintenance (DP324).
Only contacts whose recorded contact details are vital for the complete handling of the contact, are
currently recorded in the SAP CRM system (DP33). Recording the customer contact and looking up
customer account information are basic features of the SAP CRM system (DP331). Refunding money
is a special action in the CRM system (DP332), just as terminating a season ticket contract (DP333).
More complex questions can be forwarded to the second line with a notification (DP334). Questions
where the CSR is not entirely sure or wants to confirm his action are processed with the help of a
mentor (DP34). We constructed a tree where all DPs are displayed in a hierarchy in figure 5.15.

5.5.4. DP4: Handling of e-mail contacts
We decomposed the handling of e-mail contacts into five DPs. The first DP is the basic knowledge
and skill set for handling e-mail contacts (DP41). The basic knowledge contains knowledge about
NS services and how to find information regarding these services. This DP also contains the skills of
handling e-mail in the SAP CRM system. Before an e-mail can be handled, it needs to be classified
(DP42). Some e-mails are classified automatically on subject, based on the e-mail address it is send to
or the categorisation which is chosen by the customer. However, other e-mails are classified manually.
The handling of e-mails is performed in SAP CRM (DP43), which is decomposed into four elements.
All e-mails are linked to the customer account in the CRM system, so CSRs have to lookup customer
account data (DP431). This DP contains also the recording of the customer contact in the CRM system.
Specific actions as creating a payment order for refunds (DP432) and the termination of a season ticket
contract (DP433) are separate DPs. Besides, for more complex actions a notification for the second line
is created (DP434). The cases revealed a specialist action that was performed via e-mail: the handling
of a complaint about NS personnel (DP44). These type of specialist actions require more skills in how
to answer a complaint letter and what acceptable compensations are as apology. Last, CSRs can call for help from a mentor (DP45). This expert can help the CSR with on-the-spot issues. We constructed a tree where all DPs are displayed in a hierarchy in figure 5.16.

5.5.5. DP5: Handling of paper mail contacts
We decompose the handling of paper mail contacts into four elements. The first DP contains the skills and basic knowledge required for handling paper mail contacts (DP51). Paper mails are processed in SAP CRM, how to compose a reply via this system is part of the skills of this DP. The paper mails are archived in boxes, which is also part of the knowledge to process paper mail contacts. The knowledge of the NS services and the ability to search for more information forms the basic knowledge of this DP. Paper mails have to be sorted and classified (DP52). Sorting is necessary (DP521), because not all paper mails that enter the NS Klantenservice department are handled by NS Klantenservice. Some paper mails are destined for the legal, corporate communication or procurement department. All customer services letters are classified on subject, so they can be handled by the right-skilled CSRs (DP522). As mentioned, paper mails are handled in SAP CRM. Here, several actions can be performed which together form DP53. We decompose this DP further into four elements. Paper mail contacts are always linked to the customer account, so the CSR has to lookup the customer account data (DP531). Recording the contact details is included in this DP. Performing actions as the creation of a payment order for a refund (DP532) and terminating a season ticket contract (DP533) are common for paper mail contacts, as we also found in the cases. More complex questions that require specialist knowledge or special privileges can be forwarded to the second line by a notification (DP534). The support provided by the mentor forms the last DP in this decomposition (DP54). We constructed a tree where all functions are displayed in a hierarchy in figure 5.17.

![Figure 5.17: Decomposition of the physical domain that handles telephone contacts](image)

5.5.6. Synthesis of the physical domain
We decomposed the physical domain in the five contact channels. Here, we see a lot of low-level DPs that recur at all contact channels. Because of the initial decomposition into contact channels, similar DPs are present at all channels. In section 5.7, we restructure the DPs into contact channel generic and specific DPs. This iterative process is part of the Axiomatic Design method. Because we experienced this learning by doing, we also show the iterations in our thesis as it is vital to the AD method.

5.6. Overview of the Axiomatic Design artefacts
In the previous sections, we created all four domains of the Axiomatic Design. The complete hierarchical decomposition of the Axiomatic Design domains and the mappings between the domains are given in appendix C. We use the functional to physical domain mapping in the further analysis in the next section. There, we will see that some modifications of the first iteration AD artefacts are necessary.
Figure 5.18: Restructured design equation and full matrix of the FR / DP mapping
5.7. Analysis of the Independence Axiom in the first iteration

In the previous chapters, we created the four domains of the Axiomatic Design. Except the mapping of the CAs on the FRs, all mappings of the Axiomatic Design are created and displayed in appendix C. In this section, we analyse the FR/DP mapping and find no complications with the Axiomatic Design laws. However, due to our modellling we created unique DPs which are in fact not unique. After correcting for this modelling assumption, we do see a violation of the Independence Axiom. This leads to a second iteration of the analysis.

As stated in the Axiomatic Design method (see section 2.8 for the AD theory), the Independence Axiom must always be maintained in the AD. This is the case when the mapping of the functional on the physical domain is either uncoupled or decoupled, a coupled design is not acceptable. The original FR/DP mapping as given in figure C.4 is not sorted and therefore not usable for assessing the coupling. We shuffled the rows and columns of this mapping so the coupling can be assessed. Figure 5.18 shows this reshuffled matrix where all interactions displayed with an $\times$ are closely located near the matrix diagonal. Here we see five boxes with interactions, highlighted in the grey areas. Because the number of FRs is larger than the number of DPs, some pairs of FRs interact with the same DP. Besides this issue, the mapping shows a decoupled design. It is not perfectly uncoupled but we can satisfy the Independence Axiom. However, the five boxes should not surprise us. We decomposed both the functional as the physical elements in the first level in the five contact channels. The grey blocks represent the mapping of the FRs/DPs of each contact channel.

Our simplification in order to model the current situation creates a mapping where there is no real problem. This does not corresponds to the reality in two ways. First, we see coupling and complexity in the operation. Second, the unique DPs that represent unique resources and skills for each contact channel are in reality the same resources and skills. There is only one SAP CRM system that all contact channels use. There are more recurring DPs. In all channels, we find a DP that corresponds to the basic knowledge of the NS services and the basic skills for that channel. Also, we find five actions with the SAP CRM system that recur at every contact channel. Also, the mentor duty is a generic element in each contact channel. Last, we see that the classification of contacts on subject is done by both the paper mail as the e-mail channel. Since this is basically the same, we can also make this a generic element.

We replace the recurring, specific elements by generic elements with the mapping as given in table 5.2. The channel specific elements do not change, but we renumbered these DPs so the numbering is logic again. The basic knowledge DP is divided in the knowledge part, of NS services, and the basic skills of the channel. In this way, we can make a generic DP out of the basic knowledge DPs. We also divided the basic SAP CRM skills into the skills needed for registering a customer contact and the skill needed for looking up information. In the next sections, we first describe the generic DPs, then the contact channel specific DPs and last we synthesise our findings of the first analysis iteration.

<table>
<thead>
<tr>
<th>Former channel specific DP</th>
<th>Telephone</th>
<th>Live chat</th>
<th>Social media</th>
<th>E-mail</th>
<th>Paper mail</th>
<th>Generic DP</th>
</tr>
</thead>
<tbody>
<tr>
<td>DP11</td>
<td>DP21</td>
<td>DP31</td>
<td>DP41</td>
<td>DP51</td>
<td>DP61</td>
<td></td>
</tr>
<tr>
<td>DP131</td>
<td>DP221</td>
<td>DP331</td>
<td>DP431</td>
<td>DP531</td>
<td>DP621</td>
<td></td>
</tr>
<tr>
<td>DP132</td>
<td>DP222</td>
<td>DP332</td>
<td>DP432</td>
<td>DP532</td>
<td>DP622</td>
<td></td>
</tr>
<tr>
<td>-</td>
<td>DP223</td>
<td>DP333</td>
<td>DP433</td>
<td>DP533</td>
<td>DP623</td>
<td></td>
</tr>
<tr>
<td>DP133</td>
<td>DP224</td>
<td>DP334</td>
<td>DP434</td>
<td>DP534</td>
<td>DP624</td>
<td></td>
</tr>
<tr>
<td>-</td>
<td>-</td>
<td>DP42</td>
<td>DP522</td>
<td>DP625</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DP15</td>
<td>DP23</td>
<td>DP34</td>
<td>DP45</td>
<td>DP54</td>
<td>DP63</td>
<td></td>
</tr>
</tbody>
</table>

Table 5.2: Replacement of recurring channel specific DPs by generic DPs.

'-' indicates that the channel does not have a specific DP that maps on the generic DP.
5.7.1. Generic Design Parameters
We decomposed the generic DP (DP6) into four elements. The first generic DP is the basic knowledge of NS (DP61). This DP contains the knowledge of the core NS services, how the self-service website can be used and the skill to search for information to provide to the customers. The second DP is the skill to work with the SAP CRM system (DP62). In this system, we distinguish the ability to record a customer contact (DP621), to lookup customer account data like what product a customer has or what e-mail address is known at NS (DP622), how to create a payment to a customer (DP623), how to terminate a contract (DP624) and to create a notification for the second line (DP625). A third generic DP is the classification of a customer contact, so the contact can be handled by the right skilled CSR (DP63). The last generic DP is the mentor duty, which is a CSR with extensive knowledge (DP64). We constructed a tree where all DPs are displayed in a hierarchy in figure 5.19.

![Figure 5.19: Decomposition of the physical domain of the generic DPs. The specific DPs DP1-5 are decomposed in figure 5.20](image)

5.7.2. Contact channel specific Design Parameters
The introduction of generic DPs changed all DPs. Most of the DPs that we defined in section 5.5 are now represented by one of the generic DPs. Therefore, we redefine the remaining channel specific DPs. The total tree where all contact channel specific DPs are displayed in a hierarchy can be found in figure 5.20.

**Telephone channel (DP1)** is decomposed into four elements. To serve the telephone channel specific skills are required like how to use the telephone system and speaking techniques to handle a telephone call rapidly (DP11). A second DP is the D2D service knowledge and the skills to operate the D2D specific system Salesforce CRM (DP12). The skill to save a customer who wants to end his season ticket or to sell a season ticket is a separate DP (DP13). The last identified DP is the skill to operate the UVB system (DP14).

**Live chat channel (DP2)** is not decomposed further and contains solely the basic skills for live chats, like the technical skills to use the chat application and the conversation skills to ask the right questions to identify the customer question.

**Social media channel (DP3)** is decomposed into two elements of which one is further decomposed into four element. One DP is the skill and knowledge to use the Coosto application, the system where all social media contacts are handled (DP31). The second social media DP is the skill to handle social media messages and be aware of the reputation impact of the replies (DP32). This DP is decomposed in four elements, of which the first is the basic reputation management skill (DP321). From the cases, we identified three notifications that were created as follow-up action. These are a notification for urgent cleaning (DP322), a notification of too little seating capacity in the train (DP323) and a notification to the maintenance department because of defects at the station (DP324).

**E-mail channel (DP4)** is decomposed into two elements. One DP is the skills and knowledge to handle e-mail contact in SAP CRM (DP41). This also includes the skill to compose e-mail in the SAP application. The second DP is the handling of personnel complaints (DP42), which we identified on a case.

**Paper mail channel (DP5)** is decomposed into two elements. Paper mail has to be sorted on NS Klantenservice mail and mail for other NS departments (DP51). The second DP is the skill and
knowledge to handle paper mail contacts (DP52). This includes the handling of paper mail contacts in SAP CRM, but also the archiving of the paper mails in cabinets.

Figure 5.20: Decomposition of the physical domain of specific DPs. The generic DP6 is decomposed in figure 5.19

5.7.3. Synthesis of the first analysis iteration
In the first iteration, we reduced the number of DPs from 40 to 22. All DPs that are not contact channel specific are combined into generic DPs. The remaining contact channel specific DPs are added to this. The new FR/DP mapping is given in figure 5.21. Here, we identify three types of issues. In the blue box multiple FRs are highlighted that map on one DP. We also still see multiple DPs that map on one FR, as highlighted in the green box. The grey column is a DP that caused the FR/DP mapping to be coupled, because eight FRs map on this DP.

The mapping of the DPs on the PVs is not updated, since the PVs serve only as input for our analysis. The Axiomatic Design requires the independence of the FR/DPs, so we focus on the FR/DP mapping. In the next analysis iteration, we solve the identified issues.

5.8. Analysis of the Independence Axiom in the second iteration
Now we have iterated our analysis by creating generic DPs, the mapping of the DPs/FRs in figure 5.21 is more coupled. The reduced number of DPs also results in a matrix that is less square: the number of FR elements (45) is double the number of DP elements (22). The matrix tells us that quite some functions are produced by the same DP, one example of this is highlighted in the blue box. One conclusion of this could be that these functions together form one function, and that our decomposition was too deep. It is also possible that our first level of the functional decomposition (in channels) create second level functions that are similar across channels. We examine this in the next section. We see also DPs that are used only by one FR, an example is highlighted in the green box. This might imply that these DPs are in fact the same, but we separated them. We examine this also, in section 5.8.2. Reducing the number of DPs and FRs make a redesign easier, but is only useful when the design still contains the same information. The grey box highlights the DP with the most interactions, this probably causes problems when we want to uncouple the design. This problem is looked into in the redesign, in the next chapter.

5.8.1. Functions that are produced by the same DP
The mapping highlights nine sets of FRs that are produced by the same DPs. We discuss them in sets.

Directly processing of direct contact (without social) FR131, FR231 are two similar functions: the direct processing of customer contacts in the telephone channel (FR131) and live chat channel (FR231). Apart from the contact channel, these functions are exactly the same and can therefore be merged together. Live chat and telephone are both direct contact channels, so we call this combined FR the direct processing of direct contacts.

Starting and ending a live chat conversation FR21, FR235 are two functions from the live chat channel. Both functions have to do with the way-of-working of that channel: FR21 represents the accepting of a live chat request and FR235 represents the optional e-mailing the conversation to the customer. The functions are performed at different moments in the handling of a customer contact, at the start and at the end. We combine these two functions into starting and ending a live chat conversation.
Finishing an e-mail contact. \( FR434, FR435 \) are two functions of the e-mail channel. These functions are not complete similar. \( FR434 \) is the function that makes the customer receives a reply on his e-mail. With \( FR435 \), the e-mail is not finished at that moment, because it is send back to the classifiers to reclassify. For that moment, the e-mail is handled and has to go to the whole e-mail handling process again. Because these functions have an interaction with the same DP and the function is more or less the same, we merge them into the function finishing an e-mail contact.

Providing help to CSRs as mentor (without social). \( FR133, FR233, FR432, FR542 \) are similar functions among all contact channels, with the exception of social media. Customer contact can be handled with the help of a mentor when necessary and from our analysis we can conclude that this is the same for all channels. Social media contacts can also be handled with the help of a

![Figure 5.21: Restructured design equation and full matrix of the FR / DP mapping with generic DPs](image-url)
mentor, but here we see interaction with other DPs as well, specific for social media. For the other four channels, providing help to CSRs as mentor is combined as one function.

**Identifying the customer** FR122, FR222, FR322, FR422, FR532 are similar functions among the five channels. At indirect contacts, the customer is always identified because it is necessary for replying on his question. Direct contacts can sometimes also be handled without the customer is identified and his account details are loaded. However, when the identification of a customer is required, it is the same for all contact channels. Therefore, we combine these five FRs into the function identifying the customer.

**Directly executing of an action** FR132, FR232, FR541 are three functions where the contact is processed immediately by executing an action. From the mapping matrix we see that this function of the telephone, live chat and paper mail channel are produced by the same DP. Social media and e-mail also have this function, but we identified other types of actions in these channels, so the function of these two channels differ a bit. Therefore, we cannot include the functions of these two channels at this moment, but we will reconsider this in the redesign. The three functions are combined into the direct executing of an action.

**Creating a notification for the second line (without social)** FR135, FR234, FR433, FR543 are four functions that represent the creation of a notification to the second line CSRs of NS Klantenservice. This function is also present in the social media channel, but cannot be merged since we found that notifications that started with a social contact are also send to other parts of the NS organisation. This function is merged for the other four channels and named creating a notification for the second line (without social).

**Recording contact details** FR14, FR24, FR34, FR44, FR55 are five functions that are all the same. Since the details of every contact is recorded, with an exception of some social media contacts, it is logical to combine these functions into one element: the recording of contact details.

**Classify indirect contacts** FR41, FR52 are two similar functions: the classification of customer contacts on subject for e-mail and paper mails. Apart from the channel, the function is the same, making combining these functions into one function the matrix easier to understand.

### 5.8.2. DPs that full fill the same FR

The mapping highlights three sets of DPs that full fill the same FRs. We discuss them in sets.

**Specialistic action** DP12, DP13, DP14 represent three action that we identified via the cases. These actions are handling a customer with D2D service related questions, so it is handled in Salesforce CRM, retaining a customer who wants to terminate their contract and handling a question related to the UVB system. All these more special actions occur less often, because the volume of questions is less. We now identified these special actions as DP of the telephone channel, but in reality these action are not unique for the telephone channel. These DPs represent specific action that require specific knowledge and skills. Therefore, we group them into one DP that represent specialist skills.

**Notification to other NS departments** DP322, DP323, DP324 represent three notification actions that we identified from the cases via the Coosto application. As these notifications are similar, but differ from content, we simplify these DPs by replacing them by one DP. These three notifications are different from the notification to the second line, since these notifications go to other parts of the NS organisation.

**Common action via SAP CRM** DP623, DP624 represent two actions that are performed in the SAP CRM system: the terminating of a season ticket contract and the creation of a payment order. These two actions are also present in the top-10 processes as identified in figure 4.3, under the name Refund - Request for restitution | Correction for Check-In / Check-Out | Compensation for delay and Terminate/Cancel - Travel products. These actions are performed very often and via all contact channels. Although the actions are not the same, they show the same characteristics. In order to reduce the complexity, we group these two DPs as basic action skills.
5.8.3. Synthesis of the second analysis iteration
In the second iteration we examined the FRs and DPs again and grouped sets of elements. For the FRs, this means that the functions as defined in section 5.3 are not all unique for each in contact channel. Nine sets of functions are similar across the contact channels which implies that the channel dimension is removed and fully integrated into the Axiomatic Design. Three sets of DPs are also grouped in order to make the Axiomatic Design more high-level. The low-level elements that were included in the analysis due to the customer cases are transformed into mid-level elements.

5.9. Conclusions on the analysis
We analysed the NS Klantenservice with the Axiomatic Design tool. We gathered the high-level customer attributes by examining the existing internal documentation of NS and compared the customer needs with the needs we found from service quality literature. The final set of CAs consists out of customer needs from both sets of information. The translation of the CAs to the FRs is not done directly, because the high-level CAs lead to high-level FRs. Although the needs from the customer domain are not used directly in the AD, we use them in the design as they form some constraints and assumptions.

We analysed the more specific working of NS Klantenservice and therefore needed lower level functions. The functions are gathered by examining the real handling of the contact from the different contact channels. These functions are verified by CSRs via informal interviews. We gathered 38 real cases, chosen in such way that all top performed processes from each channel is included. These cases form the PVs in the Axiomatic Design. We then constructed the DPs by iterating through the PVs and FRs, so eventually all FRs are produced by at least one DP.

Our initial approach, by treating all contact channels as separate functions with separate DPs, lead to a decoupled design (figure 5.18). We saw that all interactions of a channel produced a FR/DP mapping with five blocks of interactions: the five channels. The assumption in this approach was that all channels have separate DPs, which does not corresponds with reality. We solved the modelling assumption in two iterations. First, we restructured the DPs, so all channel generic DPs interact with the FRs from all channels. This lead to a coupled design, as illustrated in figure 5.21. We also saw lots of FRs that all map on only one DP. This could mean that we did not have identified enough DPs or that we have to decompose that DP further. However, most of these sets of FRs are similar functions from different channels. Since we merged the generic DPs, it should not surprise us that there are generic functions. We discussed these sets of functions in section 5.8.1. We also see some sets of DPs that all map on only one FR. The same applies here: we should either further decompose the FR or we decomposed the DPs too far. We discussed the sets of DPs in section 5.8.2.

Merging the sets of FRs and DPs increases the readability of the AD artefacts, but does not solve the coupling problem. To comply with the Independence Axiom, we need an uncoupled or decoupled design. Figure 5.22 shows the FR/DP mapping after merging the discussed FRs and DPs. This matrix is used as starting point of the redesign. In this matrix, we see two coupling issues: the big blue box and the smaller red box. Both issues are handled in the next chapter: the redesign of the NS Klantenservice customer service system.
5. Analysis of the as-is situation of NS Klantenservice

\[ \begin{align*}
\text{FR11} & \quad X \quad 0 \quad 0 \quad 0 \quad 0 \quad 0 \quad 0 \quad 0 \quad 0 \\
\text{FR121} & \quad X \quad X \quad 0 \quad 0 \quad 0 \quad 0 \quad 0 \quad 0 \\
\text{FR131,231} & \quad 0 \quad X \quad 0 \quad 0 \quad 0 \quad 0 \quad 0 \quad 0 \\
\text{FR221} & \quad 0 \quad X \quad X \quad 0 \quad 0 \quad 0 \quad 0 \quad 0 \\
\text{FR21,235} & \quad 0 \quad 0 \quad X \quad 0 \quad 0 \quad 0 \quad 0 \quad 0 \\
\text{FR321} & \quad 0 \quad 0 \quad X \quad X \quad 0 \quad 0 \quad 0 \quad 0 \\
\text{FR31} & \quad 0 \quad 0 \quad 0 \quad X \quad 0 \quad 0 \quad 0 \quad 0 \\
\text{FR531} & \quad 0 \quad X \quad 0 \quad 0 \quad X \quad 0 \quad 0 \quad 0 \\
\text{FR544} & \quad 0 \quad 0 \quad 0 \quad X \quad 0 \quad 0 \quad 0 \quad 0 \\
\text{FR421} & \quad 0 \quad 0 \quad X \quad X \quad 0 \quad 0 \quad 0 \quad 0 \\
\text{FR434,435} & \quad 0 \quad 0 \quad 0 \quad 0 \quad X \quad 0 \quad 0 \quad 0 \\
\text{FR332} & \quad 0 \quad X \quad 0 \quad 0 \quad 0 \quad X \quad 0 \quad 0 \\
\text{FR331} & \quad 0 \quad 0 \quad 0 \quad 0 \quad X \quad 0 \quad 0 \quad 0 \\
\text{FR334} & \quad 0 \quad 0 \quad 0 \quad 0 \quad X \quad X \quad 0 \quad 0 \\
\text{FR133,233,432,542} & \quad 0 \quad 0 \quad 0 \quad 0 \quad 0 \quad X \quad 0 \quad 0 \\
\text{FR122,222,322,422,532} & \quad 0 \quad 0 \quad 0 \quad 0 \quad 0 \quad 0 \quad X \quad 0 \\
\text{FR333} & \quad 0 \quad 0 \quad 0 \quad 0 \quad X \quad 0 \quad X \quad 0 \\
\text{FR132,232,541} & \quad 0 \quad 0 \quad 0 \quad 0 \quad 0 \quad 0 \quad X \quad X \\
\text{FR431} & \quad 0 \quad 0 \quad 0 \quad 0 \quad 0 \quad 0 \quad X \quad X \\
\text{FR134} & \quad 0 \quad 0 \quad 0 \quad 0 \quad 0 \quad X \quad X \quad 0 \\
\text{FR135,234,543,433} & \quad 0 \quad 0 \quad 0 \quad 0 \quad 0 \quad 0 \quad 0 \quad X \\
\text{FR335} & \quad 0 \quad 0 \quad 0 \quad 0 \quad 0 \quad X \quad 0 \quad 0 \\
\text{FR51} & \quad 0 \quad 0 \quad 0 \quad 0 \quad 0 \quad 0 \quad 0 \quad X \\
\text{FR34,44,55,14,24} & \quad 0 \quad 0 \quad 0 \quad 0 \quad 0 \quad 0 \quad 0 \quad X \\
\text{FR52,41} & \quad 0 \quad 0 \quad 0 \quad 0 \quad 0 \quad 0 \quad 0 \quad X \\
\end{align*} \]

Figure 5.22: Compressed design equation and full matrix of the FR / DP mapping of the analysis
6

Customer Service Redesign

We described the current situation of NS Klantenservice in the previous chapter in Axiomatic Design terminology. Here, we saw a coupled design, implying that improvements are necessary. This chapter has two goals. First, we start with decoupling the design: solving the coupling issues in terms of AD (section 6.1). Second, we create an organisational design for NS Klantenservice. For this, we translate the AD artefact into a process diagram that shows how a customer contact flows through our design (section 6.2). The process diagram is an easier to read artefact and shows the distinct functions we create. These distinct functions are produced by corresponding skills. How should the pool of CSRs be designed so all the skills are present in the right amount in the organisation? The answer on this question will be our organisational design and the answer on our research question (section 6.3).

6.1. Decoupling the design

The analysis of the previous chapter ended with the as-is situation of NS Klantenservice. The AD artefact of this situation in figure 5.22 shows two boxes of elements that cause the design to be coupled. The larger, blue square is the major piece that causes a coupled design. Within the blue square we find the red box where there is a second coupling. The coupled design follows from Theorem 1 of Suh (1995, p.208) which states: When the number of DPs is less than the number of FRs, either a coupled design results, or the FRs cannot be satisfied.. The coupled design is a trial-and-error design, the FRs cannot be produced in a way that the designer decides, since the FRs are dependant on each other. We solve the coupled design in two phases: first we solve the blue box in section 6.1.1 and second we solve the red box in section 6.1.2.

6.1.1. Basic knowledge of NS services

The blue box in figure 5.22 is caused by one DP which has interactions with lots of FRs. This is DP61, the grey box of figure 5.21. DP61 represents the basic knowledge of NS services. This DP has an interaction with every channel, especially with the functions represent the identification of the customer question. Besides, the direct information provision function is also produced by this DP. In order to reduce the coupling, we treat this DP as a fundamental DP: without basic knowledge about NS services and skills to identify the customer question a CSR is not able to serve the customer. Therefore, we create a constraint in the functional domain that represents this generic function of providing information and communicate professionally with the customer. We assume that each CSR possesses the basic knowledge and some basic training in the CSR job. This is a precondition before a CSR can work in the customer service operation, in our design. The earlier combined FRs FR131, FR231 have only an interaction with the basic skills and knowledge DP. As described in section 5.8.1, the combined function of FR131, FR231 represents the direct processing of contacts by providing information. We can combine the DP that interactions with the direct processing of contacts function with the preconditional DP we created. Direct providing information is thereby also included in the preconditional skills of a CSR.

When we remove the interaction of specific FRs with DP61 and replace this with the interaction of the constraint with DP61, we see five six of FRs that now only have interactions with the same DP. We
discuss them in sets. The FRs marked with an asterisk (*) are FRs that previously had an interaction with the basic knowledge DP61.

**Starting a conversation (telephone)** FR11, FR121* are two functions that are performed at the start of the handling of a telephone contact. We distinguished the technical skills to answer a call as a function (FR11) and the human skills on how to identify the customer question at this channel as a function (FR121). Now the basic knowledge is given as a fixed constraint, these two functions utilise the same DP. We compress these two FRs into one function, which can be seen as the parent function of both functions. We call this function the starting a conversation function on the telephone.

