Decoupling multi-channel services by decomposition of service elements

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Dated: November 9, 2015

Abstract
Customer service systems suffer from poorly integrated contact channels and customer data due to legacy systems and historical growth of the organisation. The tangle of dependencies between contact channels, core services and service elements cause a complex and coupled system. This research focusses on a design approach where these problems are tackled by applying the Axiomatic Design method. This novel application contributes both to the applicability of Axiomatic Design, as it takes a new approach to design a customer service system. By analysing the situation within a case study, we are able to provide a single design structure for a contact centre that supports multiple, different core services. This design enables the organisation to provide a higher quality service with more efficiency and allows a better controllable organisation. Our research reveals standardised service processes and a high level of complexity in the service system as characteristics for service systems that can be design with Axiomatic Design. Therefore, we see opportunities to elaborate the use of Axiomatic Design in service systems design based on our exploration.

Keywords: Axiomatic Design, decomposition, multi-channel, customer service system, contact centre

1. Introduction
New technologies make it possible for service organisations to use more and more channels in their service delivering (Patricio, Fisk, Cunha, & Constantine, 2011). Multi-channel service delivering is desirable from the customer perspective, as it increases the service accessibility. Customers also expect organisations to offer their services via new channels, as we see channels that use internet and mobile techniques as new. From the company perspective, the delivery possibilities of new channels create ways to better reach certain target groups, although the core reason is often cost efficient based (Hughes, 2006). The downside of multi-channel service delivery is that the operation is often not designed for a multi-channel delivery (Neslin et al., 2006). New channels are added to the service operation, but often form distinct functional silos that serve solely that channel (Hughes, 2006). Not integrated channels lead to problems as information inconsistency, differences in perceived service delivery and redirecting customer from the one channel to the other channel. Inconsistent information leads to more contacts with the company just...
as the redirecting of customer to an other silo of the company. All of this is problematic, since it leads to a lower service quality as perceived by customers and unnecessary costs for the company. This problem asks for more channel synergy.

This article describes an approach of how we entangled the multi-channel service delivery functions of a customer contact centre and created a design where the contact channel is reduced to one element of all service delivery functions. The service system is decoupled along three dimensions: the contact channels, the core services and the service elements. The existing coupling of the three dimensions cause complexity, as it makes it hard to have a full picture because of all the if-then exceptions, e.g. this service elements of that core service is solely delivered via this channel. Earlier attempts of scholars focus on how to deliver services via multiple channels (Simons, 2006) and what modularisation can add to create a less complex design for multiple services (Feenstra, 2011), but not a combination of both multi-channels and multi-services. The design is capable of performing customer service for multiple core services via multiple channels. The definition of multiple core services in this statement needs to be emphasised. We see a distinct service fulfilling a different need and function for the customer as core service. E.g. a bank can provide multiple financial services: from mortgages for houses to insurance products to payment services as a bank account. We call these three elements from the example three core services, making the bank having multiple core services. When the bank in our example covered the customer service support at one overarching customer service department, we can visualise in what situation our research is conducted.

The service industry is growing every year in terms of percentage of the world’s Gross Domestic Product (GDP). In 2013, over 70% of the world’s GDP is produced in service industry (World Bank, 2015). The support to the customer of the services are often placed in the company’s department called the customer contact centre. Typical customer contact centres handle at least inbound telephone calls (call centres), that employs 2.7 million people in 2008 in the US alone (Aksin, Armony, & Mehrotra, 2007). Operations managers of customer contact centres have the task to provide higher quality service at lower costs. Most costs in a contact centre are the operational employees, encountering for 60-80% of the total operational expenses (Gans, Koole, & Mandelbaum, 2003; Aksin et al., 2007). An integrated customer service system design helps the management in achieving the goals of lowering costs and increasing service quality. Not only will an integrated customer service design reduce information inconsistency, the flexibility of the contact centre increases making it benefit from economies of scale and reducing costs.