**Starting and ending a conversation (live chat)** FR21, FR235, FR221* are the earlier compressed function starting and ending a live chat conversation (FR21, FR235) and identifying the customer question on the live chat channel (FR221). Since the basic knowledge of NS services is a constraint, all these functions are produced by the same DP. The functions are all slightly different, but grouping them under a higher level function makes sense as the three functions lie close to each other. When we see the identification of the customer question as part of the starting of a conversation, we group these FRs into starting and ending a conversation on the live chat channel.

**Read the message (social media)** FR31, FR321* are two functions performed at the start of the handling of a social media contact. Opening the message (FR31) and identifying the customer question (FR321) follow up each other naturally, that we can group them into the higher level function reading the message. Given the knowledge constraint, one DP produces this higher level function, so we group these two functions.

**Directly processing contact (social media)** FR331, FR332* are two other functions specific for social media contacts. On social media, a large part of the contacts are only from people who want to express their, often negative, experiences with NS (FR331). Replying on these contacts require additional empathy skills, but other than that these contacts are processed directly. FR332 represents the handling of informative questions, where empathy is also important, but needs to be supplemented by the NS basic knowledge. The latter is given as a constraint, so both functions are similar in terms of the needed DPs. The functions now the same, so we combine them into the function direct processing of social media contacts.

**Reading the message and finishing the contact (e-mail)** FR434, FR435, FR421* are the earlier compressed function finishing an e-mail contact (FR434, FR435) and identifying the customer question (FR421). As with other channels, it is logical to group the channel specific functions into one higher level FR. With the basic knowledge as given DP for all contacts, identification of the customer question only requires some additional channel specific skills. These specific skills are also needed for finishing the contact, so we group the three functions together in reading the message and finishing the contact for the e-mail channel.

**Reading the message and composing a reply (paper mail)** FR544, FR531* are two functions from the paper mail channel for starting and finishing a customer contact at that channel. Identifying the customer question (FR531) is needed at the start of the contact handling and composing a reply (FR544) at the end. Now we have made using the basic knowledge and conversation skills a constraint, these functions have only an interaction with the paper mail channel specific DP. Starting and ending are not entirely the same functions, but can be grouped together under the higher level function reading the message and composing a reply at the paper mail channel.

By removing a DP that interacts with a lot of functions, the basic skills and knowledge to help a customer, and making this DP a precondition in the design, one coupling issue is solved in the Axiomatic Design. The solution of making certain skills and knowledge mandatory for each CSR is realistic in our view. It is normal in organisations to ask a certain level of education before an employee is able to perform this job. In plain language, this is what we applied on the Axiomatic Design.
6.1.2. Decoupling the social media reputation DP

Although we solved the larger coupling issue in the previous section, we remain with a coupled design. The red box of figure 5.22 highlights the coupling we discuss in this section, which we zoom into in figure 6.1. In order to make a decoupled design, we discuss two solutions. The solutions concern mainly three functions: Providing help as a mentor for social media (FR334), executing an action in SAP CRM for social media (FR333) and the direct processing of a contact for social media (FR331, FR332*).

\[
\begin{align*}
\end{align*}
\]

Figure 6.1: Partial design equation of the FR/DP mappings showing the remaining coupling

Solution 1: Integrating the social media functions

One solution to the coupled design would be to integrate all social media functions into one function. The three mentioned functions FR334, FR333 and FR331, FR332* (earlier grouped into one function) could be grouped as one function. This would create a decoupled AD, as illustrated in figure 6.2. The number of FRs and DPs are then equal, reshuffling the order enables a decoupled design.

The question is whether this solution is realistic. Although the three functions are all part of the same hierarchy (FR33x, handling the contact of social media contacts), not all functions of this hierarchy are included. FR335 stays a separate function in our design. Does it make sense that all contact handling with SAP CRM functions of social media are grouped together, except the creation of notifications in SAP CRM to the second line? Four social media cases that we picked in section 5.4 and need SAP CRM indicate that the combination of the four functions make sense. However, after consulting a mentor, we found out that all contacts still have to be processed. This indicates that grouping the three functions does not make sense. We assess this solution as infeasible, since the design solution does not match the reality. Therefore, we look to the second solution for this problem.

\[
\begin{align*}
&\{\text{FR122,222,322,422,532, FR132,232,541, FR431}\} & \{\text{DP622, DP623,624, DP42, DP321}\}
\end{align*}
\]

Figure 6.2: Partial design equation of the FR/DP mapping solving the coupling with solution 1

Solution 2: Reducing the need of the social media reputation management skill

In this solution, we decouple the design by changing two functions: providing help as a mentor for social media (FR334) and executing an action in SAP CRM for social media (FR333). Both functions now have an interaction with the social media reputation management skill (DP321). However, executing one of these two functions happens behind the scenes: the customer does not see what happens. The result of the function is communicated to the customer, where the social media reputation management skill is needed. Separating the functions behind the scene and the function of communicating the result implies that we remove the interaction of FR333 and FR334 with DP321. The result is that these two functions have only one interaction left, like two other functions that we previously grouped. We discuss the functions in sets. The resulting design matrix for this solution is illustrated in figure 6.3.
Directly executing of an action (without e-mail) FR333 represents the execution of an action in SAP CRM. We earlier grouped FR132, FR232, FR541 together as the function direct executing of an action. This direct execution is also performed in SAP CRM, so we conclude that all these functions are similar and the channel does not make a difference. Only the e-mail channel already had an interaction with a different DP, this is because we identified a specialistic function/action for this channel.

Providing help to CSRs as mentor FR334 represents the provision of help at the social media channel. We earlier grouped FR133, FR233, FR432, FR542 together which represents the same function for the other channels. Now we split the provision of help from the communication of the result, there is no difference between these functions. Therefore, we combine the five functions to the function providing help to CSRs as mentor, independent from the contact channel.

Synthesis of the social media decoupling
We proposed two solutions to solve the coupled design caused by the social media functions. In the first solution, we proposed to merge three functions related to social media contacts. This would solve the coupling issue, but results in a design that does not represent the reality. In the second solution, we re-examined the interaction of the FRs and DPs. We saw that two social media functions are solely background functions, the customer does not experience this functions since the functions are performed between the operation. These background functions of social media do not require social media reputation management skills, which enables to merge the background functions with similar functions of the other contact channels. This solution is realistic and chosen as solution to our coupling issue.

6.1.3. Conclusions on decoupling the design
We started this section with the twofold problem in our design: two changes are needed in order to make the design decoupled. We tackled this problem by making the DP basic skills and knowledge of NS services map on a constraint in the design, a precondition to possess for each CSR. It is logical to say that some skill level is required before a CSR can perform any action. This solution brought the coupled design back to a smaller problem.

For the remaining coupling problem, we proposed two solutions to come to a decoupled Axiomatic Design. The first solution would merge three social media related functions. The AD would be decoupled in the model, but would not match the situation in reality. This makes the first solution infeasible and we therefore reject the solution. The second proposed solution to the problem split the functions behind the scenes of the social media channel with the functions that interact with the customer. With this solution, we can regroup the background functions of social media with similar functions of other channels. This creates also a decoupled design, which is consistent with the real situation. Therefore, we select the second proposal as solution to the coupling problem of social media functions.

The final design matrix of the FR/DP is given in figure 6.4. We renamed the (grouped) FRs and DPs and created a new, final hierarchy. The hierarchy and description of elements is given in table 6.1. The design equation of the FR / DP shows a decoupled design, which satisfies the Independence Axiom of the AD. That the AD artefact shows a successful design in term of AD is great, but does not completely answer our question how NS Klantenservice should be redesigned. We need to translate
the AD artefact to a more understandable format for management and need to design how the CSRs going to produce the DPs. The latter is a real useful artefact for NS, because then they know how they should manage the organisation according to our Axiomatic Design. We continue this design chapter with the translation of the AD artefact. After that, we design how the skills (DPs) should be allocated to the CSRs.

Table 6.1: Final hierarchy and description of the FRs and DPs

<table>
<thead>
<tr>
<th>FRs</th>
<th>Description</th>
<th>Former FRs</th>
<th>DPs</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>FR1</td>
<td>Pre-sorting paper mails</td>
<td>FR51</td>
<td>DP1</td>
<td>Sort paper-mails</td>
</tr>
<tr>
<td>FR2</td>
<td>Classifying indirect contacts</td>
<td>FR52,41</td>
<td>DP2</td>
<td>Classify incoming indirect contacts</td>
</tr>
<tr>
<td>FR3</td>
<td>Starting a conversation (telephone)</td>
<td>FR11,121*</td>
<td>DP3</td>
<td>Basic skills &amp; knowledge telephone channel</td>
</tr>
<tr>
<td>FR4</td>
<td>Starting and ending a conversation (live chat)</td>
<td>FR21,223,221*</td>
<td>DP2</td>
<td>Basic skills &amp; knowledge live chat channel</td>
</tr>
<tr>
<td>FR5</td>
<td>Reading the message (social media)</td>
<td>FR31,321*</td>
<td>DP2</td>
<td>Basic skills &amp; knowledge social media channel</td>
</tr>
<tr>
<td>FR6</td>
<td>Reading the message and composing a reply (paper mail)</td>
<td>FR44,531*</td>
<td>DP2</td>
<td>Basic skills &amp; knowledge paper mail channel</td>
</tr>
<tr>
<td>FR7</td>
<td>Reading the message and finishing the contact (e-mail)</td>
<td>FR541,542</td>
<td>DP2</td>
<td>Basic skills &amp; knowledge e-mail channel</td>
</tr>
<tr>
<td>FR8</td>
<td>Directly providing information</td>
<td>Constraint, FR131,-231*</td>
<td>DP3</td>
<td>Basic skills &amp; knowledge NS services</td>
</tr>
<tr>
<td>FR9</td>
<td>Identifying the customer</td>
<td>FR122,222,322,422,532</td>
<td>DP4</td>
<td>Lookup customer account information (SAP CRM)</td>
</tr>
<tr>
<td>FR10</td>
<td>Directly executing of an action (without e-mail)</td>
<td>FR132,232,332,541</td>
<td>DP5</td>
<td>Directly providing information</td>
</tr>
<tr>
<td>FR11</td>
<td>Directly processing contact inc. action action (e-mail)</td>
<td>FR431</td>
<td>DP6</td>
<td>Directly providing information</td>
</tr>
<tr>
<td>FR12</td>
<td>Directly processing contact (social media)</td>
<td>FR31,322*</td>
<td>DP6</td>
<td>Directly providing information</td>
</tr>
<tr>
<td>FR13</td>
<td>Directly transferring call to specialist (telephone)</td>
<td>FR134</td>
<td>DP6</td>
<td>Directly providing information</td>
</tr>
<tr>
<td>FR14</td>
<td>Providing help to CSRs as mentor</td>
<td>FR133,233,334,432,542</td>
<td>DP6</td>
<td>Directly providing information</td>
</tr>
<tr>
<td>FR15</td>
<td>Creating a notification for the second line (without social)</td>
<td>FR135</td>
<td>DP6</td>
<td>Directly providing information</td>
</tr>
<tr>
<td>FR16</td>
<td>Creating a notification for the second line (social)</td>
<td>FR335</td>
<td>DP6</td>
<td>Directly providing information</td>
</tr>
<tr>
<td>FR17</td>
<td>Recording contact details</td>
<td>FR34,44,54,14,24</td>
<td>DP6</td>
<td>Directly providing information</td>
</tr>
</tbody>
</table>

Table 6.1: Final hierarchy and description of the FRs and DPs

Figure 6.4: Final design equation of the FR / DP mapping, showing a decoupled Axiomatic Design.
6.2. Translation of AD to process diagrams

Now we completed the Axiomatic Design, the AD artefacts have to be translated into better understandable artefacts for management. The AD matrices and hierarchy trees are abstract and are a model representation of NS Klantenservice. The process diagram of this section is still a representation, but is more intuitive due to the visual representation of the different functions. The diagram shows a generic model for all customer contacts that are handled by NS Klantenservice. We use this process diagram to further design the organisation in section 6.3.

Our design in AD terminology as described in table 6.1 consists out of six first-level functions. We translate these functions one-to-one to process blocks, as illustrated in figure 6.5. Not all contacts go through all process blocks, some contacts take a shortcut. For example information questions on the telephone do not require the identification of the customer or any action executed by the CSR. Other contacts, like all contact son the live chat channel, are not sorted classified on subject. These shortcuts are illustrated in the diagram with a dotted line between the process blocks. We discuss the process diagram per function block.

**FR1: Sorting & classifying** allocates the customer question based on the subject to the CSR with the right knowledge and skills. Our analysis looked only to the functions that are provided by CSRs. E-mail and paper mail contacts are currently sorted and classified by a specific group of CSRs. Telephone contacts are classified on subject by the customer themselves: when a customer calls NS Klantenservice it has to make a choice in the IVR menu. Depending on the menu choice, the customer is handled by a certain CSR with the required skills. We can conclude that the IVR menu works as classifier for telephone contacts, so telephone contacts use the shortcut in our diagram. We put the IVR menu in italics as resource for this process, to emphasise the function of the IVR menu as a classifier - but outside our system. Live chat contacts are currently not classified, so these contacts use the shortcut. Social media contact are partly classified by the Coosto application. These contacts also use the shortcut in our diagram. The need of classification is heavily depending on how we allocate the skills among the CSRs. When all CSRs are able to process all contacts, classification on subject is not needed.

**FR2: Channel specific handling** represents all activities that are used specific for that channel. This are only basic skills, like how to use the channel specific system for answering the call, accepting the conversation and reading the message. Besides these skills, there are also different conversation skills needed per channel. The telephone is perfect for a conversation, this is also...
possible with live chat, but with e-mails and paper mails it is not efficient to ask questions to clarify the question. This can be solved by using one of the other channels when this is needed: for example make an outbound phone call to customer to ask additional questions regarding his e-mail. This option creates constraints on our organisational design: if we want to include this option in our design all CSRs have to possess the telephone specific channel skill.

**FR3: Directly providing information** is the function where, based on the basic skills and knowledge, the customer question is heard and possibly handled directly. Some questions only require knowledge, for example providing information about the different type of season tickets or information about disrupted international train services because of strikes in other countries. CSRs do not have to know all information by heart, but can also search for the right information in a knowledge management system. However, some knowledge is required about the NS services and what question requires what follow-up action. When no action is required, the contact can take the shortcut in our diagram to the last process, else it always has to identify the customer in the next process block.

**FR4: Identifying customer** is a separate function before an action is executed. Actions are changes at a customer account, season ticket contract, refund for a specific trip, so the personal information of the customer is required. Identifying the customer happens in the SAP CRM system, where all customer data is present. International travellers are currently not logged in SAP CRM, but in the sales system of NS International. Data migration to one CRM system is on the planning, which we assume as finished in this design. Until then - the brownfield situation NS Klantenservice is in - both systems need to be available for identifying the customer. Customers are recognised by a combination of their zip code, address, date of birth and name. For some actions identification is needed based on the OV Chipcard number.

**FR5: Processing contact with action** is a function which could be decomposed in multiple sub-functions, which we also have done in the AD design in table 6.1. To increase the readability, we show only one function in this diagram. There are several actions possible: more common actions like terminating a contract in SAP CRM or creating a payment order for refunding money, more specialist actions like selling a season ticket or handling complaints and social media actions where NS reputation is more vulnerable. CSRs can also ask for help from a mentor and then complete the action himself. Some actions can only be performed by CSRs with special skills or privileges. The first line CSR can then create a notification to the second line, so the question is handled later. The first line CSR still have to handle the contact, so the customer is informed. In all case the contact flows to the next process.

**FR6: Recording customer details** is the last step in handling a customer contact. Recording the contact details has multiple purposes: NS Klantenservice can see when a customer had an earlier contact and about what subject, but this information is also used to have insight what customers in general contact NS Klantenservice for. It might be that because of an action of a different NS department, for example marketing send out a proposition, lots of customers contact NS Klantenservice. For the NS it is valuable to know how much customers contact in response to this action, so improvements can be done. The registration should be done in the same CRM system as where the customer are identified in. In the current situation, the most contacts are registered in SAP CRM, but most NS International contact are not as mentioned before. Besides, only the social media contacts are registered where a follow-up action is required or where for other reasons the recording of the contact details is important. To have a full view of the customer, all social media contacts should be recorded or these messages should at least be somehow linked to the CRM system.

The biggest improvement of our design compared to the existing situation is that we include all contacts via all channels in one design. Currently, the contact channels are used as classifier to determine how a contact is handled. We removed the channel dimension as classifier, as the channel does not lead to a fundamental different handling process. By integrating all activities in one process diagram, the NS Klantenservice operation is less complex and easier to understand.
Through what processes a customer contact flows, depends on the content of the contact. Some processes are always used, others are only used for specific contact channels (sorting & classifying) or when an action is required. The shortest path through the process flow diagram is $FR_2 \rightarrow FR_3 \rightarrow FR_6$. Some actions in $FR_5$ are specialist and rarely used, other actions are used often. A design that allocates the skills to (groups of) CSRs should include the contact volumes, so we know how often a skill is needed. In addition, the accessibility of NS Klantenservice has also taken into account. The customer attributes (sections 5.1 and 5.2) poses requirements, like a 24/7 available customer service and the ability to be flexible in what channels are served, so peak volumes can be handled. How these requirements are to be fulfilled is not described in this diagram. Therefore, we continue with the organisational design. Because of the reduced complexity and better knowledge of the operation, we are able to create an organisational design that includes all required skills of CSRs in one design.

6.3. Organisational design for NS Klantenservice

We now know what functions are present in the new design and what resources each function needs. This is a first step in answering our question, but not the last. We need to translate the functional design into a design that tells us what CSRs perform what activities. To do this, we first describe the assumptions and constraints we place the design in. Subsequently, the design space of the possible solutions is described. Then, we focus on trade-offs that are present in the decision-making. Finally, we present our design with a substantiation of our choices.

6.3.1. Assumptions on the design

In order for NS Klantenservice to operate as one integrated department, of which the Service+ activities are combined in a subunit (see our scope in section 1.6, we state four constraints and assumptions that are used as starting point for the design.

The most important constraint is that all applications are harmonised. In the current situation there are some systems used for the same functionality, like a separate telephone system for each contact centre. In the to be designed situation, we assume that this functionality is provided by one telephone system. The same applies to the CRM system. Not all activities that are included in our scope are currently recorded in the same CRM system and some activities are not even recorded at all. In our design we assume that all contacts with customers are recorded in a CRM system, regardless of the chosen contact channel. This include the contact via social media, which requires quite some modifications on the current, brownfield situation. This is however a requisite to have a fully integrated customer view and deliver personalised customer service.

A second constraint on the design is an integrated and complete knowledge management system. In such a system, CSRs can find the latest and most up-to-date information regarding details of services and what procedures have to be followed for certain actions. In the current situation, some CSRs work with a knowledge management system depending of their (former) contact centre. Not all information is available in a knowledge system and not all CSRs have access to all the information that is present, because of the use of multiple systems. Integrating these multiple systems is also mentioned in the previous constraint, but assuring that all the information is also available in such a system is a separate constraint.

An assumption that leads to the optimal usage of the production capacity is that the operational management has access to real-time information about the performance of the contact centre. This will enhance the effect of the design. The design is directed to create a smart organisational structure that allows for flexible deployment of CSRs. Having real-time information present on the work floor allows the operational management to exploit the benefits of the design maximal.

The last assumption is the hardest to define but crucial to the applicability of the uniformity of the design. We assume a harmonised culture between the former contact centres. By this, we mean that CSRs have the same thoughts about how autonomously they can handle, when to take initiative, how much they can learn from each other and what flexibility is common in the organisation about working hours and work activities. Means for this are common labour conditions like procedures of
holiday planning, work schedules and how to plan a day off. Harder to change is the mindset, when long-serving employees are used to perform certain activities in a particular way or have gained unofficial privileges. These ingrained habits have to be reset to match the new, flexible organisational design.

All these the above mentioned constraints and assumptions receive attention at NS Klantenservice. The three last points are to be worked on at the moment. The integration of systems is also part of the larger integration of contact centres project, but we assess that it might take more time to complete all systems integration. Especially the use of the same CRM system for all activities including social media will probably take some years.

6.3.2. Design space of the organisational design

In the introductory chapter, we described the scope of the organisation in section 1.6.4. There, we already identified one variable that defines our design space: the number of skill sets of each CSR. With the knowledge we gained from the analysis, we can now define two other variables. Not only the number of skill sets is a variable in the design space, but also the number of skills that form one set. Besides, NS Klantenservice serves five different channels, which is also a variable. When we plot the design space based on these three variables, we obtain a three dimensional space as illustrated in figure 6.6. The configuration of our design should be somewhere inside the box.

![Figure 6.6: Complete design space of the three variables](image)

The three dimensional design space makes it hard to find the right solution. Luckily, the axiomatic design provided insights that can reduce the design space. Initially, we treated the five contact channels as separate functions of the system. By iterating through the design we saw that a lot of functions of each contact channel is similar. Eventually, we created a diagram where all functions of the NS Klantenservice operation are present as illustrated in figure 6.5. In that diagram, the contact channel specific functions and skills are included in one function. The five contact channels are transformed into skills. This reduced the number of variables in our design space from three to two.

The two remaining variables have different metrics. The number of skills that form one skill set is a variable that has probably a different answer per skill set. In the extremes, all skills are either put into one skill set or each skill set has one skill. Both extremes are very unlikely to be optimal. The number of combinations in between are numerous, since the not all skill sets have to contain the same number of skills. The same applies for how to skill sets are divided among the CSRs. Giving all CSRs the same skill set is an extreme point, as dividing all skill sets among groups of CSRs. Both extremes are not plausible to be optimal. Not all groups of CSRs have to possess the same skill sets or the same number of skill sets. The distribution of the number of skill sets among the CSRs has probably more a distribution as given in figure 6.7. Only a few CSRs have a large number of skill sets, since training a lot of skill sets is expensive for NS. The majority of CSRs has a handful of skill sets, the skills needed
to process a large part of the customer contacts.

In section 6.3.4 and further the choices of our design are elaborated in this design space. What skills form a skill set is defined by our design. We also make a proposal for how the skills sets could be combined, so we obtain certain groups of CSRs that possess certain skill sets. Before this, we look to the trade-offs that have to be made in the design.

6.3.3. Trade-offs in the organisational design
Trade-offs are inherent to decision making, but explicit naming the trade-offs makes the decision making process more transparent. Therefore, we describe three trade-offs.

Skills per agent vs training costs
One of the initial goals of integrating the four contact centres is to increase the flexibility of the operation. Translated to our design space, this means that we cannot distribute the skill sets in such way that every CSR has only one skill set. A CSR is only flexible when he can be deployed at multiple processes. A CSR should thus be trained in multiple skills. Even when it is possible to learn all skills to one CSR, this is very costly. Training means that the CSR cannot be deployed in production, but the person has to be paid. Learning all skills to all agents is not the only way to increase the training costs. When there are many different skill sets, each taught to a small number of CSRs, the number of training classes increases which is also costly. Form this trade-off we conclude that the number of CSRs with the same skills sets should not be too small, but also that the flexibility has to be reached efficiently.

Number of specialistic actions vs handling speed
Looking from the efficiency point to the customer service centre, it might be very efficient when every CSR performs one activity as in a production hall. Besides the previous discussed point of flexibility, too much different stations in the handling process increases the handling speed. CSRs might become more efficient when they are better skilled in certain activities, but every station increases the total handling time. Because we deal with a service instead of a product, each contact is somewhat different (the heterogeneity aspect of services) and every station has to spend a bit time to understand the variety in the contacts. A longer handling speed has two down sides. For the organisation it is more expensive, since there is less production in a hour. For the customer, a longer handling time is not preferable. Besides, every change in stations, every new CSR that handles a part of the case, there is a chance that the question is interpreted wrongly or a mistake is made. The chance of failure increases at every station, which leads to not delivering the service and decrease the first-time-right. Both a lower first-time-right and a too long handling speed decreases the customer satisfaction, the primary performance indicator of service quality.
6.3. Organisational design for NS Klantenservice

Fixed teams vs flexibility
Assigning CSRs to fixed teams, with a fixed team leader, makes it easy to manage. CSRs have only one contact person for their questions and their performances are monitored by the same person. This is easy to understand for CSRs and give more bounding to their team. However, fixed teams conflict with the desired flexibility. In order to be flexible, CSRs have to be able to perform other activities when the operation requires this. With fixed teams, in the current situation front office or back office activities with certain skills, this is hard to achieve. When all CSRs are allround skilled and the operational is maximum flexible, having fixed teams is hard to achieve. The word team should contain a new meaning in order to match the flexibility. A team is not any more a group of CSRs that always perform the same tasks, but for example can be a group of CSRs that possess the same skill sets. This does not mean that CSRs with the same skill sets perform the same activities at the same time. When the skill set of the group consists out of set A en B, it is possible that CSR1 is deployed on activities that require set A and CSR2 on activities that require set B. A fixed team leader can still be present, so the CSR performances can be monitored by the same person and it is also clear who the first contact person is.

6.3.4. The design solution principles
Our design solution is based on three principles. The most important principle is that we create modules, a set of skills, that can be combined in different configurations. Each module in our design corresponds to one resource of the process diagram in figure 6.5. The resources represent the DPs from the AD. Combining modules results in a group of CSRs with a certain skill set. The management has to determine the minimum capacity of each module. How many contacts can be processed when all CSRs that possess that specific module are deployed on the module specific skill? Due to the desired flexibility, CSRs have in general multiple modules so they can handle different type of contacts. Maximizing the capacity of one skill has implications for the capacity of an other skill. However, when we define the modules and define what combinations are possible and how many CSRs have what combination, all variables are known. In theory, making a work schedule that includes all the variables can be performed easily with software. In practise, preferences of employees also play a role in what is possible. Still, by defining what CSRs possess what skills and using this information in a planning system, it is easier to have an overview of the possibilities to run and adjust the operation.

A second principle in the design is that all CSRs are trained in what we call a basic skill. The basic skill enables CSRs to handle information questions via the telephone channel. This choice is explained in two ways: why the telephone channel and why information questions? As displayed in figure 5.4, more than 70% of all customers contact NS Klantenservice via telephone making this channel by far the largest channel in terms of contact volume. Besides, when there occur unplanned events, the volume of this channel increases most. Customer want a direct answer, so the use a direct contact channel (telephone, live chat and social media). It might be that the volumes of the indirect contact channels (e-mail and paper mail) increase also, e.g. customers want to have a refund for delay, but this volume increase happens after the incident. At the moment of the incident, the direct contact channels receive an increased volume of contacts. The live chat channel volume is currently regulated: when no CSR is free the link to the live chat application on the NS website is not available. An increase of contact via live chat can therefore be regulated. Social media cannot be regulated and from past experiences we know that this channel also receives more contacts during incidents. Information questions from the base of other questions. In order to perform the right action, the CSR has to understand the situation. What is common in the normal situation and what is specific for this customer question? This assessment is necessary, so the CSR already has to be able to handle the informative questions. Therefore, we say that handling information questions is a basis skill of every CSR.

The last principle in our design is the differentiation between what we call high-priority contact channels and low-priority contact channels. Low-priority contact channels are the e-mail and paper mail channel. High-priority contact channels are telephone, live chat and social media. This explicit differentiation is made because this emphasises where the ad hoc flexibility comes from. The direct contact channels have priority when the contact volumes increase because of an unexpected incident. The low-priority contacts can than be put on hold and continued later when the incident is over. This means that ideally all CSRs that can handle low-priority contacts, also have to possess the skills to handle high-priority contacts. Because we defined the principle that all CSRs possess the telephone
channel skill, this is already the case.

### 6.3.5. Modules of our design

The modules, one of the principles described in the previous section, are all separate skills that we have identified earlier. These separate skills are the resources as used in the process diagram in section 6.2 and also correspond to the DPs of the final Axiomatic Design in table 6.1. The design consist out of 23 modules, which are illustrated in figure 6.8. These modules are the most used modules at NS Klantenservice, but because we only included the most used processes in our analysis and design there are some more modules present. The modular design can be supplemented with modules that we did not include in this thesis, or in the future with new modules which are currently not present. The 23 modules contain skills that by now should be recognisable from the previous sections, so we only describe the motivation for these modules shortly. For this, we look at the six functions of the process diagram in figure 6.5.

<table>
<thead>
<tr>
<th>Legend: modules originate from process diagram function:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Post sorting</td>
</tr>
<tr>
<td>Post classifying</td>
</tr>
<tr>
<td>E-mail classifying</td>
</tr>
<tr>
<td>E-mail: contact &amp; technical skills</td>
</tr>
<tr>
<td>Paper: contact &amp; technical skills</td>
</tr>
<tr>
<td>Basic knowledge &amp; skills: NS terms / information questions</td>
</tr>
<tr>
<td>Telephone: contact &amp; technical skills</td>
</tr>
<tr>
<td>Lookup customer account data (SAP CRM)</td>
</tr>
<tr>
<td>Action 2nd line: Claims</td>
</tr>
<tr>
<td>Action 2nd line: Contracts</td>
</tr>
<tr>
<td>Action 2nd line: OPB</td>
</tr>
<tr>
<td>Action 2nd line: Custom work/complaints</td>
</tr>
<tr>
<td>Action supportive: create 2nd line notification</td>
</tr>
<tr>
<td>Action supportive: mentor duty</td>
</tr>
<tr>
<td>Action supportive: register customer contact (SAP CRM)</td>
</tr>
<tr>
<td>Action rare: create 2nd line season tickets</td>
</tr>
<tr>
<td>Action rare: Social media reputation management</td>
</tr>
<tr>
<td>Action rare: Terminate OPB</td>
</tr>
<tr>
<td>Action rare: Tickets NS International</td>
</tr>
</tbody>
</table>

**FR1: Sorting & classifying** is the function that requires three modules as a resource. *Post sorting* is also a DP (DP11) in our Axiomatic Design. DP12 from the AD is split up into two modules: *Post classifying* and *E-mail classifying* form together the DP *Classify indirect contacts*. The sorting module is used to filter NS Klantenservice mails from other NS department mails. The classification of the paper mails and e-mails are currently done manually. Classification is used to route the contact to the group of CSRs with the right skills for that type of question.

**FR2: Channel specific handling** is decomposed in the AD into five elements: the five contact channels. Each contact channel has a corresponding DP (DP21 - DP25), which are all translated into modules. For each channel, the module is named as *Contact channel contact & technical skills*. The contact skills are skills like making a conversation on telephone, writing a proper letter and knowing what you can say when you chat or send a message via social media. The technical skills are then the skills that are needed to operate the specific channel software, like the telephone system, social media application and the application where e-mails are handled.

**FR3: Directly providing information** maps on DP3 in the AD. The corresponding module here is *basic knowledge and skills: NS terms and information questions*. Knowledge about NS terms, how the OV chipcard works, how to travel with other train operators and searching the knowledge management system are all skills that are combined into this module.

**FR4: Identifying customer** is the function where the customer account is lookup (DP4). This is also the module, looking up the customer account data in SAP CRM. Included is the knowledge of
what information is needed from the customer like the postal code, date of birth or OV chipcard number, so the SAP CRM system can make a unique match.

**FR5:** Processing contact with action is decomposed into several sub elements in the AD. There are lots of actions that can be performed. In principle, each action that requires different knowledge and skills is one module. We created four types of modules for actions. First, there are supportive actions like creating a notification for the second line. Just as asking help at the mentor, this supportive action is one module each. All actions that cannot be performed immediately or do take too much time to be a first line action, are modules that start with action 2nd line. Currently at NS Klantenservice, there are four types of second line actions: handling claims that are not standard, handling contract questions that are not standard, handling customer tailored questions which are mostly complaints and OPB, which are specific actions customer account data, e.g. closing the account after a customer has deceased. All actions that can be handled immediately are divided into two type of modules based on the frequency. Action often are actions that occur often and form a large part of the volume of contacts, like modifying the customer account data, terminating a season ticket contract or issuing a refund. The action rare modules can still occur on a daily bases, but the volumes are much smaller. The three included modules from this type are ticket sale for NS International trains, safe and sale for season ticket contracts and the actions that follow from social media reputation management.

**FR6:** Recording customer details is currently performed in the SAP CRM system and maps on DP6 in the AD. The ability to fill in the right information is combined into one module: register customer contact in SAP CRM.

### 6.3.6. Design solution layout

The 23 modules are grouped together according to the principles we described in section 6.3.4. There are five types of groups, which we explain according to the layout as illustrated in figure 6.9.

**Basic knowledge & skills to handle information questions on telephone channel**

- **Mail room**
- **Supportive actions to answer customer specific questions**
- **Often asked actions to handle customer specific questions**
- **Skills of other channels**
- **Rare asked actions and 2nd line/specialistic actions**

**Skill set of CSR**

![Design layout of the five type of module groups](image)

**Basic knowledge & skills to handle information questions on the telephone channel** *(yellow)* are the group of modules according to the principle we described that all CSRs are able to handle information questions on the telephone channel. This first group of modules is also the first layer in the CSR skill set. This layer is required before a CSR can proceed with adding other modules to his skill set.
Mail room (full blue) is a group of modules that is special, because CSRs with this skill set do not handle a contact. These modules are a prerequisite for a orderly handling by other CSRs. Therefore, the layer does not recur at other layers and the CSRs who possess this skill set will normally not grow further to more skills. In the current situation, the group CSRs working at the mail room are a fixed team. In the new design this team stays the same. The mail room just provides a proper routing of the indirect contacts.

Skills for basic actions (red) are the next group of modules that is trained to CSRs. This layer is divided into the supportive action modules, that are required to possess before the often asked action modules are added to a CSR's skill set. It is not necessary that all often asked action modules are trained at once, that is why this group is shaded with diagonal lines. This layer can be the end point of a CSR learning path, depending on the required capacity for certain modules and the career perspective a CSR has, the CSR can grow to the next layer. For this, all often performed actions have to be added to the CSR's skill set.

Multi channel (striped green) is the next, optional layer after the two mandatory layers. Here, a CSR learns the modules that make him deployable at multiple channels. Because the basic, information question can already be answered just as the frequent performed actions, the CSR is able to handle a large share of the type of contacts at the new channel. This layer is also a possible end-point of a CSR's learning path. The layer is shaded with diagonal lines to emphasise that not all modules have to be trained to a CSR, before the CSR continues to the next layer.

Rare asked and second line actions (striped blue) is the last group of modules. This layer builds on the previous, mandatory layers and multi-channel layer. The modules in this layer can be combined, when all the modules are trained to a single CSR then this CSR becomes really allround deployable. All specialist, second line action modules are placed in this group. Also the rare asked direct action modules are placed in this group. As this layer is the last in our layered and modular design model, CSR's learning path is completed at this layer.

Only the yellow and red coloured groups are mandatory for each CSR. The green and blue striped groups are additional modules. Especially the blue striped elements work as modules. After learning a module of this group, the CSR can apply this module to all contact channels it possesses the modules of.

Our design solution layout follows from all the knowledge we gained during the thesis project. The layout is in general consistent with the ideas we heard from NS Klantenservice staff members (Balster, 2015) and is our creative solution of the organisational design problem. We validate our solution in chapter 7 to assess how good the design solution is.

6.3.7. Synthesis of the design layout and modules
Placing all the 23 modules in the design layout completes the design artefact. This artefact is displayed in figure 6.10. We also visualised how the learning path of a single CSR could look like in figure 6.11.

The learning path shows the partial sequentiality of the modules. Some modules are a prerequisite of the next level of modules, like the basic knowledge and skills in this scheme. However, the number of coupled modules should be reduced to as minimum as possible, to retain the largest flexibility in the organisation. The further a CSR is trained on his learning path, the larger skill set that CSR possesses. The NS Klantenservice staff has the role to forecast the required capacity of each module in the future. When the current capacity is not enough, new employees have to be hired or, for modules that require mandatory modules, existing employees can be trained in new modules.
6.3. Organisational design for NS Klantenservice

Figure 6.10: Design layout with layers and all modules

<table>
<thead>
<tr>
<th>Telephone skill + providing direct knowledge + executing most performed actions</th>
<th>Additional skills of channels</th>
<th>Specialist</th>
</tr>
</thead>
<tbody>
<tr>
<td>CSR1.1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CSR1.2</td>
<td></td>
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<tr>
<td>CSR1.3</td>
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<tr>
<td>CSR2.1</td>
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<tr>
<td>CSR2.2</td>
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<td>CSR2.3</td>
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<td>CSR2.4</td>
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<td>CSR2.7</td>
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<td>CSR3.1</td>
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<td>CSR3.2</td>
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<td>CSR3.3</td>
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<td></td>
</tr>
<tr>
<td>CSR3.4</td>
<td></td>
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</tr>
</tbody>
</table>

Figure 6.11: Proposed learning path of CSRs
6.4. **Conclusions on the customer service redesign**

We started this chapter with the Axiomatic Design artefact that we left behind after the analysis phase. The analysis of the as-is situation identified two coupling problems, which are solved in section 6.1. The design in Axiomatic Design matrices and hierarchies is completed in that section and helps us a great step towards the main goal of our thesis: creating a customer service system design that improves the service quality. The AD artefacts do however not completely solve our organisational design. For this, we translated the AD into a process diagram that is applicable for the entire NS Klantenservice operation in section 6.2. This process diagram leads to the organisational design in section 6.3.

The organisational design is formed around assumptions and constraints. The design space is given and the trade-offs that are present in the organisational design are discussed. The design solution is created according to three principles, which are discussed. The process diagram of section 6.2 reveals resources that make sure each customer contact can be handled successfully. These resources form the modules of our design. Last, the modules are placed in a layout so a hierarchy in the modules is created. The modular design solution forms the answer of how the NS Klantenservice organisation should be designed. We also proposed learning paths for CSRs that can be used in the organisation. These proposed learning paths have to be aligned with the management view on the desired capacity and flexibility.

This design is compared with the outcome of our evaluation and validation workshop in the next chapter. The constraints and assumptions that have to be met before this design can be used are discussed in chapter 8.
Evaluation and validation of the analysis and service design

In the previous chapters, we analysed the as-is situation of NS Klantenservice and redesigned the organisational part of the customer service system. As the design science literature prescribes, the design has to be evaluated. To do this we first discuss the evaluation criteria in section 7.1. Most of the design evaluation is done on the validity criterion, for which we organised an expert workshop. The setting of this workshop is described in section 7.2. We validated our analysis with the expertise of professionals (section 7.3). Besides, we let the expert group create an own design solution (section 7.4), which is used together with the experts feedback to validate our design solution (section 7.5). Last, we make conclusions on the design evaluation according to the evaluation criteria in section 7.6.

7.1. Evaluation criteria

To assess the value of the design artefact, we need to evaluate the design on criteria. The Axiomatic Design method dictates that the Independence Axiom assesses whether the design is satisfactory and thus acceptable. The Information Axiom is used to evaluate how good the design is. We did include the Independence Axiom in our thesis and our design satisfies with this axiom. The Information Axiom is out of scope, because this evaluation method requires that the requirements and design are expressed in quantitative values. We did not express our design in values or ranges, which makes it impossible to evaluate according to the Information Axiom.

Because we cannot evaluate directly on criteria based on the Axiomatic Design, we take a step back and look to our design approach. The guidelines from the design science research field give us some general criteria for evaluation. For design science studies, the criteria should address the artefact’s validity, utility, quality and efficacy (Gregor & Hevner, 2013). Our design does not comprise the entire information system of NS Klantenservice, we focussed on the organisational elements of the customer service system. Therefore, our criteria need to match the design scope. Palmius (2007) developed a framework for comparing and measuring information systems. This framework comprises 70 criteria that are operational and measurable, so they can be used for evaluation. Palmius divided the criteria in five categories: organisation, individual, information, technology and systemics.

From the criteria sets of Gregor and Hevner and Palmius we select the following nine evaluation criteria:

1. **Validity:** This criterion from Gregor and Hevner (2013) should assess the face-validity of the conceptual models. Are all major functions represented in the process diagram of section 6.2? The same applies for the modular design. With the validity, we make sure our models represent the situation of NS Klantenservice so we can assess how useful the solution is.

2. **Utility:** This criterion from Gregor and Hevner (2013) says something about whether the design can be used. Is it a realistic solution for the problem?
3. **Efficacy:** This criteria criterion both from the general evaluation criteria (Gregor & Hevner, 2013) as from the Palmius (2007) criteria list. Palmius placed this criterion under the system properties. The efficacy assesses whether the solution actually solves the problem it was intended to solve.

4. **Knowledge management:** Palmius (2007) placed this criterion under the organisational control criteria. The criterion focusses on how the information is stored in the organisation. Do individuals possess tacit knowledge and information, or is information accessible for the entire organisation?

5. **Flexibility:** Palmius (2007) placed this criterion under the organisational control criteria. The criterion focusses on how easily the system is capable to be modified for future needs.

6. **Manageability:** Palmius (2007) placed this criterion under the organisational control criteria. The criterion assesses whether the system supports the management of the organisation.

7. **Customer satisfaction:** Palmius (2007) placed this criterion under the organisational economy criteria. The criterion assesses whether external customer are happy.

8. **Productivity:** Palmius (2007) placed this criterion under the organisational economy criteria. The criterion assesses whether the system supports production in a satisfactory way.

9. **Learning:** Palmius (2007) placed this criterion under the individual emancipation criteria. The criterion focusses on whether the individual has the opportunity to develop skills to understand the system.

Since we do not deploy a real system or have a prototype version, not all criteria can be evaluated. Customer satisfaction (criterion 7) is one of the drivers of our problem and can only be measured after implementing the system. We do not evaluate on this criterion. Criteria 4, 5 and 8 are similar to the assumptions and design solution principles we described in section 6.3. These three criteria are included in the design. The design can still be evaluated on how the knowledge is managed and how flexible and productive the organisation really is, but this can only be measured by comparing a the existing performance with the performance in the new situation. This evaluation is not feasible in our study. We see the criteria 6 and 9 as important points that have to be taken into account, but which cannot be evaluated at this stage. In the discussion, we come back on the manageability of the organisation and the need to educate the users of the system.

The three remaining criteria are used to evaluate our design: validity, utility and efficacy. We performed an expert workshop session that gives us information on the validity of our design. The utility is also evaluated based on the feedback from this workshop. In section 7.6, we conclude on these two criteria and use this conclusion to evaluate on the efficacy of our design. Before we validate the analysis and design, we shortly describe the workshop setting in the next section.

### 7.2. Workshop setting

On Friday the 9th of October we organised a three hours during validation workshop. We presented this workshop and facilitated the creative session. The group of experts contained five members. Paul Likumahuwa is external project manager assigned with integrating the contact centres. His knowledge of the integration project contains high-level goals and strategic decisions, and looks mainly from the management perspective. With his knowledge of other customer contact organisations, he brings a lot of in-the-field experience of what is common in customer service systems. Sulaiman Tariq is project manager, manager of the staff department and deputy director NS Klantenservice. His knowledge is also broad but has a better view on the operational needs from the staff perspective. He also knows a lot about the IT systems used at NS Klantenservice. Stefanie van Orsouw is internal Lean consultant for NS. Her expertise lies on internal procedures and employees capabilities in terms of what support they need to perform their job well. Stefanie is extensively involved in the Werkwijzer NS Klantenservice project, which focusses on how the NS Klantenservice operation should perform in order to serve customers best. Her Lean expertise brings the view of the customer in the group. Paul, Sulaiman and Stefanie where present the whole workshop.
Jeroen Wensing is trafficker of NS Klantenservice and trainer for other traffickers on what their added value is for the operation. He has a lot of knowledge on the operational management of the customer service operation. His perspective is on how the several subunits of the operation can be controlled and how the direct and indirect customer contacts should be handled. Sjorstun Paula is team coach of the back office domestic. He has expertise on the specific processes and activities that are performed by CSRs. As team coach, he also knows what the operation needs for information in order to manage the employees. Jeroen and Sjorstun also had the intention to attend the entire workshop, but had to leave after the first part due to unforeseen, operational circumstances.

The whole workshop was video taped, so we are able to listen back to specific comments made during the workshop. The first part of the workshop contained a presentation about our subject of study, the scope, a short introduction of the Axiomatic Design method and the outcome of the analysis. The goal of this part was to receive feedback on the process diagram as illustrated in figure 6.5. The diagram is discussed in detail, so we could use the feedback as substantiation for the validation of this part. The experts listened to our presentation while we explained our analysis. The group gave feedback during the presentation in an interactive way, when all questions were handled we proceed to the next slide. Section 7.3 is written based on the first part of the workshop.

In the second part of the workshop we introduced the 23 modules which are used in the design chapter 6. We provided cards with text on it of all the modules, so the group could shuffle the modules as they liked. Figure 7.1 shows how the group could use their creativity to come to a design solution. We provided the group also the design assignment: Create a design where all the skills (modules) are present. Which groups of CSRs do you create and what skills should they possess? Don’t forget the needs of the organisation as a flexible operation. During the group creativity session, we observed the discussion between the experts. After the experts created their design, we discussed similarities and differences between their design creation and our design. The expert design is discussed in section 7.4, the further group discussion is the bases of the design validation in section 7.5.

### 7.3. Validation of the analysis

The feedback we gathered from the expert workshop is taken as input for the validation of the analysis. We did not validate the Axiomatic Design artefacts, because these matrices are very technical to understand. We did explain the AD method and emphasised its focus on the independence of the functional domain. The validation is based upon the process diagram as described in section 6.2. We describe the analysis validation per function block. Claims based on the workshop are not substantiated separately.
by a reference, all the claims of the group of experts are based on the workshop by Likumahua, van Orsouw, Tariq, Wensing, and Paula (2015).

**FR1: Sorting & classifying** are basically functions that provide the routing of contacts. The group noted that the IVR is a technical feature to provide routing of contacts, but the use of multiple telephone numbers is basically the same. NS Klantenservice has multiple telephone numbers which are communicated to the public: a separate number for consumer and business customers and for international trains. Since we only included the functions and actions that are provided by NS Klantenservice employees, this routing method is outside our scope. A second notice are regarding the e-mail contacts. Currently, a part of the volume of e-mails are handled by Webhelp. These e-mails are routed based on the online contact form where customers type their question and answer predefined questions about the subject of their question. The predefined categorisation based on the subject is used as input for the automated routing of e-mails. The e-mails that are not automatically routed, are classified and routed by NS Klantenservice agents. Based on the feedback, we conclude that this function is valid. All remarks made are on additional features that are outside our scope.

**FR2: Channel specific handling** is divided into technical and contact skills. The feedback of the group was mainly on the phrasing of the terms. We originally used the words *conversation skills* to represent the contact skills. Because the word conversation is linked to the telephone, the feedback was that contact skills is more channel neutral. Further, the group had specific questions which term covers the differences in handling time per channel. This is covered under the contact skills, a different telephone system will not require a new training about changed handling times. A subject as the handling time is closely related to the companies policy, just as how formal or informal the contact tone is. Therefore, we place these elements under the contact skill per channel. The group raised more questions, e.g. on where the ability to write a correct spelled letter is covered. This is also an example of a channel specific contact skill. After discussing some practical examples, the group agreed that there are channel specific skills and that for training purposes the division in separate elements is useful. We conclude that this function is valid.

**FR3: Directly providing information** is divided into a part regarding knowledge and a part that mainly focusses on the skill of using the knowledge management system. The group agreed that some hard knowledge is required, but that an optimal organisation should pursue a minimum amount of required knowledge. The knowledge management system is vital to work with a minimum hard knowledge. There was a small discussion about how the organisation should cope with system failure of such system. Although this is an important point, the vulnerability of a single-point-of-failure is not in our scope. The design should describe the organisational arrangement, where each feature provided by a system is incorporated in one system or application. A second discussion about this topic was about the usage of the knowledge management system. Some people agreed that in principle every customer question has to be searched in this system, every time. This ensures information consistency and that out-dated information does not exist. Others felt that this is practically impossible, because CSRs will learn some information by hard after a while. The discussion is interesting, but does not contribute to the validation. The fact that the group agreed on these skills of this function is taken as basis to conclude that this function is valid.

**FR4: Identifying customer** is a single function. The group did not have much question about this function, because the function is very clear. Only the compulsivity of this function was discussed, because it was not clear for everyone that not always the customer needs to be identified. With the possible shortcut from the previous function to the last function, this question is clear and the function is valid.

**FR5: Processing contact with action** is the largest functions which also caused the most discussion. Part of the discussion was about the phrasing and word choice. Originally we divided the actions in three groups, actions that occur often, actions that do not occur often (which we called specific) and actions that cannot be handled immediately and are handled by the second line. The phrasing of specific actions received the most comments. They linked specific actions to
the type of knowledge and skills that is required to perform the action. The difference between specific and specialist, which we used to describe these actions, is too thin. The group agreed on the differentiation of actions that can be handled immediately and actions that require more time (the second line actions). Whether or not an action can be handled immediately also depends on the contact channel. Direct contacts should be performed in a short time, because the direct availability of CSRs is essential for incoming direct contacts. The differentiation in action volume is possible, but for the phrasing it is better to use often used and rarely used. Special or specialist actions are preferably used for actions that require more heavy skills and some room for interpretation and freedom. Often, specialist (second line) actions require some time to investigate the customer specific situation, for example to verify a disputable refund claim. The group did agree on the presence of these differentiated functions, but recommended to change the wording. The supportive actions did not raise questions, so after the use of less ambiguous wording of the actions we conclude that this function is also valid.

FR6: Recording customer details is the last and also mandatory function of each customer contact. The compulsivity of this function was asked specifically. We emphasised our opinion on the need of recording all customer contacts, also the social media contacts which are not recorded at the moment. The group agreed on this statement and went even a bit further. A short discussion took place about what other companies in the field recorded in their CRM. One of the latest developments was to record not only the contact content, but also to record more features about the customer himself. This is called emotional recording, because the customer emotion is assessed, recorded and used. Does a specific customer always call with an aggressive tone? It might be that some CSRs are better at handling one emotion, while others are better at handling another emotion. This development is discussed further in our recommendations, but is left out of scope since we want to be as close as possible to the current, brownfield situation. We conclude that this function is valid.

Because all the functions are validate individually, we take the validation of our analysis as true. This implies that the expert group agreed on that all contacts follow in principle the same flow and that all channel differences can be reduced into a single skill specific for that channel.

7.4. Design artefact of the group workshop

Because the analysis is validated by the group of experts, we did not have to change any of the modules as illustrated in figure 6.8. Therefore, the experts made an own design with the same modules as we did in the previous chapter. The same group of experts did already discuss our analysis, so in our opinion their understanding of the modules was to a good level.

Figure 7.2 shows the design as created by the group. We describe this design in six groups. In the next section we compare our own design with this group design configuration.

Mail room modules are placed outside the design, because the group agreed that these functions should not be performed by CSRs. It is still possible to send paper letters by mail, but this channel does not differ from e-mail. Paper mails should be scanned automatically, so there is no physical difference with e-mail. The classification of both e-mails and paper mails should then occur with text analysis based on key words. According to the group, this technique is already used by lots of other customer contact organisations. Automating the paper mail and e-mail routing implies that the corresponding function in our design, FR1: Sorting & classifying, is not present.

Basic knowledge & skills to handle information questions and SAP handling are the generic modules in the expert design. Besides the module basic knowledge & skills: NS terms / information questions, the modules that represent basic features of the SAP CRM system are in this level. Both looking up customer account information as registering the customer contact are present, just as the creation of a notification to the second line. With these modules, the CSR can provide personalised information to the customer. This level of modules is the basic training for all CSRs. Together with at least one module from the contact layer, the CSR can already be deployed.

Contact channels are divided into three in the group design. The explicit choice of a separate layer with contact channel modules is made in order to be as flexible as possible in the organisation.
When there is a need of CSRs skilled with the social media channel, it is more flexible to hire new employees and train them with the desired skills than train telephone skilled CSRs for social media channel. The latter would imply that the capacity of the telephone channel decreases so new employees have to be hired for this channel. This makes the channels dependant from each other and lead to a fixed training path, so less flexibility. The channel layer in figure 7.2 is split up in three parts, each with different colour of diagonal lines. Especially with digitalised paper mail handling, there is little difference between paper mail and e-mail. Besides some minor differences with replying the customer, most skills as spelling and formal writing are the same between the two channels. This is the reason why the group placed these two channels together. The telephone channel is a separate channel. Social media and live chat are also placed together. According to the experts, the two channels are similar, because the channels are both chat based. Lots of skills are the same, just as with paper mail and e-mail, which is the motivation for grouping these two channels.

**Second line actions** are all separate modules, but form a cluster because they are all specialistic actions. These modules are explicit placed under the indirect contact channels, because the second line actions are performed by CSRs who possesses the indirect contact channels skills in the expert design. Second line actions are necessary because expertise knowledge and skills are required which often have a longer handling time. Indirect contacts are ideal to combine with actions take require more time, because it is not a problem to put indirect contacts in a queue. For this reason, these modules are semi-coupled to the indirect contact channels.

**Direct executable actions** are a group of modules that are similar, but do not have to be trained all to one CSR. This group of modules are all actions that can be performed immediately. The actions are independent from the channels. Some of these action occur frequent, others are only used at a small amount of contacts. Depending on the required volume, more or fewer CSRs are trained in the specific module skill. The routing system (e.g. the IVR menu for telephone) couples the contact with a specific subject to a CSR that possesses the corresponding module. When new services are introduced that require new actions, a new module is added in this group. In this way, the modular system is highly flexible to future changes.

**Mentor duty** is placed as last level module. The interpretation of this module is different from our original meaning. Our intent was that this module represents the knowledge of how make use...
of the help provided by a mentor, from the CSR perspective. The group interpreted the module as a skill to possesses as CSR, so being the person who provides help. From that perspective it is logical that the mentor module is placed as a final destination of a CSR.

The expert design is characterised by four main choices. Automating the mail room modules is the first, which is out of our scope. Treating the five channels as a group of three is the second choice. The channels that are similar, are grouped so there are less distinct elements in the design. Explicit not choosing one channel as a base makes it possible to hire new employees and train them on the one channel (group) that has the shortage of capacity. Furthermore is the grouping of elements that form the basic training a choice. Last choice is the coupling of the second line actions to the indirect channel skills.