Our research is aimed on solving the integration problem of multiple core services delivered via multiple channels, by creating a customer service system that integrates all channels and services in one design. The customer service system design describes the major functions of the contact centre operations that are performed to handle an incoming customer contact. We create this design by following the principles of the Axiomatic Design, which are explained later. The Axiomatic Design method is applied in several areas such as software design, product design, manufacturing system design and system design (Kulak, Cebi, & Kahraman, 2010). The method might be useful, since it includes hierarchical decomposition and structuring, uses four domains to differentiate between the different views in the system and poses design laws that help the designer to decouple a complex system. Application to pure service systems design are not found in our search. A customer contact centre operates in a service characterised environment, but the agents in a contact centre are often managed as-if the are machines in a manufacturing environment. The productivity of the agents is maximised by telling the agents what activity they have to perform. This similarity with a manufacturing system provides us the idea of applying the Axiomatic Design for...
designing a customer service organisation. Organisational design is also mentioned by Suh (1995) as design task where the Axiomatic Design can be applied, but is not performed as far as we found. Suh is the founder of the Axiomatic Design method.

Service system design methods are not new to science. Well-known methods are Service Blueprinting (Shostack, 1984) and the Quality Deployment Function (Stuart & Tax, 1996). These service design methods do focus on the design of a service in general, what we mean with a core service. Customer service is one of the components of a core service. Our approach to integrate multiple services provided via multiple channels is from the view of the organisation. The traditional service design methods do, in our opinion, not focus enough on the organisation's operation. Service Blueprinting does create an overall picture of the total service system, but does not provide enough analytical power to solve our complexity caused by the three dimensional coupling. Therefore, we take the Axiomatic Design method which does focus on detailed components. This approach contributes to science in two ways. First, our approach leads to a solution for the integration problem for multiple services in a multi-channel context. Second, we demonstrate that the Axiomatic Design method can be applied on organisational design tasks, in a service-oriented environment. We want to see if and how Axiomatic Design is useful for the design of service systems. Our research contributes a step to this goal by applying the method on one case, in the area of customer service systems. Adding customer service system design to the applicability of Axiomatic Design enables future scholars to apply the method in other service design areas. Designing better services increases customer satisfaction and is our contribution towards a better society.

The Axiomatic Design guided us in the design process, leading to a blueprint of the customer service organisation, where all operational activities are described. The design method helped us to reduce the channel differences into a single function. The differences in customer services due to the different core services are also incorporated, because the required functions are generic over all services. The organisational design for the contact centre results in a single functional design for all channels and services. The single design is promising in creating a flexible customer service organisation that is able to serve customers with a higher quality of service.

2. Axiomatic Design principles

The Axiomatic Design is a systematic design method based on the idea that good design is founded on principles, the axioms (Suh, 1995, 1998). Axiomatic Design divides the design object into four domains. In the customer domain, the Customer Attributes (CAs) represent the customer needs that the design should satisfy. The functional domain is a translation of the CAs in Functional Requirements (FRs) and Constraints (C) of the design object. The FRs describe what the functions of the design are in a solution neutral environment: only what functions should the design produce and not how this is to be done. The FRs form a set of independent requirements that the design object has to satisfy. The how question is answered in the physical domain and is described in terms of Design Parameters (DPs). DPs are the possible design choices that ensures the functions of the functional domain. In the last, process domain, the Process Variables (PVs) are designed that produce the specified DPs. Every domain on the left relative to the domain on the right can be seen as what we want to achieve, where

![Figure 1: Axiomatic Design framework with four domains and three mappings (Suh, 1998, p. 204)](image-url)
the domain on the right relative to the domain on the left tells how the designer wants to satisfy the what. The translation of the one domain in the other domain is made in a mapping between the two domains. The entire Axiomatic Design framework consists out of four domains and three mappings, as illustrated in figure 1. In addition, there are two principles that define what design is acceptable and how to find the best design.