7.5. Validation of the design

In section 6.3.4, we defined three principles the we used in our design. We evaluate the three principles based on the expert design and their feedback on our design. We do this by comparing the expert design with our own design solution. Based on the comparison and evaluation, we formulate our conclusions of the validity of our design.

7.5.1. Comparison of design solutions

The first major difference between our own design and the expert design is our choice of a mandatory start with the telephone channel. The expert design did argue whether they would make this channel a mandatory start, but after discussing in the group they agreed that the organisation is more flexible when new employees could start at all channel (groups). We agree that allowing new employees to start at a different channel is more flexible, but we still believe that for intra day flexibility comes from the fact that all CSRs can answer telephone contacts. These two views can be combined, by making sure that all CSRs receive a training for the telephone module, even when they originally do not start on this channel. In case of an instant capacity shortage for the next month, direct inflow of new employees on the non-telephone channels is a good solution. However, we prefer that such an instant capacity shortage is prevented by good forecasting and that existing CSRs can be trained in the required channels. The non-telephone channels have a substantial lower volume, which in our view requires more experienced CSRs because the contacts that require fewer skills are harder to route and filter. Having more experienced CSRs reduces the need of a strict separation of the contact subjects.

The largest similarity is the first layer of modules that form the basic training for all CSRs. We divided this basic training in the information provision part, after which in principle CSRs can already handle some contacts. The supportive actions in our second layer are placed in the basic layer in the expert design. It makes sense to place the modules of the supportive actions in the basic layer, since these two modules can integrated easily with the other basic feature of SAP CRM: recording the contact details. Although the modules in the basic layer are some different, the idea of creating such a basic layer is similar.

The modules that represent specific actions are grouped together in both designs, as the capacity demand should determine how many CSRs have to be trained for this module. We distinguished action modules that occur so often, that in practise all CSRs should possess this module. The expert design only separated the action modules in difficulty: the more advanced modules that cannot be performed immediately (second line actions) are grouped together. The immediate executable actions form the other group. We grouped the action modules on volume: all frequent asked questions are part of the basic action training layer. All other action modules occur less frequent and are then grouped as specific and specialist modules. It makes more sense to use the grouping as done by the expert design, since capacity planning should determine how many CSRs have to be trained in a module.

7.5.2. Evaluation of the design principles

We started the design by stating three design principles. The most important principle was the creation of modules. The CSR specific combination of modules leads to that CSR’s skill set. From the discussion with the expert group, we learned that this principle is vital in a flexible design for a customer service
organisation. The principle is so important that the NS Klantenservice integration project team is currently developing a system where all modules of all CSRs are registered. This development was out of our notice, but proofs that a modular design for a customer service organisation is the right way to go, when there are so many different services supported by the customer service organisation.

Our second principle is the basic skill set, the first layer of modules in our design. As discussed above, this group of modules is the right start for the CSR’s learning path. However, we included the telephone channel module in this basic layer with the earlier described reason. Since a design serves as a blueprint, making the telephone module mandatory in the basic layer leads to a more coupled and fixed design. We agree with the expert group that flexibility is extremely important, so that placing the telephone module in the first layer is not smart. Since we still believe that the NS Klantenservice policy should be that all CSRs can handle telephone contacts, this channel is preferred as first channel to train. Only in exceptional situations where there is an immediate capacity shortage on one of the other channels, the training for new CSRs should not start at the telephone channel. The two modules that are added in the basic layer in the expert design are, in second thought, logically to add in that layer. Although the modules lookup customer account data and creation of a second line notification are different DPs in the AD that map on separate functions, in practise these modules are so closely related to register customer contact that the effort of training these modules along with the basic modules is negligible.

Our last principle is the separation of the contact channels in high-priority channels and low-priority channels. In the expert design, the goal is to train all CSRs multi-channel. This creates the possibility to redeploy CSRs ad hoc on a direct contact channel. We are in principle not against training all CSRs skilled for all channels, but we think this is not feasible in practise. The interview with one of the developers of training programmes for CSRs revealed that not all persons are capable and confident to handle social media contacts (C. van der Heijden, 2015). The expert group did emphasise that not all CSRs have to be trained for all channels. The experts did agree that indirect contacts can have a lower priority, but that this can only be temporary. Eventually, all indirect contacts also have to be handled within communicated service level, but the average time before an indirect contact is answered is measured in hours or days, instead of seconds. We evaluate this principle to be true, with the side note that a lower priority is only meant to emphasise the flexibility, but is not a structural lower priority.

7.5.3. Synthesis of the design validity
Based on the design comparison of our design with the expert group design and the evaluation of our design principles we conclude that our design is largely valid. The most important principle is the modular system to built the organisation. The use of modules is validated by our experts, as they fully agree with this approach. NS Klantenservice is very likely to implement a system that registers which CSR is trained in what module. We find out this message at the workshop, which is a very convenient message in terms of our design validity.

Besides the modules themselves, we also made an arrangement of these modules. The distinction between a first layer of modules, that form the basic training, a second level layer where the channel skills are located and the more action specific modules is also taken as a valid approach. The precise implementation of which module should be part of what layer is partially open for managerial decision. We recommend the policy where all new employees are trained on the telephone channel, but that there is room to divert from this policy when necessary. In the future, it is possible that the telephone channel is no longer dominant in terms of contact volumes. Changing channel preferences from the customer require a change in policy, which is possible in the design. Being flexible for future changes is important in the organisational design, which is covered as far as we think.

The special position of the mailroom in our design is also validated by the experts. In their design, they go even a step further by saying that these functions should be automated. We agree on this, but as this falls outside our scope of the brownfield situation we think that until the mail sorting and classification is automated, the manual process has a peculiar position in the NS Klantenservice operation. All the above points leads us to the conclusion that our design is valid, but that the precise arrangement and what channel policy should be used is open for refinement.
7.6. Conclusions on the evaluation

We validated our analysis and design solution by the use of expert validation. Our design solution comes forward from the final Axiomatic Design of chapter 6. Therefore, we validated the process diagram as described in section 6.2. By examining each of the six functions in this diagram, we gathered feedback on each function. From this, we conclude that each function is valid and therefore also the process diagram as a whole. We take this as a confirmation that our Axiomatic Design is valid. The analysis and design by the Axiomatic Design is performed good.

The design solution of our organisational issue is compared with the solution that was formed by a group of experts. The comparison is supplemented with the validation of our design principles. The use of a modular system to design the organisation is fully confirmed by the experts. The precise arrangement of the modules as whether there should be a mandatory start for each CSR at the telephone channel is open for refinement, since this is a management decision to make. We make recommendations in chapter 9 on this topic.

The validity of the design is only one of the three criteria we select in section 7.1. We first discuss this criterion, thereafter we discuss the utility and efficacy. The design is valid when the model representation that we create does match the real situation. We did not test the design by computer simulations or refined the concept further for real use. However, the face validity of the experts gives us the best information on the validity possible in our time. Especially the enthusiasm of the experts and the ease they agreed on the design principles show that our solution is logical and fits the situation well. Based on the expert session, we are confident to say that the design is valid and the model represents the real situation of NS Klantenservice.

The utility of our design is harder to evaluate. As far we received feedback after the workshop, our approach of the Axiomatic Design and design solution is received very positively. Our external supervisor believes that our design inspired the integration project team and parts of our design will be used. Assuming that this is true, the utility of the design is good. The design cannot be implemented directly, but the concepts, principles and directions we created are useful. As we already discussed, the management has to make decisions on the organisational issue. Our design helps the organisation to discuss a concrete idea, get used to the way we and the experts look to the problem and by this helps the organisation in the decision making process. This would make our design useful.

The efficacy criterion is even harder to assess. Does our design solves the entire organisational issue? We think that the modular design for managing CSRs contributes a large part to how the NS Klantenservice organisation should be organised. However, we see a few points that are not solved and require a solution. The question of what hierarchical division of the workforce in teams and units is best is unanswered by our design. We will discuss this issue further in chapter 8. A second issue that has to be developed are the demand of each module. The real demand of each module influences how the organisation looks like. This demand will of course change in the future, but should not cause a problem since the flexibility of the organisation is a key feature of our design. Last, assumed that the design is useful, we did not include a transition plan towards our design. A smooth transition is important as it is a potential blocker for reaching the end situation, but we did not include the transition in our scope. To conclude on efficacy, we are positive but a bit reserved on the efficacy. The additional issues around the organisational design have to be solved, but our design is a large step to the right direction.

When we look to the three evaluation criteria, we see a general positive assessment of our design. Therefore, we evaluate the design as useful. In the next chapter, we discuss the open points of the design and also the theoretical contribution of our study.
Discussion and limitations

We have created a new design and evaluated our design in the previous chapters. The goal of this chapter is twofold: we discuss the design artefact for NS Klantenservice (section 8.1 to 8.4) and we discuss the scientific contribution of our thesis (section 8.5). We discuss the organisational design on a high level and compare this with the current situation at NS Klantenservice in section 8.1. What changes in the organisation when our design is implemented? Second, we discuss the novelty of the design compared to other concepts (section 8.2). After that, the design is discussed at a more detailed level. What elements of our design are debatable or should be discussed by NS Klantenservice management before it can be used (section 8.3). Fourth, we discuss limitations of our design caused by the assumptions and scope we defined in our thesis (section 8.4). The second part of the discussion focuses on the case study in academic perspective (section 8.5). How did we apply the Axiomatic Design method? Could this method be used to solve other problems? We conclude this last section on what contribution our thesis makes to scientific knowledge.

8.1. Change in the organisation

The goal of our thesis is to design a customer service system design for NS Klantenservice that improves service quality. We focussed only on the organisational element in this service system design. The IT systems and processes are taken into account and some constraints and assumptions are made on the IT systems and processes, but we did not redesign these elements. In this section, we compare the current situation with our design to emphasise the changes caused by our design. Also, we discuss the implications we see from our design for NS Klantenservice.

In the current organisation, the operation is structured along three dimensions: the core services and segments (1), the contact channels (2) and the activities performed (3). Based on the core services and segments, the organisation within our scope is structured into three separate managed units. NS International handles solely international train services. The outsourced contact centre Webhelp handles most of the domestic train services for the Consumer segment, but not the Door-to-Door services for the Consumer segment. The in-house Domestic contact centre handles the Business segment of the domestic trains service and the Door-to-Door services for both the Consumer and the Business segment.

The three units divided along the core services and segments (1) are then further divided along the contact channel dimension (2). How the outsourced contact centre is organised is out of our scope, but both the International as the Domestic contact centre are divided into subunits that handle social media and live chat (International), social media (Domestic), the front office handling telephone contacts and a back office handling paper mail and email contacts. Within this second division, there is a further division into activities (3). Especially the back office is further divided into activities, but also the Domestic contact centre subunit that handles telephone contacts is divided into a Business subunit and a Door-to-Door subunit. Some CSRs possess the skills to handle more than one subunit, but in general there is a clear division along these three dimensions. This organisational structure is presented in figure 8.1a.
Our design integrates the three dimensions into one organisation. We do not assume that all CSRs can serve all contact channels or handle all activities of all core services and segments. However, the contact channels and core services are not determining how the organisation looks like. The content of the customer contacts, the different type of processes, do determine the organisational structure. As we saw in the detailed analysis of what activities are performed at NS Klantenservice in chapter 4, a large part of the activities are the same for all core services. Especially providing information is an activity that is generic along all core services and segments, which can easily be combined when the right resources are present such as an integrated knowledge management system (Balster, 2015; C. van der Heijden, 2015; Likumahu et al., 2015).

In the new organisational structure, all CSRs form one unit and possess a standard skill set which makes it already possible to deploy CSRs. Additional modules can be trained, depending on what the operational needs are. A single CSR can be trained in multiple additional modules, making him deployable at multiple activities. The contact channels are taken into account, but are not a dimension in the organisational structure. CSRs possess the skills the handle contact of a certain or multiple contact
channels, but this is not making them a Front Office or Back Office CSR. The organisational structure of the redesign is illustrated in figure 8.1b.

The organisational structure in the redesign does not make clear how the workforce should be managed. In the as-is situation, the division in subunits is also the hierarchical structure of command. In the redesigned situation, we do not include a hierarchical structure of command. We do recognise that such a structure is necessary, however we uncouple this command structure with the operational structure. CSRs can still be managed in teams with a team coach as hierarchical leader, but a team does not have to perform the same activities and be trained in the same modules. The operational performance can be monitored by leaders of a (group of) activities, making the leader responsible for these activities. We call this an operational team. It is possible that CSRs are deployed every day in a different operational team, but we do not see a problem with that. Eventually, the total operation is flexible and can be allocated to maximise productivity, which is key. The organisational structure demands the operation to be consistent in information and requires unified procedures. Due to the flexible design, CSRs handle often different contacts so the uniformity and consistency is necessary. There is no room for tacit knowledge and habits, because of this regular change in work activities.

The change of the organisational structure requires a different way of working for team coaches and operational management, but their current function is still necessary. The fixed teams disappear making it fuzzier who is in charge for a CSR. This has to be clear and requires further elaboration, which we did not perform due to lack of time. Besides the change in the organisational structure, we left as much in place as possible. Especially the IT systems and process elements are left unchanged, although we posed requirements on the IT system elements as harmonising systems that perform the same function. The need of an integrated knowledge management system is stated by several people we involved, which we agree. A consequence of our organisational design is the need of a new planning system, that can handle our modular system. Also, an unified administration is necessary where is recorded which CSR is trained in what module. A link between those systems makes it possible for the planning system to optimise the planning according to certain rules, like a CSR has to be deployed on each module every once in a while so he does not forget the trained skills.

We continue with a comparison of our design solution with other concepts used in the field. After, we discuss the design on a more detailed level. This involves the choices we made and the limitations the design has due to our scope and assumptions.

8.2. Novelty of the design

To contribute knowledge, our design has to be novel and some extent and be non-trivial. For this, we compare our design with two concepts regarding organisational structures, namely task specialisation and modularisation; and the channel synergy concept from multi-channel literature. The organisational concepts are common used in organisational design. The channel synergy concept is a hot item in multi-channel service design. After that, we form a conclusion on the novelty of our design compared to these existing ideas on organisational structures.

Task specialisation is used in organisations where each employee produces a small piece of the total product. Compared to our design, this concept is only partially used. To be able to serve customers fast and efficient, a customer should be served in one-time-right (one of the customer attributes in section 5.1). This means that the customer only has to contact NS Klantenservice once and is helped directly. This is not always possible. Some actions require more investigation on the customer specific situation or require specialised knowledge and skills. In these situations, we can speak of task specialisation since the one CSR handles a part of the customer contact, while a second specialised CSR handles the remaining part. However, in general our design is not comparable to the concept of task specialisation. The goal of NS Klantenservice is to help a customer in one time, directly, by one CSR. We see task specialisation in the context of NS Klantenservice when each of the six functions as described in the process diagram in figure 6.2 would be handled by one CSR.

Modularisation comes from the creation of a modular system. Modularity is seen as an useful con-
cept in a large number of fields to deal with complex systems (Baldwin & Clark, 2000). A module is a unit whose internal elements are strongly connected, but are loosely connected with elements of other units. The Design Structure Matrix and Axiomatic Design theories also use modules, which are blocks of elements that interact with each other but are independent from the other elements. In that light, the grey boxes of figure 5.18 are modules. We do make use of modules in our design, as the operation activities are structured in modules. So in that sense, the operation is structured in modules. However, we do not structure the employees in modules. Because the incoming contacts of a customer contact centre fluctuate, the requires activities do also vary. The organisation is therefore not solely structured according to the modules, but the modules do influence the organisation. So, is our design a form of modularisation? The modularity concept plays an important role in the structuring of the functions, resources and skills. The structure of the organisation is linked to these modules, as illustrated in figure 8.1b, but the employees are not structured solely on modules. The latter would reduce the flexibility of the customer service organisation.

Channel synergy is a concept from multi-channel literature. Synergy between channels is realised when assets are reused so costs can be minimised (Simons, 2006). Without going deeper into multi-channel literature, we fully agree that our design creates channel synergy. In fact, all differences that solely belong to the contact channel are packed together in one module while the generic parts of the service are other modules that are reused at each channel. The synergy between channels does not only reduce costs, but also increases the information consistency and in theory also the customer satisfaction.

By comparing our design with the concepts of task specialisation and modularisation, we see some elements of these two concept in our design. Especially the modularity concept is highly used in the structuring of the service system, but is explicit not applied on the organisational design. The organisational design has only some small parts of task specialisation included. The customer service centre requires some specialists that are trained for complicated processes, but in general CSRs handle a complete customer contact making it the contrary of task specialisation. The routing of contacts does of course already sort tasks to the right-skilled CSRs, but the separate functions needed to handle a customer contact are not divided along employees. The design is in line with the concept of channel synergy. This does not only minimise costs, but also improves service quality and thus increases customer satisfaction. Compared two the two organisational concepts of this section, we believe our design is novel.

8.3. Discussing our organisational design

We emphasise four points of discussion regarding the organisational design. To start, the number of modules is arguable. The 23 modules of the modular design do not include all activities of NS Klantenservice, and even not all possible modules within our scope of Service+ activities. Especially the action modules are not complete. Our intention was to include all type of modules in the design. We assume this is the case, since the expert workshop did not reveal any new type of module. The often performed actions are with fairly confidence included in the design, since the activities with the highest volumes are included in the case analysis selection (section 5.4). The less often, or rarely, performed actions are not included completely in the design. However, since the type of module is the same for all these actions - all rare actions are in one group of modules - the missing actions can be added in the design very easily. Therefore, we are confident to say that the chosen modules are represent all activities of NS Klantenservice.

A second point of discussion is our grouping of action modules in the design. In the workshop, the discussion arose what dimensions are present in the different type of action modules. We grouped the action modules on the frequency of use, while the other modules are not grouped on frequency. Only modules that are essential for every customer contact are made compulsory. The experts agreed that frequency is one dimension, but that the difficulty of the action is a more important dimension for grouping. Since we also do not include how many CSRs should possess a channel module, grouping on difficulty makes more sense. Workforce management has to determine how many CSRs should possess a certain module, so the frequency dimension is handled there. It might turn out in practise that the
often performed actions become a de facto basic module, as all CSRs are trained in these modules. Although this might be true, declaring it as such in the design makes the design less flexible.

Third, we understand the channel grouping of the expert design, but we do not fully agree. We do agree that e-mail and paper mail are two channels that are very similar. Especially when paper mails are scanned and attached in the digital system, there is little difference between the two channels so the channels can be grouped into one module. Only the mean of reply (electronic, by letter or otherwise) might differ in that case. We see the point of doing the same with the live chat and social media channels, since both channels are electronic and are used via dedicated applications. Although we think that the direct need to respond is certainly similar, the channels cannot be treated as one and the same. Social media is a channel on its own, because of the social aspect. The reply from the customer service is publicly visible, making the service sensible for the company’s reputation. A playful action can give a positive boost to the reputation via social media, but is very hard to achieve via live chat. We do see possibilities of mixing channels, for example adding a channel like Whatsapp. This is more similar to live chat, although NS Klantenservice cannot control the inbound volume of Whatsapp which is possible with live chat by disabling the website link. To conclude, we agree on grouping modules of contact channels, but the similarity of the channels might be less comparable as it seems.

In traditional design engineering, the designer creates multiple designs and creates a test that selects the best design option. In Axiomatic Design, this principle is also included by the Information Axiom which selects objectively the best design when more feasible solutions are possible. We did not create multiple design options, although the expert group created a different configuration in the workshop. We think that our design solution is not necessarily the best solution, but does give a good and valid direction of the design solution. The precise details of the best solution depend not only on good systems engineering, but also on management decisions based on long term plans that are not accessible to us. We think that the design solution as presented in this study will therefore contribute significantly to the issues of NS Klantenservice.

8.4. Limitations based on the scoping and assumptions

The research is scoped and bounded in section 1.6 in four levels. We discuss all the four boundaries of our research and the possible impact on the design in section 8.4.1. The design itself is based on four assumptions posed in section 6.3.1. These assumptions are discussed as second topic in section 8.4.2. Last, we synthesise the discussion points on the limitations of our research.

8.4.1. Limitations caused by the scoping

The first boundary of our research is on the customer service department of NS. As we defined in section 2.1, customer service is the service system ensuring customer satisfaction, by delivering supporting services to the customer in addition to the core service. Customer service does not stand on its own. In fact, one could pose that the customer only needs support from the customer service department when something went wrong in the core service. Interaction with other parts of the organisation are present and influence what customer contact NS Klantenservice for, influence what can be offered to the customer and might determine what systems have to used. The modules with skills can change due to other departments influence, but we see no problem for that. When a module changes, CSRs have to be trained again so they know the content of the changed module. However, the organisational design is not influenced by changing modules. The organisation is capable of adapting new modules and be flexible on what activities they have to perform. The flexibility is one of the key reasons to create the organisational design in this way. Therefore, we are confident that excluding the interactions of NS Klantenservice with other NS departments does not influence our design.

Within NS Klantenservice, we scoped only on the activities that are to be performed in the Service+ division of the customer service department. The Special Care services are excluded from our scope. We excluded this part of the customer service, because NS Klantenservice plans are to divide the department in these two divisions. We ask ourself the question, what would change when we included the Special Care services in our scope? Partly the Special Care services could be included in our design, since it would only add some specialistic modules. However, especially the MCC is fundamental differ-
ent from the other activities. The MCC supports NS personnel on the train and at stations, which is a complete different kind of customer service. Eventually, the user of a train is served by the MCC, but this service is provided via the NS employee contacting the MCC. The MCC does not have contact with the end-users: the customers of the MCC are NS own employees. This fundamental difference makes it logical to place these activities in a separate division. If we would have included the Special Care services in our scope, we expect that the MCC activities would end up in a special position because of the fundamental difference in customer. Therefore, we are sure that leaving the Special Care services out of scope made our thesis less complex and we believe the design solution is better because of this scope.

A second scoping of our research was on the contact channels. We only included direct contacts between customers and NS Klantenservice CSRs. When we would include the MCC in our scope, indirect customer contacts would be logical to include also. However, there are a lot of indirect customer contacts. NS Klantenservice is not the only department of NS that provides information to customers. Customer gather their information from the NS website, other websites, the NS mobile application, people around, NS personnel or physical displayed information at stations, trains or printed materials. NS Klantenservice is not or only for a tiny part responsible for all this information. Including indirect contacts would also require including other NS departments responsible for this information. Although making all this information consistent is a very interesting and relevant topic for NS, probably increasing the overall customer satisfaction, this would be way too much to handle for a master thesis. Only the indirect customer contacts via the MCC would be realistic to add to the scope, but we already discussed the inclusion of the MCC in the previous paragraph. Therefore, we believe the scoping on the contact channels is not too small. We could also include only one or two contact channels, but this would detract the real complexity present at NS Klantenservice. Having only one contact channel in our scope would reduce the dimensional problem creating the current unclear situation.

The last scoping of our research is on the organisational domain of NS Klantenservice. We did focus primarily on the organisational design, but we kept the processes and IT systems in mind. We posed some assumptions on the IT systems as we will discuss in the next section, so we do not entirely comply with to our own scope. Also, in order to implement our organisational design a IT system is needed that administrates which CSR possess what module. It would also be logical to link this new system with the scheduling system, requiring even more changes in the IT system domain. The interaction between the IT system, process and people elements is strong, so in that sense requiring some changes in these elements might be inevitable. However, we see our design primarily as an organisational design because we did not design new IT systems or new wrote procedures for processing customer contacts. Therefore, we believe that we complied as good as possible with the set scope. Including the IT systems and processes elements in the scope would result in too many variables to take into account. Because of our limited time, this would result in a much less detailed design. Besides, we believe it is not realistic to say everything has to be changed at once. The brownfield situation of NS Klantenservice makes it impossible to implement new processes, new IT systems and a new organisational structure at once.

8.4.2. Limitations caused by the design assumptions

We stated four assumptions on which our design is built. Three of these assumptions concern IT systems that have to be changed. As we discussed in the previous section regarding the scoping, the systems assumptions conflict with the scope. We see our assumptions on the IT systems not as blocker of our design, but without the stated assumptions the simplicity and uniformity of our design cannot be reached. We discuss what the impact is on our design when the assumptions are not satisfied.

The first assumption is the harmonisation of IT systems, by which we mean that each IT system support a unique feature. In the current situation this is not the case, since there some features are provided by multiple systems for separate parts of the NS Klantenservice organisation (see section 4.4 for the analysis of the current situation). Our organisational design would be less uniform without harmonised IT systems. The number of modules would increase in our design, as one part of the processes have to handled with the one application and the other part of the similar process with a second application. Increasing the number of modules does not only require more training because
of more modules, but the larger number of modules will also reduce the flexibility and potentially the productivity of the operation. The operation is more coupled without harmonised IT systems.

The second assumption is on the integrated knowledge management system. Like the previous assumption, not having an integrated knowledge management system would increase the required training for CSRs. In fact, we see two scenarios when there is no integrated knowledge system. First, it could be that there are multiple systems available to gather information and all CSRs can access these systems. This scenario is similar to the previous discussion on harmonising IT systems. The second scenario causes more problems: CSRs do not have access to all information. This scenario describes the current situation. When CSRs are not able to provide all information, the modular organisation design is not feasible. The basic modules for the basic skills and knowledge cannot be created, because we defined information provision as a basic function. This assumption is therefore also a constraint of our design. It is not realistic to think that all information is always present and up-to-date in a knowledge management system. A discussion with the experts revealed the thought of an ideal situation where all CSRs consult the knowledge system for every contact. In this way, all CSRs provide the same information and changed procedures are executed immediately. In practise, this will never become reality since humans are no machines. CSRs will gain tacit knowledge and remember the answer of often asked questions. The utopia of a knowledge management system has to be corrected for such human factors. A not 100% complete knowledge system can therefore already be used, while the goal remains that all information is up-to-date in this system.

The third assumption related to IT systems is the availability of real-time information for operational management. Our design can still be implemented without complying with this assumption. However, we are confident that without a complete picture of real-time operational information it is much harder to adjust the operation and being fully in control. This reduces the productivity, as the created flexibility by our design cannot be used optimal. In the current situation, the operation does have access to real-time information, but not to all information and the information is not always provided optimal. E.g., there is no single view available for all inbound telephone lines and the real-time information is not refreshed automatically. By stating that real-time information is assumed to be available, we hope to stimulate the realisation of this. Without real-time information, it is very hard to make a well considered decision about the allocation of resources. Our organisation design makes it easier to deploy the resources on multiple, in advance decided, activities, but the real benefit from this has to be realised by operational decisions. Therefore, we assume the real-time information to be available.

The last assumption posed on the design is not on IT systems, but on cultural harmonisation. Creating one culture is not done in a short time, such a process might take years. The hard agreements like labour conditions are easier to make, but still requires involvement of employees and consultation of the works council. This already takes multiple months before agreement is reached. Hard agreements as labour conditions and working times are more needed to harmonise, since without harmonisation two CSRs with the same set of modules are not exchangeable. This reduces the flexibility hugely. Softer cultural differences do less impact the applicability of the design. We recommend further research on what cultural change is necessary before the organisational design can be implemented. Due to our limited time, such research was not feasible for us.

8.4.3. Synthesis on the limitations
We discussed the four layers that formed our research scope and the four assumptions we posed on the design. In the scoping, the we see two points that are open for debate. The first point is the focus on Service+ activities and not on Special Care activities. This also excludes the MCC, which reduces the complexity of the problem because of the different type of customer the MCC has. We think that dividing the whole NS Klantenservice department in the Service+ and Special Care divisions make sense due to the fundamental difference of customer interaction. It is even arguable whether the two divisions are logical to place in one department. Although the differences between the two divisions, we see still a lot of similarities between the two divisions making it logical to together form one department.

The scoping on the organisational elements and not on the process and IT system elements is more arguable. We recognise that we did not completely comply with this scope, since we posed three
assumptions on IT systems of which one is a constraint. However, the interaction between processes, IT systems and people elements makes it in our eyes impossible to completely move in the people domain. From the four assumptions, two assumptions are constraints of the design. The hard IT system constraint is that all CSRs should at least have access to all knowledge management systems. Having multiple systems providing this feature is not ideally, but the accessibility to all the systems providing this feature is a hard constraint for our design. Second, the hard agreements on labour conditions and working hours have to be harmonised. Without this, the organisation is less flexible and the coupling in the design increases. The remaining two assumptions are stated to increase the added value of the organisational design, but are not blockers for implementation of the design.

8.5. Discussing the Axiomatic Design method

We selected the Axiomatic Design method to guide us in the analysis of the as-is situation and to come to a satisfactory design. We discuss the use of this method on our case study in section 8.5.1. What did we use of the method, how did we use it and what is not used. Second, we take a step back and look to the application of Axiomatic Design on customer service systems in section 8.5.2. Along what dimension did we decouple the system? Last, we look on what types of service systems the Axiomatic Design can possibly be applied (section 8.5.3).

8.5.1. Application of Axiomatic Design on our case study

We started the Axiomatic Design from three directions. First, we gathered the customer attributes from NS Klantenservice archival documentation and service quality and contact centre literature. We only gathered six high-level CAs and did not decompose this domain further. The mapping between the CAs and FRs is also not performed, as the FRs are decomposed in more details. The customer attributes and customer needs are of great importance, especially for a customer service organisation. We believe that further decomposing the customer attributes would largely lead to elements that interact with the core services. Since the customer service system is only a supporting system for the core service, the customers do mainly have needs that are satisfied by the core services. Nobody requires primarily customer service, the customer wants a good core service. The general customer attributes are taken into account in the further design, but not as prominent as the Axiomatic Design method prescribes. However, not performing all mappings between domains and purely focus on the mapping between FRs and DPs is not new. We got the inspiration from a study by Cochran, Eversheim, Kubin, and Sesterhenn (2000), where a production system is redesigned according to AD principles. The customer domain received less attention in this study and the process domain is entirely ignored. The focus on the FRs and DPs do correspond to the Independence Axiom, which states that the functions should be independent and that this can be achieved by designing the DPs correct. The other two domains do not contribute to satisfying the Independence Axiom. Due to these two arguments, we think that it is acceptable to focus more on the functional and physical domain and leave the other two domains aside. We come back on this statement at the end of this section.

The second direction of the Axiomatic Design approach was to gather real customer cases and see them as process variables. Reflecting on this, we have second thoughts on this choice. We think interpreting real cases as PVs is not entirely correct. In the article of Suh (1995, p. 204), the application of AD on organisations states that the physical domain contains programs or offices and the process domain contains people and other resources that can support the programs. In our AD, the physical domains contains people with certain skills to operate programs. One could state that we integrated both the DPs and PVs in the DPs, when comparing our design with the explanation given by Suh. When we strictly follow Suh’s explanation and the we take the DPs as things that perform a certain function, the organisational design and modular skill system can be seen as mapping between the physical and process domain. In that case, the CSRs are the PVs and the mapping tells which CSR is able to produce what DP. So when the real life cases are not PVs, what are they? Comparing the case study to a production system, the customer cases are the products that come out of the factory. By examining the products, one could find out what processes were used and what production resources were required to produce the product. The product is not equal to one of the PVs, but when the processes are unclear due to the complexity they still reveal information on the production system. In our analysis, the as-is PVs were hard to analyse for two reasons. We did not had clear what the PVs represented.
Besides, knowing what they represent it would have been very difficult to structure the as-is employees to skills mapping because of the threefold dimensional structure as described in section 8.1. The PVs served in the analysis phase as mean to construct the Axiomatic Design, which they did. Therefore, we see this discussion point not as crucial for the validity of the design solution. We are certain that the AD method guided us in the process to find the missing piece of how to organise NS Klantenservice.

The last direction we took in the AD process is starting with the decomposition of the functional domain in the five contact channels. We struggled on how to deal with the different contact channels, different core services and the different functions. These three dimensions create more complexity when the dimensions are included as independent elements. We took the freedom to rearrange and restructure elements so eventually the channel and core service dimensions are eliminated. The approach to take the channels as separate functions is driven by the emphasis on the channels in the organisation and in multi-channel literature. We do agree that multiple channels do increase complexity as consistency between channels is vital, but now we finished the analysis and design it makes sense that there are no functional differences between channels. Channel synergy is realised in a high form, which is a good thing according to multi-channel literature.

So to conclude on the use of the Axiomatic Design in our study, we summarise what is used of the method, what we did add and what is not used. The Axiomatic Design theory comprises two axioms (the Independence and Information axiom), four domains (customer, functional, physical and process domain) and three mappings between the four domains. We left the Information Axiom out of scope, since we did not describe the domains in quantitative elements making it possible to calculate information content of the design. The Independence Axiom is used, as we see this axiom fundamental for the AD. Using the Independence Axiom and not using the Information Axiom is not unique. The literature study on the application of AD in studies revealed that only 7 of the 63 papers used both axioms, 46 out of 63 used solely the Independence Axiom and 10 out of 63 solely the Information Axiom (Kulak et al., 2010).

We described all four domains, but as discussed earlier the focus was on the functional and physical domain. The customer and process domain served only as input for the analysis and are not elaborated in the design solution. We also did not create all three mappings. The CA/FR mapping is not created and the DP/PV mapping is only used as input. We even doubt whether we correctly used the process domain, as the customer cases are not the processes in the customer service system. The use of customer cases is new from the original AD theory. We see this fifth domain as a useful source to gather information for the physical domain. In our case, this fifth domain is possible to examine. In other applications of AD, it is less plausible to examine the artefact that comes out of the system and see all the steps the artefact made in the system.

8.5.2. Applicability of Axiomatic Design on customer service systems

With a bit of reservation, we can say that we successfully applied the AD method on the case of NS Klantenservice. The question we discuss in this section is why the AD was useful and what characteristics of the NS Klantenservice case caused this.

Axiomatic Design is not the most simple method to apply. All the domains, mappings and the two axioms demand a lot of effort. A simple problem could better be solved with a less sophisticated method, since the AD is likely to be excessive: one does not kill a bee with a shotgun. The as-is situation at NS Klantenservice is characterised by three dimensions. First, there are multiple core services supported by the customer service department. Second, the customer has multiple reasons to ask for support for each of the core services: each core service has multiple processes. Third, the customer support is provided via multiple contact channels. The three dimensions are coupled as some processes of a core service are handled only via the one contact channel. These three dimensions cause the coupling of NS Klantenservice and create the complex operation as-is.

We decoupled the customer service by decoupling all the three dimensions. The customer’s choice of the contact channel does not influence how the contact is processed internal at NS Klantenservice in our design. The multiple core services are integrated in the operation, by structuring all generic
processes in a generic module. The AD helped us in restructuring the elements, because the mapping matrix visualises what functions interacts with what recourse. By decoupling the matrix, we also decoupled the customer service system.

So, would the AD method be useful for the design of other customer service systems? This depends on the complexity of the system. For customer service systems that support one product via one channel, it is probably not very hard to design a satisfying structure. When there is a lot of complexity, the AD method can be useful to structure the complexity and possibly reducing the complexity. We think that the AD method can help designers to create a uniform structure for an organisation, which has potential to increase customer satisfaction.

8.5.3. Applicability of Axiomatic Design on service systems

Now we discussed the possibilities of applying AD on other customer service systems, we generalise one more step to service systems. What characteristics do customer services have that make it possible to use AD and what does this mean for other service systems?

Customer service has the general characteristics of a service like intangibility, heterogeneity, inseparability and perishability (Vargo & Lusch, 2004b). Heterogeneity does not completely fit customer services. There are several different services supported at a customer service system and the customer specific situation influences what is exactly needed, but all processes are standardised and procedures are created that dictate what is possible and what is not. In that way, a customer contact centre shows similarities with a production factory for goods. Besides, the employees of a contact centre are often managed as-if they are production line workers, by strict monitoring the performance of individual employees the overall productivity is maximised. Customer service, especially at NS, is a volume business by which we mean that the number of contacts is very high: over 3.2 million contacts in our scope (see figure 5.4). The high number of contacts makes it logical to standardise processes. The standardised processes make it possible to apply the Axiomatic Design method.

Besides the standardised processes, the service system should also have enough complexity as discussed in the previous section. We think that these two factors form the minimal set of requirements to select service systems that could be designed according to the Axiomatic Design method. A concept as (value) co-creation is harder to combine with AD, since co-creation requires interaction between the customer and the service supplier, making standardisation harder to realise and is the complexity probably not that large. The more the customer is involved in the service delivery process, the less standardised the outcome of this process is. Service systems with a high level of standardisation in the service delivery process are qualified as potential systems to be designed with AD.
Conclusion and recommendations

We have performed all activities that we stated to be done in order to answer the problem statement and research questions. We answer the research question and sub questions in section 9.1. We conclude on the relevance for NS Klantenservice in section 9.2 and the relevance of our research for the academic community in section 9.3. We give our recommendations for NS Klantenservice in section 9.4. Last, we state recommendation for future research in section 9.5.

9.1. Conclusion of the Research Question
We first discuss the sub questions in the same order as we stated them in section 1.4.3. These conclusions enables us to answer the main research question: Given the existing situation, what would be a service system design for NS Klantenservice that improves the service quality?

9.1.1. State-of-the-art in service systems design
The first sub question states: What is the state-of-the-art in service system design and how useful is this for our research? We started the literature study on service quality and service design literature. The goal of this study was to find useful theories and methods from the service system design literature for our multi-channel and multi-service problem at NS Klantenservice. The Gaps Model of Service Quality (Parasuraman et al., 1985) and Service Concept (Goldstein et al., 2002) are very general starting points for service design. These theories give a structured context for service design and give general points of attention that matter, but are not helpful in how the theories can be applied in real life situations like our case study. The Service Prerequisites (Edvardsson & Olsson, 1996) from NSD literature emphasise better what the internal organisation should provide before a service is perceived as high quality. More specific service design methods should guide us better. We examined the Service Blueprinting and Quality Function Deployment methods. Although the maturity of the methods in literature, in our opinion the methods are not suited for our design of a customer service system.

We conclude, based on the literature review, that the customer service system as present at NS Klantenservice is too specific to be handled with the service design methods. The traditional service design methods are then also not used in our research. Although the service design methods are not well-suited for our problem, the literature recommends to define the service prerequisites. For this, we
still need a design method that performs this task. We looked for the right design method and describe this in the next section.

9.1.2. Methods for designing a customer service system

The second sub question states: What method can be used for the design of a customer service system? We looked into specific design method literature that shares the ideology of systems engineering to find a design method that guides us in redesigning the customer service system at NS Klantenservice. Two design methods that have a lot in common were reviewed. The Axiomatic Design and Design Structure Matrix share two major features. Both methods divide a system into domains, use hierarchical decomposition to structure the domains and use matrices to represent the interaction. What differs are the domains and what is mapped in the matrices. Originally, DSM maps the interaction of the elements of one domain with itself, e.g. what process have interactions with other processes. The domain of processes can also be replaced with elements of the organisation or product. A later addition adds a cross-domain mapping, so the organisation and processes can be mapped. The AD starts with four different domains of one system that are already connected. The matrix maps the interaction of the one domain on the other domain, where the matrix solves the equation $\text{Domain}_1 = [A] \cdot \text{Domain}_2$.

The customer service system at NS Klantenservice provides customer service for multiple services. The domain describing the functions of the system has therefore multiple functions. Integrating multiple functions of a system is possible in the AD. The mapping of the domain with itself is less interesting for our problem. We want to know how the functions are produced and what shared components are present in the production domain. The DSM method uses the matrices to communicate and visualise the interactions, which makes it easy to understand the system and change it. AD matrices have a similar function, but the AD method has incorporated design laws (the axioms) that leads the designer to a good design.

Both the AD as the DSM method could be used, but we picked the AD method to guide us. Because we do not only want to analyse the current situation, but also make a redesign, the AD is better suited to guide our research. Besides, the content of the domains in the AD make it possible to go in more depth, since the functions and the production resources are two domains that are connected in the AD but they are not separated as such in the DSM. These two arguments substantiate our choice for the AD method.

9.1.3. The customer service system design

The third sub question states: What could be a customer service system design that incorporates the NS Klantenservice activities? To make a design, we started with an analysis of the current situation guided by the AD method. We made initial assumptions in how the NS Klantenservice operations works. One of these assumptions is the strict division of the five contact channels. During the analysis, we iterated through the AD artefacts and regrouped several elements. In the analysis it became clear that the initial assumption of strict divided contact channels is incorrect when one looks to the functions of each channel. The channel dimension is reduced to an element in the design, where other elements are generic for all channels.

The AD method is not very clear in what is analysis and what is design. Both activities are intertwined in the AD. We choose our division by saying that building the AD for the current situation is analysis, where some modifications of the AD are integrated in the analysis phase as it concerns changing our initial assumptions. The analysis created a coupled AD, which does not fulfil the independence axiom of the AD. In the design part, we solved the coupled design which leads to the final version of our design in terms of AD artefacts. The AD solution is a large step to our service system design focussed on the organisational elements, but does not gives direct answers to organisational questions.

We translated the AD to a process diagram that represents the first-level functions of the AD. All customer contacts flow through parts or the entire diagram. The organisational question is then how the workforce should be organised in order to support efficiently all the functions of the diagram. The six identified, distinct functions can be produced with 23 distinct skill modules. The modules follow from the AD design parameters and are translated back to the actual NS Klantenservice elements. The
organisational design is built according to three principles: a modular system to train CSRs in specific modules of skills, a layer of modules that form the basic skill set for all CSRs and the policy that all CSRs who possess low-priority, indirect contact channel modules, also possess high-priority contact channel modules so the ad hoc flexibility is maximised. Our organisational design is described in an artefact that guides the management in how the workforce is divided and how module combinations should be made. In our study, not all NS Klantenservice operational activities are represented. We selected the most common activities so that a broad range of activities is present in our design. The activities that we did not incorporate can easily be added to our design, as they can be placed in the group of modules that show the most similarity in the type of skill the activity requires.

9.1.4. Evaluation of the design
The last sub question states: How to evaluate the designed customer service system? Because of the major impact of our design on the NS Klantenservice organisation and the amount of effort that is required to implement the design, we were not able to test and evaluate the design in a real setting. The evaluation is done based on the conceptual design we created. We evaluated the design on three evaluation criteria: validity, usability and efficacy. To assess how the design scores on the three criteria, we organised a workshop so we could use expert validation for the validity criterion.

The expert validation was divided in two parts. First, the experts validated our outcome of the Axiomatic Design. Second, the organisational design is validated. The outcome of the Axiomatic Design is translated into a process diagram that shows how customer contacts in general flow through the different functions of the NS Klantenservice operation (also, see section 6.2). This uniform diagram is the key starting point of our organisational design, since all contact channels and core services are integrated in this diagram. All of the six main functions in this diagram were discussed, which led to the conclusion that the diagram is a valid representation of the desired operational situation.

In the second part of the expert validation, the expert group created an own design with the modules that follow from the Axiomatic Design. By discussing their design solution and comparing the expert design with our own design, we were able to gather feedback on the design validity. We validate our design principles and concluded that our design solution is valid. The experts agreed largely on the design principles, only critiqued our mandatory coupling of the telephone channel skills in the basic training. As they argued, this coupling makes the design less flexible but also has some benefits on the uniformity of the CSRs employability. This minor point of critique is more a management decision and changing this principle does not have a large impact on the design solution.

Based on the feedback during the workshop, the enthusiasm of the experts on our design solution and the feedback after the workshop from within the NS Klantenservice organisation, we received signals to believe that our design solution is usable. The most important signal is that the integration project team is inspired by our design. Our conceptual design has to be fine-tuned, but leaves a concrete idea of how to tackle the organisational structure issue. Based on this, we assess the utility criterion positive. The efficacy criterion is not entirely satisfied. We see some remaining issues in the organisational design that have to be solved, like the hierarchical control structure. The flexible organisation makes it harder to monitor and manage CSRs, since the CSRs perform often different activities. Due to our time limit, we were not able to elaborate on this issue and left this issue open in the discussion.

9.1.5. Synthesis: the main research question
The main research question states: Given the existing situation, what would be a service system design for NS Klantenservice that improves the service quality? Our answer on this question is: a modular organisational design with CSRs trained in multiple modules, where each module is a set of similar customer service functions supported by a single IT system.

To improve the service quality, NS Klantenservice is integrating their four contact centres. A successful integration requires that systems and applications work as it should and that systems that perform the same function for different parts of the organisation are replaced by a single system that serves the whole organisation. Processes that are performed have to be streamlined, so similar processes are
executed similar by different organisational parts. Processes that have a fragmented responsibility are brought together to one team with responsibilities. These prerequisites are currently being fulfilled by the NS Klantenservice integration project team.

The organisational part of the NS Klantenservice redesign is the last prerequisite that has to be right. Our design effort identifies an important piece that completes the organisational puzzle. The modular system of allocating skills to the workforce makes it possible to design and manage the organisational structure. The modular system is capable to provide the desired flexibility of the organisation, because it makes it very visible what the deployment possibilities are of the current workforce. Minimum capacity requirements should inform the management of possible future capacity shortages. The modular system makes it easy to decide if new employees should be hired and trained for the required modules, or that current CSRs can be trained in additional modules.

The modular system is not the only artefact needed before the organisational prerequisites are fulfilled. Other organisational elements as a same culture, what freedom does a CSR has, how flexible does a CSR has to be in work times and what are the responsibilities CSRs have and take, is also necessary to align. More practical questions as how CSRs should be supervised, are there still teams, do CSRs have a fixed manager and what is the role of this manager or supervisor has also to be defined. However, we think that the modular system is a major step in the organisational redesign. The design as we present it, is validated by experts in the workshop we organised. This validation gives us confidence to say that the modular system is the right solution for our scoped problem.

9.2. Relevance of our research for NS Klantenservice

NS Klantenservice has already gathered a project team that has the task to complete the contact centre integration project. Part of this team are external project managers who have lot of experiences with other customer service organisations. This team is currently realising the prerequisites as we stated them for the process and systems domains. The organisational domain can be changed a bit, but before the major redesign can be executed the other domains have to right first. As they already are working on the process and system domain, we put them out of scope and focussed on the last domain: the organisation.

At our workshop, the NS Klantenservice integration project team was also represented. Our research is valued as a good substantiation and supplementation to the project teams thoughts. As we described in the evaluation chapter, our modular design matches the ideas of the project team of how the organisation should be built. Our rigorous analysis and design approach is a validation for their ideas. The knowledge of the project team is largely based upon their experiences and lessons learned from previous projects. Our scientific substantiation is valued, especially since our outcome matches their feelings on how to solve the problem.

9.3. Relevance of our research for science

In our thesis, we searched for a service system design method that could guide us in the design of a customer service system. We found the traditional service design methods not usable enough to design a specific part of the total service system. Eventually, we found the Axiomatic Design method as design tool. AD is applied to a range of different subjects, as described in section 2.8.3. Especially in product, production systems and software design the AD method is applied on multiple cases. Application of the method to service systems is novel and also our contribution to science.

The differences between products and services are emphasised by several scholars, especially by Vargo and Lusch (2004a, 2004b). Some sceptics whether our approach to apply AD on service systems design is therefore understandable. But as our design solution is validated by experts and this solution is built upon the AD artefacts, we are confident to say that the AD method can be used for customer service systems design. The fact that it appears useful for the design of a customer contact centre might be less surprising as it seems. Customer contact centres do perform services, with largely heterogeneous questions from customers and for sure deal with intangibles. Customers have to trust that their question is solved, because tangible evidence will be noticed after some time, when their sea-
son ticket is received, their refund is paid or their e-ticket for an international train trip is mailed. Besides all these elements that make customer service for sure a service-based operation, the contact centre is managed as if it is an assembly line. The heterogeneity is present in the customer question, but looking to all questions there also is a large share of similarity making customer service homogeneous. In addition, employees receive strict orders for what channel they should handle and what work the have to perform. In this analogy, the employees are the machines that produce the products. Of course, the CSRs are not machines and normal machines do not process all functions for that product. The last is the reason to create a design that allocates the skills (or machine-specific functions) to the CSRs.

We think that our research shows that the AD can be applied to customer service systems design. Whether the applicability is limited to customer service systems is not something we can claim. However, as long as the internal company operation is included in the AD, we see potential of using the method on other service systems especially when there is a high level of standardisation present and the operation is complex due lot of elements that create coupling.

9.4. Recommendations for NS Klantenservice

Our recommendations for NS Klantenservice are twofold. First we discuss our recommendations of our modular design outcome. Second, we look at the outsourced contact centre of Webhelp and how NS Klantenservice should deal with the outsourced activities.

We recommend NS Klantenservice to implement the modular system for allocating skills to CSRs. This is probably going to happen, as the project team is forming a proposal to introduce such a system. From the discussion, we learned that the project team’s modular system is focussed on the CSR view. We do not argue on the importance of a system where the managers can keep track of which CSRs possess what modules. From the human perspective, such a system contributes to a major part of the organisational design. What we recommend is that this system is connected to at least the planning and scheduling system. This opens up possibilities for a better workforce management. The planning software should be able to use the information of which CSR possesses what modules. Instead of ordinary, manual scheduling with software, more advanced planning can be performed when the software can interact with the module/skill system. It is feasible to include lots of constraints in the planning logic when the variables for the constraints are given as automatic input, instead of when the planners themselves have to update what CSR can be deployed on what activity. Also the real-time adjustments of the work schedule, the tasks of the traffickers, should be coupled to this planning and skill module system. Traffickers can detect what activity has a too low capacity at that moment, and can use integrated planning system to see what CSRs are currently at the work floor who can be deployed to the activity with capacity shortage. Does reallocating that particular CSR causes a direct problem on the activity that CSR is performing now? When the current capacity demand can be linked to the trafficker’s system, that system has enough information to even suggest what CSR can be redeployed best, or what new configuration of the current workforce handles best the actual demand. The latter might be too sophisticated and would require to much change in the brownfield, but linking the module system to the planning system is a realistic option, especially with the introduction of a new planning system at the end of 2015. Therefore, we recommend that interaction of the module / skill system is one requirement for a new planning system. This interaction also poses requirements on the modular system. Before implementing this system, we recommend an advanced study on the precise cultural harmonisation that is required. What needs to be changed first at NS Klantenservice, what should the modular system that is present at this moment but will change in the future and what other future system changes should be compatible with the modular system. We think that the modular system can be implemented soon, with some of the desired changes not completed yet.

The activities of the outsourced contact centre by Webhelp are in this research neglected as a separate unit. Just as we integrated the activities of the international contact centre and the domestic contact centre, we included the activities operated by Webhelp. We realise that in the real world the contract with Webhelp cannot be terminated in one day. For this reason, we recommend the NS Klantenservice management not to withhold making a decision about the position of Webhelp in the future. A rigorous different position will need a long time path before this can be realised. We discussed
the position of Webhelp shortly in our workshop with Likumahua et al. (2015).

In our view, the role of Webhelp has to be redefined. From operational efficiency view, having all activities under one contact centre leaves the most flexibility on ad hoc basis as for longer planning. This implies that either all Service+ activities should be performed by Webhelp, or that NS Klantenservice should stop using an outsourced contact centre. In the current situation, 74% of the contacts are handled by Webhelp. Choosing a position between the two extreme points is possible, but increases the operational complexity to benefit from the same flexibility possibilities. Outsourcing customer contacts is only interesting when this company can benefit from economies of scale effects. The outsourced part has to be a significant share of the total contacts: the general business rule is the more is outsourced, the lower the costs (Likumahua et al., 2015). The more strategic question to NS Klantenservice management is what the primary strategy is of their customer service operations. Should it be as cost-efficient as possible? Or is the highest priority to serve customers as best as possible? Probably, both questions are answered with yes and the trade-off leads to a situation somewhere in between. But in making decisions, one sometimes has to be sharp. A mixed trade-off in this situation does in our opinion lead to the worst-possible decision. When the outsourced centre is used to cut costs, this is primary possible because the salaries at an outsourced centre are lower. There are also constructions possible where NS keeps their Service+ customer services in-house, but still cut costs at salaries. Used solutions by other companies is the founding of a separate customer service company, so the collective labour agreements of the mother company are not applicable (Likumahua et al., 2015). Our recommendation to NS Klantenservice is that choosing a position of Webhelp should not only be argued on direct costs of handling contacts and the service quality, but also on what the operation wins or looses on flexibility.

For recommendations on this subject, we try to include the flexibility, efficiency and quality issues in the trade-off. For quality and flexibility reasons, we think that it is best to perform all type of activities by NS Klantenservice self. Based on the contact volumes, we think that a significant share of the telephone contacts can be handled by Webhelp. The least training-intensive activities should be outsourced, since the cost benefit can than be maximised by Webhelp. We recommend the outsourced share to be smaller than in the current situation, so it is easier to complete a 24/7 roster for NS Klantenservice CSRs. Besides, the operational flexibility to adjust the deployment of CSRs is easier done with a larger base of CSRs. NS Klantenservice does handle the largest variety of activities, which needs more CSRs to be flexible. The efficiency of the entire operation is higher in this division than when no contacts are outsourced. Since the costs of the NS customer service are mainly caused by the amount of inbound contacts, reducing the volume by increasing service quality is more likely to reduce costs than making extensively use of cheaper personnel.

9.5. Recommendations for future research

We have four recommendations regarding future scientific work. Two directions of future research regarding the Axiomatic Design theory are discussed in section 9.5.1. We also have to recommendations regarding customer contact centre research, discussed in section 9.5.2.

9.5.1. Research for Axiomatic Design

We divide our recommendations regarding Axiomatic Design in two. First, we recommend on how to use the AD method more complete in case of customer service systems. Second, we recommend on the possible application of AD at other service systems.

We applied the Axiomatic Design method on the customer service system of NS Klantenservice. To do this, we altered the original theory slightly. The customer domain is described, but we did not use the mapping of CAs/FRs. In our study, the CAs contained out of six high-level elements. We can imagine how to create low-level customer attributes for customer service systems. Customers contact the customer service for certain reasons, which are often referred to as call reasons. Because the customer might use a different channel than telephone, we rather use the term contact reason. Each contact reason can be seen as a customer attribute: the customer has these specific needs to contact the customer service. All the contact reasons together could form the customer domain, describing in detail what the customer wants. The functional domain than described how these contact reasons
are handled. Here, it is possible that one function takes care of multiple contact reasons as some CAs show similarities. We encourage other scholars to explore this thought. A fully described customer domain will probably identify all FRs, instead of our most used functions. Applied on our research, this would enhance the design to include all activities giving a complete picture. A second thing we can recommend to explore is our own discussion on what the process variables are in customer service systems. As we discussed in section 8.5.1, we see potential in treating the (groups of) CSRs as process variables. Exploring on this could confirm that our organisational design artefact is in fact the mapping between the physical and process domain. This would be interesting, since it implies that we cannot only design the activities in the organisation with AD, as we did, but possibly also design the hierarchical organisational structure. The hierarchical structure is one thing that is missing in our design.

A second addition on our research on customer service systems is the inclusion of the Information Axiom. We only used the Independent Axiom in our study, since we did not focus on describing FRs and DPs quantitatively. When FRs and DPs are described in probabilities or ranges, it is possible to include the Information Axiom in the design. Since we translated the design parameters as skills and IT systems that are operated by trained CSRs, the most obvious way of including probability ranges is to describe the probability that one FR can be satisfied with the interacting DP. In terms of contact centres: the probability that the specific customer reason can be handled by a certain skill / IT system. This does still not entirely match the information content as described by Suh. We encourage scholars to explore further on how to include the Information Axiom in customer service systems design, since the Information Axiom can be used in the design evaluation. The Information Axiom tells the designer how well the design fits the requirements.

Last but certainly not the least important recommendation is to explore the applicability of Axiomatic Design on other customer service systems and service systems in general. We already discussed the application of AD on our case study and (customer) service systems in section 8.5, but because of the novelty of using AD in service design we want to emphasise this discussion. We named two factors that we think are necessary to make application of AD on service systems design possible: enough complexity in the system so the analytical method really is useful and a certain level of standardisation in the service processes. We think that our research is small beginning in the exaptation of using AD in the field of information systems. Future research could examine our presumptions on the applicability of Axiomatic Design on service system design and substantiate our findings.

9.5.2. Research for customer contact centres
In the context of the customer contact centre, we observed developments that require a further exchange of data and interaction of systems. Scholars as Gans et al. (2003) and Mitchell (2007) already emphasised the importance of integrating all customer data in a contact centre to create a 360-degree view of the customer. We agree with them, but can recommend more detailed research directions. The social media channel enables a lot of new techniques, because all information is automatically available via the internet. Social media application can thereby analyse the impact of a single customer by his reach: a customer with thousands of Twitter followers has more impact than someone with only a few followers. With text analysis, it is even possible to follow the sentiment of the public and interpret expressions as sarcasm. Emotional information about the customer can be very useful to pursue personalised customer service. A customer with a bad temper should be served different then a very emphatic customer or a customer who is very informed about the possibilities. CSRs can anticipate on emotions recorded in the past.

A last suggestion for future research builds further on the intelligent, emotion-based routing. The common used effective way of routing telephone contacts is the use of an IVR menu, where the customer hears questions and chooses a menu option according to his question. This system can be innovated in many ways, as voice recognition techniques are performing better. With voiceprint, or DNA of the customer voice, the customer can be identified and all the database and CRM information can be used in the routing. CSRs are all different, as they are people who have more talent for handling the one emotion than the other emotion. Recording emotional information in a CRM system is not a major innovation, but using this information for the routing is. Preferably the social media customer information is also used, together with all other customer specific characteristics. Developing
an algorithm that utilise such information from the customer and combines that with the available CSRs talents leads to a best-possible match at that moment between the customer and customer service. Such a pro-active routing requires a lot of data stored about the customer, but when such a system is in place, the customer only has to say his name before he is connected with the best-matched CSR. This mass-customisation technique leads to a more personalised customer service, which is expected to lead to a better customer satisfaction.
As last part, we reflect on our research activities and the personal experiences we gained during the graduation process. We zoom in on finding an internship and a subject for graduation (section 10.1), the use of the Axiomatic Design as a new method to us (section 10.2), the evaluation workshop (section 10.3) and conclude on the overall graduation at the TPM faculty (section 10.4).

10.1. Finding my own research subject

My graduation process started while I was studying in Gothenburg during my Erasmus exchange. I already decided to graduate at an external company, so I contacted several companies. Eventually, I found the possibility at NS Klantenservice just before the start of the second semester. The place is interesting since a lot of improvement projects are running, however there were no real boundaries around the graduation topic from NS side. I agreed to first start with a regular internship, so I could orientate on an interesting topic and could learn the organisation. I benefited from the orientation phase, but the agreements of division between graduation work and non-graduation work were not entirely clear and not always easy to maintain. Eventually it took quite some time before I found a balance and after the (second) midterm I could fully focus on graduation. I was not always happy with this process, but I learned better how to set boundaries and stand up for my own priorities and goals.

One of my first meetings with Scott was regarding my (more) precise subject. In fact, I proposed three thesis at that time which was way too much to handle in the SEPAM graduation time. With all the available data of the contact centre, a simulation study was one of the options. I think that this option was still a good one, the fact I like discrete simulation also helped in the formation of this option. I probably had an easier time with a simulation of the contact centre then I’ve experienced now. However, I’m still happy with my choice on customer service design. This subject brought me in touch with Axiomatic Design and gave me a design-oriented thesis, instead of a more regular thesis. The design-oriented thesis requires more creativity in my opinion, but felt also more like a consultant job than a (lab) researcher job. Gaining information from people, be responsible yourself for all input and learning by doing is more in my comfort zone than pure desk work.

The focus on the organisational design of NS Klantenservice became clear to me only a few weeks before the green light meeting. Having the precise scope clear so late in the process was of course not ideal, but part of the design process. Having a clear set thesis subject, like other TU Delft studies, would create a whole different graduation process. I think that the less clear graduation process better fits the wicked problems SEPAM students are focussing on. At the end of the process I can look back on graduation and be content with the work I delivered.
10.2. Applying Axiomatic Design

The idea of applying the Axiomatic Design method was brought up by Scott in the beginning of the graduation process. However I did not have a clear scoped problem, I liked the method as it uses the engineering perspective as taught at SEPAM. The AD method is quiet an engineering approach, as it uses structural decomposition and especially the design equations with matrices are pretty hard. Though, the interpretation of the matrices and solutions to come to an acceptable design are not well described in AD. It is almost a black box where some magic happens, or as Scott explained the creative part of AD is not explained well, but you’ll figure it out. Eventually, I did figure out how to be creative in my own way. The AD artefact is relatively small, as the FR/DP matrix only contains 17 elements. On the one hand this is a pity, since I collected a lot of detailed information about the NS Klantenservice operation, so a further decomposition was possible. On the other hand the precise details of all the different type of activities are all comparable. The organisational design and the modular structure to manage CSRs did not require more details, but when NS Klantenservice implements the structure all activities have to be linked to a module. Then, the details of the reality do matter, but probably I could have finished the same design with some lesser detailed knowledge.

In a discussion with Scott, he revealed that at the TPM faculty there have been discussions to include Axiomatic Design in the regular curriculum. I think that students can learn a lot from this design method. It might even be better to combine AD with a project, where different groups apply different design methods on projects. Normally students can choose their own project, but when fixed projects are given students can compare both the results of the same subject, from a different design methods, and make a comparison between design methods applied on different projects. As a graduated TPM student, it would be very valuable to know when certain design methods can be applied and what method has what benefits. One can find out themselves of course, but I think that the comparison discussion can bring a lot of insights. Discussing on a detailed level is maybe a bit missing in the SEPAM curriculum.

10.3. Preparing the workshop

When I look back, the validation workshop is very valuable to my thesis. I planned such an expert input session already in an early stage, but the program of the group session was not clear to me until the last weeks. I only realised the value of the session after I held the workshop. The preparation itself took almost four days, but this included creating illustrations that I also used in the thesis. The workshop served therefore also as deadline for my own thesis progress. Initially, I was worried that I could not fill the three hours I had available, but as Sulaiman commented the other way around was more probable. It turned out that the time schedule was all right, because two workshop members had to leave after the first part we finished thirty minutes early. The discussion of the expert design would be even more valuable with two expert groups, but the situation did not allow for this setting.

I discussed the choice of the workshop members with Sulaiman. There were no operational agents present, which allowed to use a bit more complex and abstract material in the workshop. On the other hand, operational agents would be valuable for detailed feedback on the content of the modules. The members of the workshop covered multiple expertise areas of the contact centre with four of the five members having experiences of contact centres at other companies. On the one hand, the external experience had an open view of the possibilities of the organisational design. On the other hand, having more permanent NS staff members present might increased the discussion in the workshop. The chosen workshop members did generally agree on their group design.

Presenting and facilitating a workshop was a valuable experience, not only for the content of my thesis, but also for my personal experience. All SEPAM students are educated to be a designer of systems or institutions and I think that they should be able to lead workshops or other user experience input sessions. In an university setting, this experience is hard to gain. With student groups alone, expert opinions are hard to simulate and especially the expert behaviour cannot be mimicked by students. In a project like the graduation project, the setting is perfect to gain experiences of begin a workshop facilitator. I think this is should be a standard skill that is educated in the SEPAM program, comparable to to students of e.g. Industrial Design.
10.4. Graduation at TPM

As last, I want to reflect on the graduation process as a whole. I experienced the thesis as a project with a lot of freedom. It is good to have a lot of freedom and be responsible for what you do, when you do it and how it is done. I expect my working career to be the same, so that the thesis project is a good completion to an independent and critical engineer. Being independent is not always easy, as I experienced during the project. I like to share my thoughts and discuss directions and possibilities, as with a sparring partner. The provided supervision does of course fulfill parts of this role, but the major part of the thesis is executed alone. The substantive support about the details of the thesis subject are hard to communicate to the TU supervisor, especially when he has to create an image of the situation by the story you give him.

A separate point of reflection on the graduation process is the choice of a non-Dutch first supervisor. I realized that having to talk English brings some inconveniences when I asked Scott. In some conversations, I struggled a bit to find the right words and express myself precisely, which would be a lot easier in Dutch. However, I think I also improved my English due to the choice of a non-Dutch supervisor. It is very likely that I have to consult and discuss in English in the future. I do not think that the quality of the work suffered from my fewer possibilities of express myself in English to Scott, but I did learn from it. So, I am glad of my choice.

Finally, I want to reflect on my personal choice to study at TPM. I always liked the multi-actor perspective of the TB bachelor and SEPAM master, but also liked more analytical subjects as operations research and optimization. Still, I think the TPM studies are a great choice for someone with a large span of interest and a favour for having a holistic view of subjects. I cannot imagine at the moment what I will do in 10 years, but when the possibilities stay available to try and trust my feelings on what I like, I think that I will still learn a lot of new and interesting things.
References


Balster, J. (2015, August 12, 2015). *Vragen over de diensten van ns* [Interview].


References


Research Approach

In this appendix, we look on the foundations of doing research in the field of Information Systems and the Design Science Research approach. The goal of this theoretical deepening is to find guidelines, tips and tricks in doing a design oriented academic study.

The subject of our thesis can be described as a study in the field of Information Systems. Information Systems as a field of study started somewhere in the 1950s, when the era of computers started. Computers are not the only aspect of Information Systems, in fact the focus is wider then purely technology. The definition of the UK Academy for Information Systems states: “The study of information systems and their development is a multidisciplinary subject and addresses the range of strategic, managerial and operational activities involved in the gathering, processing, storing, distributing and use of information, and its associated technologies, in society and organizations.” (Avison & Elliot, 2006, p.5). It is not surprising that this field with multi-disciplinary subjects is interesting for a MSc. student of the TPM faculty.

The definition of the UK Academy for Information Systems can be sharpened. Lee (2001) [editor of the MIS Quarterly - red.] names the interaction of the technical and the social system the phenomena that is of interest in the Information Systems discipline. We take this approach as the definition of the field of Information Systems.

The position of the field of Information Systems in relation to other field is shown in figure A.1. Information Systems can be plot in relation with both IT disciplines and Social Sciences. This emphasis

![Diagram of Information Systems and IT disciplines](A-1_a.png)

![Diagram of Information Systems and Social Science disciplines](A-1_b.png)

(a) Information Systems and IT disciplines  
(b) Information Systems and Social Science disciplines

Figure A.1: Differentiation of the Information Systems discipline from other fields (Avison & Elliot, 2006, p. 6)
the broad and multidisciplinary of the field. Information Systems focus on the application of technology to organizations and society. One issue of this broad field is that a variety of theories are present. Orlikowski and Baroudi (1991) concluded that there are three research philosophies present and useful in the field of Information Systems. We will not further elaborate into research philosophy directions. However, Orlikowski and Baroudi (1991, p.24) emphasize that “researchers need to understand the implications of their research perspective [...] and be open to the possibilities of other research practices”. The three research philosophies are related to three views of theory-building in Information Systems, which are elaborated in section A.2

Now we know that Information Systems is positioned as applied field with lots of interactions with other field, our next question is how to do research in this field of study. The traditional, Natural Science is aimed at explaining how and why things are (March & Smith, 1995). This is then used to understand reality, and by validation with reality, Natural Science theories can be developed. Since Information Systems are artificial, human-made, the Natural Science approach is not applied often in this field. In stead, the Design Science approach is used. Design Science does not try to understand reality, but to create artefacts that serves human purposes (March & Smith, 1995). With this knowledge, we can dive deeper in the subject and elaborate on Design Science, specific Design Science in Information Systems.

A.1. Design Science in Information Systems

When we ask ourselves the question "What is Design Science", several scholars give a definition. “Design science is the scientific study and creation of artefacts as they are developed and used by people with the goal of solving practical problems of general interest” (Johannesson & Perjons, 2014, p.7). "Design science, [...] creates and evaluates IT artefacts intended to solve identified organizational problems“ (Hevner et al., 2004, p.77). “Design science then is knowledge in the form of constructs, techniques and methods, models, well-developed theory for performing this mapping [the functional space to the attribute space - red.] —the know-how for creating artefacts that satisfy given sets of functional requirements“ (Vaishnavi & Kuechler, 2015, p.11). These definitions are more or less alike. It is a learning by doing approach. By performing the design, an artefact is created that solves the problem. This is a description that gives us some guidance, but needs more explanation. Therefore, we look at different aspects of Design Science.

A.2. Theory in Design Science

Many scholars name the work of Simon (1996), first published in 1969, the foundation of the design-science paradigm (Blessing & Chakrabarti, 2009; Johannesson & Perjons, 2014; Lu & Suh, 2009). “The classic work that threatens technology or artifact design as a special prescriptive type of theory is Herbert Simon [...]“ (Gregor, 2006, p. 615). “The design-science paradigm has its roots in engineering and the science of the artificial (Simon, 1996). It is a problem-solving paradigm.“ (Hevner et al., 2004, p. 76). “The classic work that gives the knowledge underlying the construction of artefacts the status of theory is Herbert Simon [...]” (Gregor & Jones, 2007, p. 317). Before further exploring the Design Research literature, we ask ourselves the question "What is theory?“. Gregor (2006) distinguishes three different perspectives on theory. In physical and natural sciences theory should provide testable explanations and predictions. In the words of Popper (2005, p. 37) “Theories are not cast to catch that we call ‘the world’: to rationalize, to explain, and to master it.”. A second view is more experience oriented. The focus is on “understanding the complex world of lived experience from the point of view of those who live it.” Schwandt (1994, p.118). The last view is a combination of the objective first perspective and the subjective second perspective. Gregor (2006) continues her essay in this last view, where theory is an abstract entity and separated from the understanding of the individual.

An important aspect of theory is some degree of generalization. Substantive theory scopes on a specific area, while formal theory has a broad scope. The degree of generalization is of a different level in these types. A second aspect is whether the theory is explanatory or predictive. Both types are not exclusive: a theory can possess both explanatory and predictive elements. The amount of each type is used as classifier to create five types of theory: (I) Analysis; (II) Explanation; (III) Prediction; (IV) Explanation and Prediction; (V) Design and Action. This classification of theory is done specifically for
A.3. Research in Design Science

Information Systems. Type V is the type of theory that is suitable for Design Science in Information Systems. The other type of theories are also present in Information Systems literature, but type V fits with the description of Simon’s science of the artificial (Gregor, 2006). The Design Science approach is suitable to obtain the knowledge of this study. The learning by doing approach will gradually focus us towards the right, precise area we need to look. Regarding the view on theory in our study, we adapt the view of Gregor (2006). Now we know what perspective on theory we take, we can continue with Research in Design Science. What does Research in Design Science attempts to investigate?

A.3. Research in Design Science

However Research in Design Science, or Design Science Research, is a mature field of science, there exist no common view on Design Science Research. As in the types of theory, scholars are divided in understanding design and the practical improvement of design (Blessing & Chakrabarti, 2009). Blessing and Chakrabarti (2002) rises three main issues in the current state of Design Research:

- the lack of overview of existing research;
- the lack of use of results in practice;
- the lack of scientific rigour.

Blessing and Chakrabarti (2009) elaborates on these main issues and especially the first and third issue are supported by the argument that design research literature is fragmented. They continue with the lack of definition and common terminology, and that there are many referencing islands of scholars. This is a clear signal for our research. The reference island that we choose might focus us in a perspective that blind spots are missed. The further Design Research Methodology of Blessing and Chakrabarti (2009) is loosely connected with the scholars we mentioned earlier, which is the reason to abandon this perspective. Instead, we continue with the problem-solving perspective of e.g. Gregor (2006) and Hevner et al. (2004). The three main issues mentioned are still to be considered in our thesis. We think that all three issues can be tackled. The overview of existing research is to be provided in the next chapter and the scientific rigour is to be contained in the embodiment of the artefact that we create in this thesis. Whether the results will be used in practice is unknown, but the embedding of the practical issues of NS gives a good possibility that our results will be used.

<table>
<thead>
<tr>
<th>Guideline</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Guideline 1: Design as an Artifact</td>
<td>Design-science research must produce a viable artifact in the form of a construct, a model, a method, or an instantiation.</td>
</tr>
<tr>
<td>Guideline 2: Problem Relevance</td>
<td>The objective of design-science research is to develop technology-based solutions to important and relevant business problems.</td>
</tr>
<tr>
<td>Guideline 3: Design Evaluation</td>
<td>The utility, quality, and efficacy of a design artifact must be rigorously demonstrated via well-executed evaluation methods.</td>
</tr>
<tr>
<td>Guideline 4: Research Contributions</td>
<td>Effective design-science research must provide clear and verifiable contributions in the areas of the design artefact, design foundations, and/or design methodologies.</td>
</tr>
<tr>
<td>Guideline 5: Research Rigor</td>
<td>Design-science research relies upon the application of rigorous methods in both the construction and evaluation of the design artefact.</td>
</tr>
<tr>
<td>Guideline 6: Design as a Search Process</td>
<td>The search for an effective artifact requires utilizing available means to reach desired ends while satisfying laws in the problem environment.</td>
</tr>
<tr>
<td>Guideline 7: Communication of Research</td>
<td>Design-science research must be presented effectively both to technology-oriented as well as management-oriented audiences.</td>
</tr>
</tbody>
</table>
Apart from the issues related with Design Science Research, there is also literature regarding how to perform Design Science Research. Hevner et al. (2004, p.77) developed seven guidelines which should “inform the community of Information Systems [...] of how to conduct, evaluate and present Design Science Research”. These guidelines are listed in table A.1 and create the practice rules for Design Science Research (Peffers, Tuunanen, Rothenberger, & Chatterjee, 2007). The guidelines are drawn from the problem-solving perspective. As described in Guidelines 1 & 2, Design Science Research should produce a viable artefact that solves relevant business problems. Furthermore, via rigorous methods the design can be evaluated which leads to a contribution to research (Guidelines 3, 4 & 5). The design process is a search of effective and available means (Guideline 6). The latter includes existing theories from other domains, also called kernel theory. The concept of kernel theory requires some more elaboration and is to be described in the next section. The last guideline is the communication of results. We use these guidelines in our thesis.

A.4. Kernel theory

In the previous section, we mentioned the term kernel theory. This term originates from an early paper in the field of Informations Systems, by Walls, Widmeyer, and El Sawy (1992) that defines Information Systems Design Theory. One of the core components is the use of kernel theories: prescriptive theories from natural science, social science and mathematics. The kernel theories (or reference theories (Gregor & Hevner, 2013)) are then applied, modified and extended to support the design of the artefact (Hevner et al., 2004). The authors of the Information System Design Theory (ISDT) reflected on their theory and concluded that their theory is used only limited (Walls, Widmeyer, & El Sawy, 2004). Gregor and Jones (2007)’s critical issues on the ISDT theory are mainly the separation of design processes and design products, and if both are necessary. Walls et al. also acknowledge that the product and process aspect are not entirely independent. In our opinion the design of an artefact contains both aspects and are so entangled, the learning by doing concept or the Design as a Search Process guideline, that separation of the two is unnecessary. The ISDT theory does not completely fit into Design Science Research view, so we leave it aside. Although the critics on the ISDT, the concept of kernel theory is used further Design Science Research methodologies (Peffers et al., 2007; Gregor & Jones, 2007; Kuechler & Vaishnavi, 2012). The use of kernel theories could therefore be useful. When we see the contact centre literature as kernel theory for our problem, the general rules of this field as a probabilistic arrival process and higher service levels possible with a larger scale of operation, we should at least allow for these flexibilities in our design.

A.5. Structure of Design Science Research

In several sections, we noticed the difference between natural science research and Design Science Research. This difference has also some implications on the structure of a Design Science study. Gregor and Hevner (2013) created a publication scheme for Design Science Research (table A.2) and noted the main differences between the traditional content of a chapter and the specific DSR content. The scheme does match with the guidelines of performing Design Science Research as described in section A.3. We adapted this scheme for our thesis, as we also describe in the precise mapping of sections to our chapter in section 1.8.

A.6. Output of Design Science Research

The goal of research is creating knowledge (Vaishnavi & Kuechler, 2015). Gregor and Hevner (2013) specified this goal for Design Science Research. They distinguish two types of knowledge: descriptive and prescriptive knowledge. Descriptive knowledge describes natural, artificial and human phenomena. “What do I see” would be the general question. Prescriptive knowledge is about constructs, models, methods and instantiations and answers the question “How can I ..”. The descriptive and prescriptive knowledge interact with each other, for Design Science specifically the descriptive knowledge consists often out of the earlier discussed kernel theories. Both types of knowledge can add value to the academic community. The type of added value be mapped on the axes of Solution Maturity and Application Domain Maturity, as done in figure A.2. Only applying known solutions to known problems is not contributing to scientific knowledge. We want to make an improvement. The type of problem is known, how to design a service system, but the solution of using Axiomatic Design to reach this goal
Table A.2: Publication Scheme for a Design Science Research Study (adapted from Gregor & Hevner, 2013, Table 3)

<table>
<thead>
<tr>
<th>Section</th>
<th>Contents</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Introduction</td>
<td>Problem definition, problem significance/motivation, introduction to key concept, research questions/objectives, scope of study, overview of methods and findings, theoretical and practical significance, structure of remainder of paper. For DSR, the content are similar, but the problem definition and research objectives should specify the goals that are required of the artefact to be developed.</td>
</tr>
<tr>
<td>2. Literature Review</td>
<td>Prior work that is relevant to the study, including theories, empirical research studies and findings/reports from practice. For DSR work, the prior literature surveyed should include any prior design theory/knowledge relating to the class of problems to be addressed, including artefacts that have already been developed to solve similar problems.</td>
</tr>
<tr>
<td>3. Method</td>
<td>The research approach that was employed. For DSR work, the specific DSR approach adopted should be explained with reference to existing authorities.</td>
</tr>
<tr>
<td>4. Artifact Description</td>
<td>A concise description of the artifact at the appropriate level of abstraction to make a new contribution to the knowledge base. The section (or sections) should occupy the major part of the paper. The format is likely to be variable but should include at least the description of the designed artefact and, perhaps, the design search process.</td>
</tr>
<tr>
<td>5. Evaluation</td>
<td>Evidence that the artefact is useful. The artefact is evaluated to demonstrate its worth with evidence addressing criteria such as validity, utility, quality, and efficacy.</td>
</tr>
<tr>
<td>6. Discussion</td>
<td>Interpretation of the results: what the results mean and how they relate back to the objectives stated in the Introduction section. Can include: summary of what was learned, comparison with prior work, limitations, theoretical significance, practical significance, and areas requiring further work. Research contributions are highlighted and the broad implications of the paper’s results to research and practice are discussed.</td>
</tr>
<tr>
<td>7. Conclusions</td>
<td>Concluding paragraphs that restate the important findings of the work. Restates the main ideas in the contribution and why they are important.</td>
</tr>
</tbody>
</table>

is novel for as far we found in literature.
A.7. The case study research method

We started this section with a description of Design Science. One of the core components in the definition is that the research has to solve relevant problems. In the field of Information Systems, (Benbasat & Zmud, 1999) stated that there is a lack of attention to relevance in the field of Information Systems. This is caused by the emphasis on rigour, institutional factors and a limited exposure to relevant contexts. Recommendations Benbasat and Zmud gives are, among others, the selection of a topic based on future interests of stakeholders and the use of qualitative and case-oriented studies. Information Systems are complex systems, that can better be understand in its context. Observing such system in the context can be done by the method of the case study. It is “well-suited to capturing the knowledge of practitioners and developing theories from it” (Benbasat, Goldstein, & Mead, 1987, p. 370). Some characteristics of a case study are that no experimental control or manipulation is used, in contrast to experiments in laboratory setting or in the field. Besides, the researcher is not required to possess a priori knowledge of what variables are of interest, in contrast to field studies. Data can be collected by multiple means and the only a few number of entities are studied (Benbasat et al., 1987).

A last important aspect of a case study is the observer role of the researcher. Benbasat et al. emphasizes three types of qualitative research that some may call case study. Two of these types are in conflict with the observer role of the researcher, because the researcher has become a participant. Action research is one of the conflicted qualitative research methods. In action research the researcher solves immediate organisational problems by theory generation and intervention (Sein, Henfridsson, Purao, Rossi, & Lindgren, 2011). The word action already implies that there exists an intervention, the research is performed while effecting change. This type of research can be very strong because of the understanding and participation of the researcher; but it is not a case study. A second type of research is the application descriptions. These are really practical descriptions of how a successful project is implemented. The implementation is also the primary objective of the author; the description is mainly how it’s done. These two types of qualitative studies are different from the case study as defined by (Benbasat et al., 1987), which we agree on. The Action Design Research method is also not feasible in our thesis, because implementing the change takes more time then available for the master thesis.

For our research we need to ask how and why questions. The method of the case study seems appropriate. How much cases do we need in our research? For testing a hypothesis, one critical case can be enough to reject the hypothesis. In our study, we do not want to test a hypothesis. The knowledge we try to add is in the improvement phase. This can be done with one case. For the design of a service system we have one case, the NS Klantenservice. However, within the context of NS Klantenservice there are multiple cases available of customers, of which we gave three examples in section 3.8. These multiple cases give us the possibility to learn and make some degree of generalisation. As noted earlier, generalisation is required in order to create a theory (Gregor, 2006). Besides the distinction between single or multiple cases, Yin (1994) defines a second axis in the design of case studies. The second axis is the unit of analysis, or the subject the case is representing. When a single unit of analysis is used, a holistic view can be made. With multiple cases an embedded view is created. In our study we take the only one unit of analysis: a traveller of NS. By analysing multiple cases, we ought to generate a holistic view of the traveller’s requirements.
This appendix contains background information about what we call the people element of NS Klantenservice and a description of how the top activities described in section 4.3 are selected.

**B.1. People**

We selected two illustrative examples of working rules and working agreements as present at the NS Klantenservice operation. Table B.1 shows the ten agreements that are printed on posters at the walls of the NS Klantenservice department. The ten agreements should create a more transparent and positive work environment and are meant to influence the work culture.

<table>
<thead>
<tr>
<th>10 afspraken</th>
<th>10 agreements</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Afspraak = Afspraak (deadlines worden gehaald en er worden punten gezet)</td>
<td>Deal is a deal (deadlines are to be met and items are to be finished)</td>
</tr>
<tr>
<td>2. Benoemen hoe het is</td>
<td>Name it as it is</td>
</tr>
<tr>
<td>3. Open en transparant</td>
<td>Open and transparent</td>
</tr>
<tr>
<td>4. Denken in kansen, pro-actief</td>
<td>Thinking in opportunities, pro-active</td>
</tr>
<tr>
<td>5. PrP = positief rondpraten</td>
<td>Talking positive around</td>
</tr>
<tr>
<td>6. Eerst onderzoeken, niet oordelen en vinden, objectief</td>
<td>First investigate, no judgement, objective</td>
</tr>
<tr>
<td>7. Eigenaarschap over waar ik invloed op heb, over de afdelingen heen</td>
<td>Ownership of the things that I can influence, across departments</td>
</tr>
<tr>
<td>8. 2 keer rappelleren = escaleren, hulp zoeken</td>
<td>2 times recalling = escalating, look for help</td>
</tr>
<tr>
<td>9. Verwachtingen afspreken (vragen stellen)</td>
<td>Manage the expectations</td>
</tr>
<tr>
<td>10. Werken vanuit gemeenschappelijke doelen</td>
<td>Work from the common goals</td>
</tr>
</tbody>
</table>
Ziekte
Ziekmelden doe je bij je direct leidinggevende (bij afwezigheid ziekmelden bij het secretariaat) én bij de planners; voor uitzendkrachten geldt: ook bij uitzendbureau
Bij ziekte dien je telefonisch bereikbaar te zijn conform CAO - afspraken
Je meldt je beter bij je teamcoach en zegt eventueel afspraken bij bedrijfsarts af
Bezoek aan tandarts en regulier doktersbezoek in eigen tijd; bij frequent bezoek maak je afspraken met je direct leidinggevende.

Werkplek
Je hebt een actieve werkhouding (rechtop in je stoel)
Geen stemverheffingen en luid gesprekken; denk aan de klant en je collega
Tijdens de telefoonondienst wordt er op de werkplek niet gegeten
Bij het verlaten van je werkplek 'lock' je het beeldscherm (shift F1)
Aan het einde van je dienst uitleggen en PC en beeldscherm uitzetten
Laat je werkplek altijd schoon en opgeruimd achter na einde dienst
Je mobiele telefoon staat uit/stil tijdens werktijd
Er wordt niet privé gebeld op de werkvloer. Dringende privé gesprekken voer je buiten de kamer.

Werktijden
Bij aanvang dienst zit je ingelogd achter je PC
Tijdens je pauze is het de bedoeling dat je de werkplek verlaat
Bij de laat komen overleg je met je leidinggevende wanneer je de verloren tijd inhaal of hoeveel verlof wordt afgeschreven
Werkbriefjes worden digitaal verwerkt na check dienstindelers.

Internetgebruik
Er mag niets van Internet gedownload worden
Er wordt niet geïnternet (alleen op werk gerelateerde sites) en er worden geen spelletjes gespeeld tijdens werktijd
E-mailen is uitsluitend werk gerelateerd toegestaan tijdens werktijd
Het versturen en in bezit hebben van porno is reden tot ontslag

Kleding
Je dient representatief gekleed te zijn, want het kan zijn dat je een klant moet ontvangen of dat er een rondeleiding wordt gegeven
Strand- of sportkleding wordt niet geaccepteerd
Je kleding dient schoon en heel te zijn

Figure B.1: Work rules of NS Klantenservice operation

The working rules that are printed on the walls as illustrated in figure B.1 are in our opinion an excellent example of how the customer service operation is managed as a factory. Evidently, the (operational) management found it necessary to communicate very clear and commanding what is acceptable and what not. The fact the rules are communicated clearly is not direct a problem in our opinion, but the tone of voice is not inviting and in sharp contrast with the ten working agreements that stimulate a positive culture.

The organogram in figure B.2 shows the current organisation of the customer service department in hierarchical structure. The management team of NS Klantenservice consists out of three operational managers, two staff managers (in the future only one staff manager), the director who also holds a seat in the NS Commerce board and supporting members like a secretary, financial controller, human resource advisor and change advisor. The operation is divided under fourteen team coaches, which are partly a legacy from the former separate contact centres. Not all team coaches coach the same number of agents. Size is not the only determinant in the number of team coaches, e.g. the MCC provides 24/7 service and always have a team coach present. For scheduling reasons, more team coaches are required.
Figure B.2: Organogram of NS Klantenservice
B.2. Processes

This section elaborates on the assessment of the top processes handled by NS Klantenservice. We start with the selection method of the CRM processes, next we add the processes that do not use the CRM system. For the analysis of processes data of first six months of 2015 is used, exceptions are explicit mentioned.

B.2.1. Processes of the CRM system

The processes of NS Klantenservice are analysed by the data of the SAP CRM system. This data is structured in several data fields. The ones we used are the categorisation of the customer contact, the channel that is used and the unit that handled the contact. The CRM data is not directly comparable for all units: the categorisation tree for domestic operations is slightly different from the international categorisation tree. The international categories are modified so they match the domestic categorisation tree. Besides, the tree consists out of groups of products for specific consumer and business customers. All travel products are recategorised so all travel product types can be combined. Of all the data, we excluded the categories of outbound contacts and internal redirected contacts. Both types of contacts are not specified in more detail than that, which makes it impossible to assess which process would be used. Besides, a redirected call is registered again by the unit where is redirected to. Outbound contacts also follow upon an earlier contact. We judge that the exclusion of these two types of contacts is required in order to analyse the processes correctly.

From this step, we collected all categorisations per department per channel. This creates ten combinations: for the Domestic unit the channels telephone, email and paper mail are available; for Webhelp (the outsourced contact centre) the channels telephone, email, paper mail and live chat are available; and for the International unit only the Back Office channels of email, paper mail and telephone are available. The International Back Office telephone channel is a special number where customers can call for complaints or refunds, the channel is separated from the Front Office telephone channel that handles ticket sales and service.

<table>
<thead>
<tr>
<th>Process / Unit - Channel</th>
<th>Domestic - Call</th>
<th>Domestic - Email</th>
<th>Domestic - Paper</th>
<th>Webhelp - Call</th>
<th>Webhelp - Email</th>
<th>Webhelp - Paper</th>
<th>Webhelp - Chat</th>
<th>Int B - Call</th>
<th>Int B - Email</th>
<th>Int B - Paper</th>
</tr>
</thead>
<tbody>
<tr>
<td>Terminate/Cancel - Travel products</td>
<td>4 11 2 2 4 3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Refund - Correction for Check-In / Check-Out</td>
<td>2 2 10 3 5 1 4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Refund - Compensation for delay</td>
<td>5 3 5 3 3 1 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Refund - Fine on train</td>
<td>6 6 10 10 10 7 5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Refund - Request for restitution</td>
<td>7 3 1 6 3 6 5 2 2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Redirect external - Customer Service OV Chipcard (TLS)</td>
<td></td>
<td>7 11</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Information - Usage website</td>
<td>5 9 5 6 7 8</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Information - NS general</td>
<td>6 6 4 1 2 1 4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Information - OV Chipcard</td>
<td></td>
<td>11 8</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Information - Travel products</td>
<td>1 1 9 1 2 1 3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Check status - Termination</td>
<td></td>
<td>9 7</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Check status - Order</td>
<td>8 12 12 11</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Check status - Payment</td>
<td>4 4 8 9 9</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Modify - Customer account information</td>
<td></td>
<td>10 8 13 8</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Figure B.3: Ranking of processes as registered in the CRM system

Per Unit - Channel combination a list of top processes is created. We could also direct look at the top overall processes, but because the volumes handled per combination differs largely, this could suppress processes that are important for a combination. It is possible that certain processes are only used for specific channels, which should not initially be suppressed by the processes with high volumes. This list is compared with the overall top processes. In figure B.3 the top processes per combination are compared with the overall top processes. In each column, the ranking of the processes of that combination is displayed in comparison to the overall processes. The result is that for Webhelp, all top processes are included, with the exception for a small share in the live chat channel for the process of providing travel information. For the Domestic unit, the largest process that is excluded is providing information about te door-to-door services of NS. The door-to-door services consist out of rental
bikes on the stations, short term rental cars and payed parking places for bikes on the station. The door-to-door services are only supported by the Domestic unit and take in total a 5,0% share of all Domestic processes. Specified for the telephone channel of Domestic, the share is even bigger (9,1%). However, we do not include this process in the overall top processes. The last unit that is supported by the SAP CRM data is the International Back Office. The two largest processes that are excluded are handling complaint about Customer Service (4,8%) and handling refunds for additional costs (4,5% of total International Back Office processes). The last process is specific for international train services: in cases where an international train is canceled some travellers receive a free hotel accommodation.

The list of overall top processes is then created as illustrated in figure B.4. In this figure, all channels of a unit are combined. The list of top processes covers between 75,7% and 87,7% of all SAP CRM registered contacts, depending on the unit. The top 10 processes is created out of this list of 14 processes, by deleting the processes with a less than 3% share in one of the units. The final top 10 is illustrated in figure 4.3.

<table>
<thead>
<tr>
<th>Process / Unit</th>
<th>Domestic</th>
<th>Webhelp</th>
<th>International B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Terminate/Cancel - Travel products</td>
<td>8,9%</td>
<td>17,0%</td>
<td></td>
</tr>
<tr>
<td>Refund - Correction for Check-In / Check-Out</td>
<td>8,7%</td>
<td>16,0%</td>
<td></td>
</tr>
<tr>
<td>Refund - Compensation for delay</td>
<td>6,6%</td>
<td>0,9%</td>
<td>45,2%</td>
</tr>
<tr>
<td>Refund - Fine on train</td>
<td>2,6%</td>
<td>2,6%</td>
<td>1,4%</td>
</tr>
<tr>
<td>Refund - Request for restitution</td>
<td>9,8%</td>
<td>3,9%</td>
<td>15,6%</td>
</tr>
<tr>
<td>Redirect external - Customer Service OV Chipcard (TLS)</td>
<td>0,3%</td>
<td>2,9%</td>
<td></td>
</tr>
<tr>
<td>Information - Usage website</td>
<td>3,5%</td>
<td>4,7%</td>
<td>1,5%</td>
</tr>
<tr>
<td>Information - NS general</td>
<td>3,5%</td>
<td>8,8%</td>
<td>9,0%</td>
</tr>
<tr>
<td>Information - OV Chipcard</td>
<td>0,3%</td>
<td>2,3%</td>
<td></td>
</tr>
<tr>
<td>Information - Travel products</td>
<td>20,4%</td>
<td>19,0%</td>
<td>5,3%</td>
</tr>
<tr>
<td>Check status - Termination</td>
<td>1,3%</td>
<td>2,8%</td>
<td></td>
</tr>
<tr>
<td>Check status - Order</td>
<td>1,5%</td>
<td>2,0%</td>
<td></td>
</tr>
<tr>
<td>Check status - Payment</td>
<td>5,0%</td>
<td>2,9%</td>
<td></td>
</tr>
<tr>
<td>Modify - Customer account information</td>
<td>3,2%</td>
<td>2,0%</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>75,7%</td>
<td>87,7%</td>
<td>78,0%</td>
</tr>
<tr>
<td>Volumes per week</td>
<td>6.865</td>
<td>32.547</td>
<td>723</td>
</tr>
</tbody>
</table>

Figure B.4: Top processes as registered in the CRM system

### B.2.2. Processes of NS International Front Office

The channels served by the International Front Office are telephone and live chat. Live chat has an average volume of 220 chats a week. These chat contacts are not recorded and categorised, which makes it impossible to assess what type of contacts these are. Other methods could be used to retrieve information about the content, but due to the low volume this is not used in this thesis. We assume that international live chat contact have a similar content as the other channels of the International contact centre.

The telephone contacts of the International Front Office are not registered in a CRM system at the moment. Plans are running to connect this unit to the SAP CRM system, so information is stored better and is more useful as feedback to the organisation. Calls are now coded in seven call reason codes. These codes and their distribution are listed in table B.2. All calls not specified with a code (the seventh code) are excluded. In general there are three main reasons. The largest category is providing after sales services, like modifying a booking. Providing information of the NS International services is the second largest category. The last category is making bookings via the telephone. Sales of tickets via telephone is not the desirable channel for NS, they rather have customers make bookings via their website. The website is however not a channel of Customer Service and therefore out of scope. The categories as mentioned in table B.2 do not reveal the truth processes: is providing information regarding the travel information, train and station facilities or ticket validity? Similar questions can be asked by the after sales services category. This is one of the reasons to implement a CRM system,
but for our study it will be too late. We could treat international trips as one of the travel products, it requires specific knowledge because specific terms are applicable. In this way, the processes of the International Front Office are comparable to the processes identified in the top 10 in figure 4.3.

<table>
<thead>
<tr>
<th>Category</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Booking possible on website</td>
<td>6,2%</td>
</tr>
<tr>
<td>Booking not possible on website</td>
<td>6,8%</td>
</tr>
<tr>
<td>Information possible on website</td>
<td>14,6%</td>
</tr>
<tr>
<td>Information not possible on website</td>
<td>17,2%</td>
</tr>
<tr>
<td>After sales service - sales via website</td>
<td>49,6%</td>
</tr>
<tr>
<td>After sales service - sales via telephone</td>
<td>5,6%</td>
</tr>
<tr>
<td><strong>Volume per week</strong></td>
<td>4,095</td>
</tr>
</tbody>
</table>

### B.2.3. Activities of the Social Media team

Twitter and Facebook are the online networks that are serviced by the Social Media team. Twitter is the largest of both media and forms the base of our analysis. In general, the social media cases are not recorded in the SAP CRM system. The messages are handled in the application Coosto, where the work is divided between the available CSRs and these CSRs also reply via the application. The Social Media team started to use the Coosto application in April 2015, for this reason the data used is from the weeks 16 until 29.

<table>
<thead>
<tr>
<th>Category</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Punctuality</td>
<td>23,4%</td>
</tr>
<tr>
<td>Travel information</td>
<td>16,8%</td>
</tr>
<tr>
<td>Facilities in train/on station</td>
<td>14,2%</td>
</tr>
<tr>
<td>Travel products</td>
<td>12,8%</td>
</tr>
<tr>
<td>In train seating capacity</td>
<td>7,3%</td>
</tr>
<tr>
<td><strong>Volume per week</strong></td>
<td>6,909</td>
</tr>
</tbody>
</table>

Coosto groups messages of users into cases: multiple messages in a short time frame from the same customer or replies on NS Klantenservice reactions are grouped. The cases should also be automatically labelled by the system or by the CSRs otherwise. The labelling is only applied in 43% of the cases. Of the labelled cases, the ones with the label ‘Cause outside feedback loop’ are excluded. These cases do not reveal information regarding what type of knowledge is required. As shown in Table B.3, the content of the social contacts is very much focused on on-the-spot information. Real-time travel information or complaints about the punctuality are the top two subjects via social media. An other major subject are the facilities in the train and on the stations, like pollution and defects on location. The topic of travel products is similar to the ‘information - travel products’ process that we identified from the CRM system.

### B.2.4. Processes of NS Onderweg

The NS Onderweg units do use SAP CRM to register contacts, but the registration is far from complete. The Service Centre registered 12% of their contacts in the first half year of 2015. The MCC has a registration share of 87% which is a solid base for analysis, however the processes are that much different to merge this data with the CRM data of figure B.4.

Table B.4 comprises the distribution of incoming phone calls per group. There are three ways that lead to the Service Centre. Lost&Found item calls enter the Service Centre via the general Customer Service line, where customers have to choose in a phone menu the type of question they have. The ‘Lost&Found item’ group is the line where customers enter who call the general CS phone number. The ‘Service OC Chip+’ and ‘Disabled customers’ groups are phone lines for specific customers: those who have a disability. These customers can call a special phone number that direct lead to the Service
### Systems

#### MarketResponse

MarketResponse is a company and system that executes the customer satisfaction surveys. Based on the daily SAP CRM input, customers who’s email address is known receive a invitation for the survey. To prevent customers from an overload of survey invitations, there is an additional check that the customer only receives an invitation once a half year. A lot of meta data from SAP CRM is send to MarketResponse, so that the output from the customer satisfaction data can also be analysed based on the SAP CRM categorisation, the (team of) CSRs that served the customer and the channel that the customer had used. At the moment the survey information does not flow back into the SAP CRM system as enriched data, but is stored separately in MarketResponse.

#### Invision

Invision is the Workforce Management (WFM) software that is used to schedule the activities of all CSRs in the NS Klantenservice contact centres. CSRs receive weekly their schedule when they have to work from the Invision system. There are four planners that place CSRs on shifts, however these shifts have to be created first by the demand. The two forecasters make the input for the number of shifts on each time block, based on historical data. Invision is connected with two of the four telephone systems: the telephone system for Domestic and International. Other activities, like e-mail, paper mail and social media are added based on the current backlog and expected income flow. Special activities that have an impact on the number of travellers

---

**Table B.4: Inbound groups of the Service Centre**

<table>
<thead>
<tr>
<th>Category</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lost &amp; Found items</td>
<td>25,6%</td>
</tr>
<tr>
<td>Service OV Chip+</td>
<td>23,9%</td>
</tr>
<tr>
<td>Serviceline</td>
<td>18,2%</td>
</tr>
<tr>
<td>Help via machines</td>
<td>16,2%</td>
</tr>
<tr>
<td>Disabled customers</td>
<td>16,1%</td>
</tr>
<tr>
<td><strong>Volume per week</strong></td>
<td><strong>7,819</strong></td>
</tr>
</tbody>
</table>

Centre. Service OV Chip+ is a special service for customers who have visibility problems. They do not have to check in and check out when they use the train, instead they can call the special number so their journey is registered and billed afterwards. The ‘Disabled customers’ group is for customers who need special assistance to board and unboard the train. When these customers call the special number, train and station employees will be informed so the customer receives the assistance. The last type of incoming calls to the Service Centre is via fixed pillars and ticket machines on the station. These contact points have a call or help button, which connects to the Service Centre. The content of these contacts are more related to topics of the Social Media team: focused on the immediate help.

**Table B.5: Categories of the Employee Service Centre**

<table>
<thead>
<tr>
<th>Category</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lost &amp; Found items</td>
<td>38,2%</td>
</tr>
<tr>
<td>Taxi and hotel requests</td>
<td>14,7%</td>
</tr>
<tr>
<td>Support of ticket validation</td>
<td>7,4%</td>
</tr>
<tr>
<td>Travel information</td>
<td>7,0%</td>
</tr>
<tr>
<td>Other</td>
<td>5,8%</td>
</tr>
<tr>
<td>Travel product information</td>
<td>4,3%</td>
</tr>
<tr>
<td><strong>Average per week</strong></td>
<td><strong>3,364</strong></td>
</tr>
</tbody>
</table>

Table B.5 comprises the top processes of the MCC. There is some overlap with the processes of the Service Centre, as the ‘Lost & Found items’ process. Support of ticket validation and information about travel products are processes that we also see in the Domestic and Webhelp unit. Other processes like the ‘Taxi and hotel requests’ is specific for the MCC. The MCC serves also the role as intermediary between the train employees and other employees, for example in informing the station operator that information on that station is incorrect or facilities are defect.
(e.g. Kingsday) are also included in the forecast. Activities from other NS business units are also included, e.g. the monthly invoicing for post paid services, the renewal of season ticket in the begin of the calendar year or the start of the academic year with thousands of new students. Invision is also linked to the Timerecorder.

**Timerecorder** is a system that tracks the activity of each CSR. In this way, NS knows how much time is spent on specific activities, e.g. processing complaints. It serves also as input on the CSR performance: do they make the required hours of work, do they take too long lunch breaks or toilet breaks.

**Phone systems** are present on two platforms: the SAP BCM system (for the MCC) and the CIC. However, the four contact centres are de facto four phone systems. Before a telephone call enters the CIC, it starts at the MTEL platform of telephone provider Tele2. On this platform, the IVR menu sounds for the customer. The IVR routes a call to a specific number based on the customers choice. This specific number enters a workgroup in the CIC. Details on the technical details of calls, like the number of incoming and answered calls, average speed of answer (ASA), service level (SL) and average handling time (AHT) come from this system. The AHT consist out of three elements: the call time, the hold time (when a CSR pauses during the call) and the after call work (ACW) time which includes all activities that the CSR requires to do before the contact is completed. One of these activities is registering the call in the SAP CRM system, but also follow up activities like an outbound call or creating a service notification for the back office in order to give a complete answer are part of the ACW.

**Oracle RightNow** has a similar function as CIC, but then for the live chat channel. All technical details from live chat contacts are recorded by RightNow, so information can be gathered regarding the number of contacts per interval, their ASA, SL and AHT. For the International contact centre, a categorisation is made whether the contact was in English or in Dutch.

**External complaint websites** like Klacht.nl and Klachtencompas.nl are set up by the Consumer Association. These websites collect the complaints of customers of all kind of companies, also for NS. Every complaint is forwarded to NS, who handles them as a case, in the same way as complaints that would be direct sent to NS.

**Service Forum** is a crowd source channel of NS, where customers can ask their questions. Answers are primarily provided by other customers. NS’ CSRs have more a supervisor task in supporting escalated posts and keeping the forum neat and friendly. If a lot of customers ask the same question, the NS CSRs responsible for the forum post an answer.

**Coosto** is the system that handles social media like Twitter and Facebook. The application collects the tweets and messages send to the account of NS and divides them under the CSRs. CSRs also reply via Coosto, it is like the CIC platform for telephone contacts. Coosto records the technical details of which CSR handles what message, the number of messages with and without reply and the contact centre metrics ASA and SL.

**SAP CRM** is the CRM system where customer contact transactions are recorded. All contacts of the MCC are recorded in SAP CRM, but in a different interface as the other contact centres. Domestic records its contacts also in SAP, but not for social media. Live chat conversations are copied and pasted in SAP CRM, but the customer is not always identified. E-mail contacts enter automatically a work list in SAP CRM and the content of the mail is attached to the CRM record, but paper mail is not scanned and attached. However, the replies to the customer are stored in SAP CRM, which is not the case for telephone contacts. International does not record its contacts in a CRM system (this in in planning for autumn 2015), but the paper mail and email are handled by the BackOffice which uses the Domestic system - so paper mail and email contacts are recorded in SAP CRM. The Service Centre only record a small amount of their contacts in the CRM system. In the CRM system records are categorised on the type of question, as the categories in figure 4.3. The goal of recording the content of a contact is to have knowledge about what topic customers do contact NS Klantenservice for. The CRM system is a vital piece of information as feedback to repair or prevent problems, e.g. ambiguous terms of certain tickets or the performance of the self-service website.
**SalesForce CRM** is a separate CRM system for the door-to-door services of NS. The product OV-fiets, rent a bike at the rail station, is registered in this CRM system. Information regarding a rental of OV-fiets is stored in Salesforce, but not all door-to-door services are recorded in this system. Besides, CSRs have to record the customer contact also in SAP CRM, since all customer contacts should be registered in SAP CRM. This dual CRM system has its origin from the different product owner: the door-to-door services are owned by NS Stations instead of NS Reizigers. The planning is to integrate all Salesforce CRM functions into SAP CRM, so only one CRM system has to be used.

**Refund** is the system where customers can send an application for a (partial) ticket refund by paper form or via the website. The application is processed automatically in a work list, however some applications require additional manual tasks due to incomplete information on the application. The refunds that can not automatically be processed, are processed by NS Klantenservice CSRs.

**UVB system** is the system where UVBs (Uitstel van Betaling - delayed payments) are registered. UVBs are the fines that are issued to a customer when he does not have a valid ticket on the train. The fines that are issued can be managed via this application, like waiving the fine and only issue the ticket price.

**Intershop** is the system where online non-seasonal tickets are sold. Single e-tickets and special action tickets are registered in this system. CSRs might have to use Intershop to lookup a ticket or its validity when a customer has an issue with these tickets.

**AVG** is a system for travellers that need assistance with boarding and disembarking the train. Travellers can register themselves via a web application, the Service Centre and MCC informs the personal on train that a traveller with special assistance will be on board. The personal at the station is also informed, so they can help the traveller with the actual boarding.

**EVA Live Presence** is the virtual assistance on the website of NS. It is a chat robot that gives explanations on frequent asked questions. When the customer is not satisfied with the answer, EVA suggests channels to contact NS Klantenservice. Emails are also sent via EVA to NS Klantenservice and the virtual assistance asks questions to identify the customer and categorise the message for NS Klantenservice. EVA is considered outside the scope of our thesis, but the emails the system generates are inside our scope.

**Reisregie** is a system that is used by the transportation operators to inform about disruptions. Actual information regarding disruptions is provided via this system and the MCC uses the system to support train employees. The information is only regarding NS information, whether there are buses deployed and there are free coffee and toilet access for travellers on specific stations. The MCC executes orders to deploy the buses and free facilities.

**ISVI** is the transportation operating system for the whole rail network in the Netherlands. The information is provided via the network operator and consist of the technical information regarding disruptions. The system provides information about what has happened, what is the alternative route and what is the expected time that the disruption is solved. The MCC uses this system to support on-train personnel.

**BAP** shows the actual schedule of trains and train employees. The MCC often wants to contact a employee on a specific train. BAP helps them to find which person is currently on that train. The system also knows the logistic schedule of the train units, so when the train has reached its final destination the MCC knows where that specific train is heading to. This information is used for tracking lost items on the train.

**Search engine** on the website is provided by Google. This system does not only redirect customers to the webpage where their answer can be found, but does also keep track on what search terms customers use, how much search queries are entered. With this system, the website content managers can keep track on what people are looking for and if they can find an answer to it. E.g. it can be the case that a special ticket is launched to visit a festival and this information is added on the website, but the search engine does not redirect to this page. The search engine is considered part of the self-services and fall outside our scope.
Taxi Munckhoff is the system to make reservations for taxis. NS uses taxis for their own employees, in order to transport employees to and from the switch yard. These taxis are part of the regular schedule of train operators, but sometimes the scheduling is incomplete and the MCC has to arrange a taxi for this employee. Besides, in case of disruptions and a traveller has missed his last train due to the disruption, taxis are deployed for customers. For larger groups, buses can be ordered via Taxi Munckhoff. Only the MCC uses this system.
We described all four domains of the AD in the sections 5.1, 5.2, 5.3, 5.4 and 5.5. In this appendix, we present the complete picture in terms of AD artefacts. The complete decomposition trees of the functional, physical and process domain are presented in figure C.1, C.2 and C.3.

The other artefacts of the AD are the mappings between the domains. The customer domain contains solely high-level attributes, which do not map on the detailed functions. Therefore, we have not create a mapping of the CAs to the FRs. The mapping of the FRs to the DPs is illustrated in figure C.4. The mapping of the DPs to the PVs is illustrated in figure C.5. The mappings are based on our own findings and learnings from the analysis.

The further analysis and redesign of the customer service system is not included in this appendix, but is described in section 5.7 and further and the design chapter 6.
Axiomatic Design artefacts

Figure C.1: Hierarchical decomposition of the Functional Requirements

Figure C.2: Hierarchical decomposition of the Design Parameters

Figure C.3: Hierarchical decomposition of the Process Variables
<table>
<thead>
<tr>
<th>FR/DP Mapping</th>
<th>Design Equation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Figure C.4: Design equation and full matrix of the FR/DP mapping</td>
<td></td>
</tr>
</tbody>
</table>
Figure C.5: Design equation and full matrix of the DP/PV mapping.
This appendix contains the transcripts of the semi-structured interviews as discussed in section 3.4. It contains interviews with:

- Paul Likumahu in section D.1;
- Jonne Balster in section D.2;
- Corina van der Heijde in section D.3.
D.1. Paul Likumahua

Vragen over de herinrichting van NS Klantenservice

Wat is je functie bij NS Klantenservice?
Ik ben ingehuurd als projectmanager bij NS Klantenservice voor het project samenvoeging centrales. Dit doe ik vanuit het bedrijf CCC (Customer Contact Centre – red) waarvoor ik al meerdere opdrachten heb uitgevoerd bij verschillende bedrijven. Dit is altijd in het klant contact centrum.

Wat is het project samenvoeging centrales en wanneer is dit project begonnen?
Samenvoeging centrales bestaat uit het samenvoegen van de vier contact centra tot 1 afdeling. Dit zijn de centrale van Binnenland, Internationaal, het MCC en de Servicecentrale. De Servicecentrale was onderdeel van het Concern Veiligheid, waar ook de Veiligheidscentrale onder valt. De serviceprocessen zoals de servicepalen op het station zijn uit de Veiligheidscentrale gehaald en naar de Servicecentrale verplaatst. Het hele project is ingegaan in het begin van 2015. Dit wil zeggen dat de vier centrales organisatorisch onder 1 afdeling zijn geplaatst, maar van een echte samenvoeging is nog geen sprake.

Wat waren de beoogde doelen met de samenvoeging centrales?
De beoogde voordelen waren een verbeterde efficiëntie en een betere klanttevredenheid. Op de vraag hoe dit gerealiseerd moest worden was echter nog geen antwoord. Wij hebben toen vragen gesteld over wat voor soort klant contact centrum NS Klantenservice moest worden. De verschillende modellen zijn cost-centre, value-centre, service-centre en profit-centre. Het verschil tussen deze modellen is de verhouding tussen de waarde die een klantcontact zou moeten opleveren versus de moeite het moet kosten voor de klant om contact te zoeken. Je zou kunnen stellen dat je als het ware een zeer goede service verleent, dat elke klant voor elke vraag de NS opbelt. Dit is natuurlijk erg prijzig. Bij een cost-centre wordt er gestuurd op kosten minimalisatie. Bij een profit-centre stuur je op omzet maximalisatie, dus bijvoorbeeld ook een agressieve verkoop van abonnementen. Een value-centre richt zich meer op de bredere waardes dan alleen omzet, bijvoorbeeld ook behoud van klanten en klanttevredenheid. Een value-centre voegt waarde toe voor de organisatie als geheel. Een service-centre richt zich op een excellente service voor de klanten. Uiteindelijk heeft de NS gekozen voor een soort van tussenvorm tussen een value- en een service-centre.

Wat is de beoogde indeling van de samenvoeging centrales?
Het plan is om alle activiteiten samen te voegen en in te delen in drie type processen. De serviceprocessen zijn veel voorkomend, generiek tussen de centrales en zijn snel af te handelen. Daarnaast zijn er verkoopprocessen, de verkoop bij NS bestaat uit de verkoop van abonnementen, behoud van abonnementsklanten en verkoop van internationale reizen. Het laatste type proces noemen we special care. Hierin zitten de overige processen die minder vaak voorkomen of ingericht zijn voor kwetsbare doelgroepen zoals gehandicapten. Uiteindelijk moeten de verkoop en service samen worden gevoegd tot Service+ processen. Dit is omdat de verkoopprocessen bij NS niet echt agressieve verkoop is, maar meer wordt gezien als service voor mensen die een abonnement willen aanschaffen of opzeggen. Wij hebben geen outbound campagnes om abonnementen te verkopen.

Tegen welke problemen liepen jullie aan in het begin?
Het probleem is dat niet van alle centrales data beschikbaar is. Van Binnenland is bijvoorbeeld veel data beschikbaar, maar van het MCC en de Servicecentrale niet. Ook worden er vele verschillende systemen gebruikt wat het lastig maakt om goede antwoorden te krijgen op de vragen. Daarnaast is er het probleem dat bij Internationaal (bijna) geen categorisering wordt gemaakt van de klantcontacten, omdat ze geen CRM systeem hebben.
Wat is de aanpak die je tot nu toe hebt gedaan?
Wij zijn begonnen met het in kaart brengen van de processen. Behalve de volumes hebben ze deze ook geclassificeerd op moeilijkheid, omdat lastige processen wellicht onder de Special Care categorie moeten vallen. De moeilijkheid is een opdeling van de benodigde vaardigheden, kennis, het type proces, de impact op het imago en de afhandeltijd. Een deel van deze analyse is te zien in Figuur 1.

Voor Binnenland was deze analyse redelijk makkelijk te maken, omdat alle klantcontacten worden geregistreerd in SAP CRM. Van de andere centrales is veel minder gedetailleerde informatie beschikbaar. De data waar we het mee moeten doen is te zien in Figuur 2.

Hoe ziet de roadmap tot een nieuwe inrichting eruit?
Deze is roadmap ziet er uit zoals te zien in Figuur 3. De centrales van Binnenland en Internationaal zijn al samengevoegd door de integratie van het bedrijfsonderdeel Internationaal binnen het onderdeel NS Reizigers. Dit was eerst een los onderdeel van de NS Groep holding. Op dit moment zijn de vier centrales in 1 afdeling geplaatst, maar zoals ik al eerder zei is dit alleen een organisatorische stap dan een daadwerkelijke integratie van processen. De vervolgstap bestaat uit het samenvoegen van de Front- en Backoffice van International en van Binnenland. Ook worden de special care processen van NS Onderweg ontvlochten. Op dit moment zijn er processen die gedeeltelijk door beide centrales worden uitgevoerd. De vervolgstap is om de Service & Verkoop processen te integreren van alle centrales, waarna uiteindelijk deze twee type processen ook samengevoegd kunnen worden. Deze laatste stap is nog niet helemaal zeker of dit wenselijk is, maar dat wordt te zijner tijd bekeken.
Wat moet er nog gebeuren om tot de eindsituatie te komen?
Er moet vooral aan de processen worden gewerkt. Van een aantal processen, voornamelijk van NS Onderweg, is op dit moment slecht zicht hoe deze verlopen. Dit zijn we nu aan het bekijken en ook aan het verbeteren. Ook moeten er dezelfde systemen worden gebruikt. Dit levert dan ook kengetallen op die volledig zijn en waarop je de verdere samenvoeging kan doorvoeren.

Wat zijn de grootste obstakels die de samenvoeging verhinderen?
Zoals ik al zei moet eerst de basis op orde zijn, dit zijn de processen. Ook moet de cultuur op de centrales gelijk worden gemaakt. Onder de cultuur valt bijvoorbeeld hoe wordt omgegaan met pauzes, werktijden en verlof. Ook is er inzicht nodig in de prestaties. Deze punten zijn historisch gevormd. Voor een samenvoeging is harmonisatie nodig. De muren tussen de afdelingen, de eigen eilandjes, zorgen er op dit moment voor dat de schaalvoordelen niet kunnen worden benut. De beoogde efficiënte voordelen kun je alleen halen als de muren weg zijn en medewerkers buiten hun huidige centrale kan inzetten.

Hartelijk bedankt voor je uitleg en verhaal!
Vragen over de diensten van NS

Woensdag 12 augustus 2015
Interviewer: Luuk Weerens
Interviewee: Jonne Balster

Wat is je functie bij NS Klantenservice?
Ik werk als verbetermanager bij de stafafdeling PCV (Proces-, Campagne- en Verbetermanagement) van NS Klantenservice.

Wat kun je vertellen over de verschillen tussen de diensten (Zakelijk, Consumenten, Deur-tot-deur) van NS?
De diensten van NS zijn organisch gegroeid. Als voorbeeld pak ik de d2d dienst OV Fiets. Dit is een dienst van het NS onderdeel NS Stations. Hierdoor heeft het van oorsprong een eigen applicatie en een eigen visie op Klantenservice, bijvoorbeeld dat je alleen per mail contact kan hebben met Klantenservice.

Tegenwoordig kun je ook wel bellen met Klantenservice en uitkomen bij OV-fiets toch?
Ja dit klopt. Vanuit de IVR kun je worden doorverbonden met medewerkers die in de applicatie van OV-fiets kunnen. Vanuit klantperspectief wil je gewoon 1 telefoonnummer of 1 ingang waar je je vragen kan stellen, of dit nu over je treinreis gaat of over een OV-fiets.

De verschillende merken (of segmenten – red) zijn vanuit commercieel oogpunt ingestoken. De splitsing tussen Zakelijk, Consumenten en Internationaal zie je ook terug in de organisatie. Binnen NS Reizigers heb je een directeur Zakelijk, een directeur Consumenten en een directeur Internationaal, met bijbehorend MT (management team – red). Vanuit commercieel oogpunt is er ook wel wat te zeggen over deze splitsing, echter ben ik van mening dat NS een logistieke dienstverlener is. Zeker vanuit het klantperspectief, en dus voor Klantenservice, is deze indeling niet perse de beste.

Maar wat is dan het verschil tussen Zakelijk en Consumenten?
Er is wel zeker een fundamenteel verschil tussen Zakelijk en Consumenten. Dit ligt vooral in de contracten en reisproducten die zij hebben. In figuur 1 is dit uitgetekend.

Bij consumenten is het basisprincipe Reizen op Saldo (ROS). Dit wil zeggen dat je een prepaid kaart hebt en altijd vooraf betaald. Je moet saldo hebben op je kaart wil je kunnen inchecken. Dit is gelijk aan hoe het vroeger was met een papieren kaartje: je koopt en betaalt een kaartje voordat je een reis maakt.

Bij zakelijk is het basisprincipe Reizen op Rekening (RoR). Dit is een dus een creditcard, aangezien je aan het einde van de maand betaalt voor de reizen die je gemaakt hebt. Alle reizen

Figuur 1: Verschil tussen consumenten en zakelijke producten


Wat betreft de reisproposities zijn er ook verschillen. De abonnementen die voor consumenten gelden, zijn anders dan voor zakelijk. De rekenregels qua geldigheid kunnen wel gelijk zijn, bijvoorbeeld een Trein Vrij abonnement voor zakelijk biedt hetzelfde reisrecht als een Altijd Vrij abonnement voor consumenten. Dat er twee verschillende benamingen worden gebruikt is ook een probleem in mijn ogen, omdat dit verwarring schept. Echter, doordat de marketing gescheiden is, gooit iedere afdeling zijn eigen marketing ‘saus’ eroverheen.

Niet alle abonnementen van consumenten hebben een zakelijke variant. De abonnementen van zakelijk hebben wel een consumentenvariant met dezelfde reisrechten. Wat ook anders kan zijn is de prijs van hetzelfde reisrecht. OV-fiets voor zakelijk is bijvoorbeeld duurder dan voor consumenten, omdat de laatste een abonnementsgeld per jaar moeten betalen. Verder is de dienst wel gelijk.

Wat betreft de d2d diensten zijn niet alle d2d diensten beschikbaar voor consumenten. Alle d2d diensten zijn beschikbaar voor zakelijke klanten, maar alleen sommigen voor consumenten. Greenwheels (auto huur) en Logius (vergaderruimte huur) is niet mogelijk voor consumenten.

Ik heb net verteld dat consumenten als principe Reizen op Saldo en zakelijk Reizen op Rekening. Dit is waar, behalve dat consumentenklanten met een Traject Vrij abonnement wel Reizen op Rekening. Bij Traject Vrij reis je bijvoorbeeld gratis tussen Utrecht en Delft. Wanneer je dan reist van Delft naar Dordrecht, is een stuk van dat traject (Delft Rotterdam) onderdeel van je Traject Vrij. Het andere deel (Rotterdam Dordrecht) niet. Er moet worden berekend hoeveel je dus buiten je traject reist. Dit kan niet in de 0,3 seconden die een check-in paal gebruikt. In plaats daarvan wordt deze reis ’s nachts berekend en krijg je dus de kosten van buiten je traject op rekening.

Het verschil tussen een consument die Traject Vrij heeft en een zakelijke klant die het vergelijkbare abonnement heeft is toch ook niet groot?

Nee dat klopt. Vaak willen werkgevers geen contract afsluiten met de NS. De werknemer krijgt misschien wel zijn traject vergoed, maar moet dit als consumentenklant zelf afsluiten. In wezen is er hier geen verschil, behalve dat het contract op een andere manier is afgesloten.

**De verschillen tussen Consumenten en Zakelijk heb je uitgelegd, wat zijn de overeenkomsten?**

De gemene deler tussen Consumenten, Zakelijk en Internationaal is natuurlijk het traject (zie figuur 2). Rondom de traject zijn een aantal logistieke processen, zoals reisinformatie, faciliteiten op het station en de traject. Zoals ik heb geteld zorgen de logistieke processen en specifieke consumenten vragen voor 90% van de klantcontacten. Zakelijk draagt 8% bij en Internationaal 2%. Het grootste deel van de 90% (logistiek en consumenten – red) bestaat uit algemene vragen: de logistieke vragen.

Jij zegt dat de algemene/logistieke vragen onder Consumenten zouden moeten vallen. Je kan deze natuurlijk ook los trekken als overkoepelend geheel en specifieke consumentenvragen los behandelen zoals Zakelijk en Internationaal.

Ja dat kan ook, dat komt ongeveer op hetzelfde neer. Het algemene/logistieke deel is de brede koker waar de meeste vragen worden afgevangen. Reisproduct of ticket kennis is het specifieke deel en dat is dus ook afhankelijk van of je Consumenten, Zakelijk of Internationale klant bent.
Zoals het nu is ingedeeld heb je drie trechters. Een klantcontact komt bovenin de trechter binnen. Wanneer de vraag te lastig is om door de eerste lijn / front office geholpen te kunnen worden, wordt deze doorgezet naar een tweede lijn / back office. Hiervoor wordt ook gebruik gemaakt van een service- en it melding. Dit is een melding die in de werklijst van de back office verschijnt. Zij pakken de vraag dan op. Dit doorzetten is noodzakelijk omdat er bijvoorbeeld specialistische kennis nodig is, of specialistische applicaties gebruikt moeten worden. Niet alle medewerkers kunnen en mogen in alle systemen. Het doorzetten naar een team specialisten is dus altijd wel nodig voor sommige vragen.

Waar je naar toe wil, is dat je trechter veel breder is en een aantal specifieke teams heeft.
Alles wat on-the-spot kan worden afgehandeld bij het algemene deel, hoeft niet verdeeld te worden in een van de segmenten. Abonnement/ticket gerelateerde vragen gaan naar 1 van de segmenten. Eventueel heb je daarbinnen nog een back-office, net als voor algemene vragen die verdieping nodig hebben.

Wat betreft de leercurve van medewerkers is het logisch dat deze steeds meer specialismes erbij leren. Sommige processen zijn opgebouwd in deel 1, 2 en 3. Voor 2 moet je ook 1 hebben en voor 3 moet je 1 en 2 hebben. Na training van alle drie de onderdelen kun je dan het gehele proces en ben je het breedst inzetbaar.

Hartelijk bedankt voor je uitleg en verhaal!
Vragen met het oog op opleiding

Woensdag 12 augustus 2015
Interviewer: Luuk Weerens
Interviewee: Corina van der Heijden

Wat is je functie bij NS Klantenservice?
Als Regisseur Vakmanschap &Ontwikkeling, werk ik voor NS Groep, afdeling Talent & Organisatieontwikkeling. Vanuit deze rol heb ik twee domeinen die ik adviseer en regisseer m.b.t. opleidingen; dit zijn Klantenservice en Reisinformatie.

Welke projecten werk je momenteel aan in het kader van herinrichting NS KS?
Samenvoegen Centrales, zoals het ook wel genoemd wordt is het totale plan waar ik als Regisseur bij betrokken ben. D.w.z. dat alle herinrichtingszaken die binnen KS worden geïnitieerd, ik mijn visie over ontwikkeling erop loslaat. Op die manier ben en word ik betrokken bij alle ontwikkelingen binnen Samenvoegen centrales die (mogelijk) impact hebben op de ontwikkeling van de (operationele) medewerkers van NS KlanteNService.

KS is nu opgedeeld in een aantal kokers van producten: Consumenten, Consumenten JKF, Zakelijk, NS/OV Fiets, International. In hoeverre zit er overlap tussen deze kokers qua benodigde kennis van het proces?
Ik zou hier niet spreken over kokers; men spreekt over werkpakketten en skills. Ofwel; divisies binnen Klantenservice. Qua proces zit er gedeeltelijk overlap in, echter dit vraagt om een wederzijds overlap in, wanneer dit vraagt om een wederzijds overlappend in, wat bedoel je met proces?

De afgebakende werkpakketten noem ik hier een koker.
Opleidingen worden nu geïnitieerd door centrales: Internationaal, Binnenland of NS Onderweg. Binnen de centrale kan er weer een speciale wens zijn, bijvoorbeeld een opleiding van NS fiets bij Binnenland. De ‘oude’ opleidingen zijn nog losse onderdelen. Bij de opleiding van 24/7 hebben we gezien dat er wel overlap zit.

Hoe ziet de opleiding van 24/7 eruit op het moment? (zie Figuur 3)
Bij 24/7 hebben we een selectieprofiel opgesteld voor medewerkers die vooral in de avonden, nacht en feestdagen willen werken. Zij zijn begonnen met de opleiding 24/7. Dit houdt in dat ze of specialist Binnenland of specialist Internationaal worden. Na de opleiding draaien ze een aantal weken productie bij hun specialisme, om ervaring op te doen met klantcontacten. Na de productie gaan medewerkers in dooropreiking om het andere deel te leveren (binnenland of internationaal), dit is een verkorte opleiding. Hierna kunnen ze in productie bij 24/7. De planners moeten vervolgens rekening houden dat niet 2 mensen met hetzelfde specialisme worden ingedeeld in 1 nacht, omdat je team anders niet allround is.
Het idee is dat de medewerkers de top 5 vragen van NS Onderweg, Internationaal en Binnenland kunnen beantwoorden in de nacht. Sommige vragen worden doorgezet naar medewerkers overdag. Dit zijn vragen die om specialistische kennis vraagt, of om meerdere handelingen vraagt. Het kan dus zijn dat een klant in de nacht wordt gevraagd wanneer hij mag worden teruggebeld door NS overdag, om zijn vraag te beantwoorden.
In hoeverre worden nieuwe opleidingsmanieren al toegepast?
Het probleem is dat we de opleidingen opnieuw moeten inrichten (Building the business), terwijl het werk gewoon doorgaat (running the business). Zo is er laatst een klasje geweest dat een specialistisch werkpakket ging leren, omdat we vanuit planning aan zagen komen dat door pensioneringen en vertrekken er te weinig capaciteit was op de huidige processen.

De oude opleidingen blijven dus gegeven worden tot een nieuwe inrichting af is?
Er worden wel kleine “lessons learned” meegenomen bij de huidige opleidingen. Zo is de opleiding van Internationaal verkort van 6 naar 3 weken. Dit was mede doordat er minder parate kennis gevraagd werd en meer vaardigheden, waardoor medewerkers niet 6 weken lang moesten stampen.

Agents hebben nu vanuit de historie vaak direct klantcontact (telefonisch, chat) of contact op afstand (via brief, email). Is het realistisch om te verwachten dat agents dit allemaal kunnen en willen?
Bij de agents die social media doen merken we nu dat niet iedereen geschikt is. Er worden andere competenties gevraagd voor social media dan voor telefonie. We hebben zelf een stroomschema ontwikkeld (zie figuur 4) voor opleiding mbt kanalen. In principe is elk kanaal een vaardigheid. Binnen een kanaal krijgen medewerkers nu een specifieke opleiding, bijvoorbeeld Internationaal. Dit is dan kennis en vaardigheden van het domein Internationaal. Voor 24/7 leren we medewerkers maar twee kanalen, namelijk telefonie en webcare. De andere kanalen liggen stil in de nacht. Andere medewerkers kunnen vanaf telefonie doortromen naar email, brief en zo wellicht uitkomen bij Webcare. Wanneer je eenmaal de vaardigheden van een kanaal hebt, kun je wel verbreden door een ander domein erbij te leren. Deze kennis en toepassing van de kennis voeg je toe.
Ik kan mij voorstellen dat telefonie voor zakelijke klanten andere vaardigheden vereist dan telefonie voor consumenten. Is dat ook zo?

De gesprekstechnieken binnen een kanaal zijn voor alle werkstromen/domeinen gelijk. Het is niet zo dat bij zakelijk een klant met ‘u’ wordt aangesproken en bij consumenten met ‘jij’. Vaardigheden over het kanaal zijn dus universeel. Wat natuurlijk wel anders is, is de kennis die nodig is om de klant te woord te staan. De toepassing van de kennis kan ook anders zijn, omdat er andere regels gelden. Echter, als je telefonie ‘kan’ bij de ene centrale, kun je dit ook bij een andere zodra je de kennis hebt bijgespierd.

Bij de verandering in de benodigde kennis van agents lijkt het alsof agents alleen maar meer moeten weten. In hoeverre denk je dat agents dit nog aankunnen bij hetzelfde competentieprofiel? Wat zou er anders moeten zodat men wel ‘bredere’ service kan verlenen?

Een verandering die wij ondergaan is een verschuiving van kennis naar vaardigheden. De oude blik is dat medewerkers veel kennis nodig hebben om klanten te helpen. Dit willen we verschuiven naar minder parate kennis maar juist meer vaardigheden om kennis te vinden. Bij opleidingen gebruiken we vaak de driehoek kennis - houding&gedrag – processen & vaardigheden (zie Figuur 5 – rood). Veranderende tijden vragen ook om andere vaardigheden. Een van de vaardigheden waar wij meer op willen inzetten, is vindbaarheid van kennis. Hiervoor zijn we een kennisbank (content management system) aan het opzetten. Natuurlijk hebben medewerkers parate kennis nodig, maar veel specifieke zaken kun je op deze manier ook vinden. De integraties van de centrales heeft ook een impact op de kennisbank. De informatie is nu verspreid in een kennisbank per centrale. Dit moet dan ook worden samengevoegd.
De nieuwe kijk op opleiding (minder parate kennis, meer zoekvaardigheden – red) zorgt ervoor dat we klant-/ vraaggestuurd kunnen werken bij NS Klantenservice. De inrichting van opleidingen sluit hier bij aan. Wij willen dat medewerkers de klanten faciliteren naar het goede proces. Het kan zijn dat de medewerker de klant direct kan helpen, maar als dat niet is moet hij de klant faciliteren. Bij processen die vanwege complexiteit niet direct kunnen worden afgehandeld, ‘houden we de klant aan de hand vast’ zodat deze zonder zelf meer moeite hoeft te doen naar het juiste proces gerouteerd wordt. Bij processen waarbij vanuit beleid geen service wordt geleverd door Klantenservice, ‘helpen we de klant oversteken’. Dit wil zeggen dat we de klant de weg wijzen hoe hij het zelf kan regelen.

Ik kan mij voorstellen dat Geld-terug-bij-vertraging of Vergeten-Check-In-Check-Out processen zijn waarbij in de toekomst wordt gezegd dat dit alleen online kan worden ingediend.

Dat zou kunnen. Dit is dan een voorbeeld van de klant helpen oversteken. We gaan in dat geval de klant uitleggen hoe hij het zelf kan regelen en waarom dit gemakkelijker is.

Het concept faciliterend opleiden willen we bij alle Klantenservice opleidingen gaan toepassen. Dit moet vervolgens ook getoetst worden om de kwaliteit te kunnen waarborgen. Dit gebeurt niet door ons (opleidingen – red) maar door de collega’s van Kwaliteit.

Een faciliterende rol van een medewerker werkt denk ik goed voor de Service+ processen. Hoe zit dat bij Special Care?

Bij Special Care heb je veel meer specialisten nodig. Sommige processen vereisen strakke protocollen, zoals bij medewerkers die achter klanten met schulden aan zitten. Schuldhulpverlening is een vak apart, waar ook wettelijke regels voor gelden. Dit soort processen moet je dus wel specialistisch houden. Waar je wel voor moet opletten is de betrouwbaarheid van een proces. Als er maar 2 mensen zijn die weten hoe iets moet, is dat gevaarlijk. Eentje kan ziek zijn en de andere op vakantie, waardoor je proces stil ligt. Hier moet je voor opletten. We leiden daarom mensen ook op zodat ze specialistische vaardigheden erbij krijgen, en dat de betrouwbaarheid gegarandeerd blijft.
Hoe zie jij de rol van een outsourced contact center (Webhelp in dit geval) in het geheel? Als NS alles terug zou halen, wat voor voordelen zie jij daar vanuit opleiding en kennis? En wat voor nadelen?

Webhelp heeft een hele andere business strategie dan wij hebben. NS moet klanten helpen, Webhelp verstrekt vooral directe kennis en informatie, of routeert de vraag door naar ons. Dit zijn natuurlijk ook afspraken, maar Webhelp vangt vooral de grote bulk op.

Je zou kunnen zeggen dat dit afvangen en doorzetten waar nodig ook een methode is die bij NS gebruikt kan worden.

Ja dat willen wij eigenlijk ook. De onderwerpen van de kanalen die Webhelp niet afhandelt zijn hetzelfde als dat zij doen. In principe doet Webhelp niks wat wij niet ook kunnen. Alle lastige/tweedelijnsvragen komen naar NS, terwijl de vragen die Webhelp wel afhandelt ook door NS worden gedaan op momenten ('s nachts) of via kanalen die Webhelp niet bedient.

Verder heb ik niet direct een mening over Webhelp. Wij (opleiding) werken wel samen met Webhelp om te leren over opleidingen. Webhelp stuurt veel strikter op het leerproces, welke vaardigheden moet iemand beheersen. Zij zijn ook veel zakelijker als het gaat om medewerkers die het niet aankunnen.

Hoe zou je, volgens jou, de “Service+” afdeling moeten inrichten met betrekking tot de kennis van agents en opleidingen?

Medewerkers alle skills leren van alle centrales is niet mogelijk. Dit is gewoon teveel. Wel zou je medewerkers meer allround kunnen laten zijn. Het faciliterend aspect zorgt ervoor dat klanten worden begeleid naar de juist plek, indien ze niet direct geholpen kunnen worden. Daarnaast zou de vaardigheid om met minder parate kennis en meer vindbare kennis je meer onder allround kan laten vallen. Een voorwaarde hiervoor is wel dat je een geïntegreerd en goed werkend kennis systeem hebt.

Bedankt voor je informatie en tijd!