The two principles are the two axioms that give the name the Axiomatic Design method its name. The first axiom is the Independence Axiom, which states that the independence of the FRs should always be maintained. From this follows that each function in the design object can be satisfied, without that other functions are affected. The Independence Axiom prevents coupled designs where functions are interrelated and changes in the one function cause another function to change. The independences of the FRs poses requirements on the DPs. The set of DPs has to be designed in such way that the first axiom is not violated. A design satisfying the first axiom is an acceptable design. When multiple acceptable designs are possible, the second axiom determines the best design. The second axiom is called the Information Axiom and states that the design with the highest probability of success is the best design. Concrete, it means that the information content in the design is minimized. The information content is defined in terms of probability ranges. When the FR range matches the DP range fully, the probability of the DP of satisfying the FR is maximum, thus the information content minimum.

Our design approach makes use of the Axiomatic Design principles, but focuses more on some principles and leaves other principles aside. Our approach is rather high-level in terms of FRs and DPs, resulting in a reasonable number of elements. This makes it hard to define hard, quantitative ranges for each FR and DP. The Information Axiom tells us to minimise the information content, by maximising the probability the DP satisfy the FR. The probability ranges are hard ranges, which we did not define. Therefore, we did not include the Information Axiom in our design. We fully focused on the Independence Axiom, which resulted that the functional and physical domains received more attention than the other two domains. Since we applied the Axiomatic Design in a novel environment, we provide proof that the method can be applied in (customer) service systems. Limitations in our research should be studied in future research.

3. Methodology

The Axiomatic Design has to be applied on a real environment. We performed a case study at the customer service department of the Dutch railway company Nederlandse Spoorwegon. The case study gave us access to empirical evidence of the operations of the customer service department. This evidence is used as input for the analysis and design.

We used five types of evidence in our research. We conducted three semi-structured interviews with employees, responsible for process improvement of the customer services, for developing and giving training to customer service agents and the project manager who is responsible for the project of integrating four contact centres into one customer contact centre. Besides semi-structured interviews, we also performed informal interviews with staff and operational employees of the department. The opportunity to conduct informal interviews was largely possible due our nine months internship at the department. Here, we also gained experience which can be described as ethnographic research. Observations and experiences during this time contributed to our sophisticated understanding of the current operation. The detailed understanding from ethnographic research is not necessary, but helped us to gain a complete understanding including all interactions that are to be described by the Axiomatic Design.

The last two types of evidences are related to archival evidence. Presentations, documentations and training material for agents provided us information about instructions and policies used in the operation. Policy docu-
ments contributed to our knowledge of channel strategies that are to be developed and the customer needs as perceived by the management of the customer service department. A second source of archival information is treated separately, this is database information. The largest database that provided information is the database where all interactions between the customer service department and the customer are stored. These interactions are recorded in a Customer Relationship Management system (CRM). The CRM system contains data fields as used channel for interaction, links the contact to the customer account and stores the categorisation of the contact based on the content of the customer question. The agents select the category of the contact, so the organisation knows the frequency of the type of questions. Business intelligence tools provide insights in the enormous amount of data that is stored in the CRM system. The most important insight we used, is the amount of contacts for each process in the organisation. Based on this information, we selected the top-used activities and analysed the required resources for these activities. This information was vital for our analysis and therefore for our design. The top-used activities are used to select real cases in such way that all the top activities of each contact channel were included in our analysis. The cases formed the input as PVs in our Axiomatic Design. Based on what resources and skills were involved in handling the cases, we identified the DPs. The analysed functions per contact channel were also analysed on required DPs. Looking form both domains to the DPs, created the complete list of DPs that were used in the study.

4. Application at the case study

The observed customer service department makes use of five contact channels that are served with agents. The customer service is provided for three core services. The first core service is the largest in terms of contact volume is divided into two customer segments: consumer and business customers. The second core service requires some specific activities supported by the customer service department. The third core service is more a auxiliary service to the first core service, where there are differences in the service according to the segments of the first service. This mixture of channels and services make that the current situation is complexly organised, since the organisational structure is formed by legacy systems, separated core service silos and historical growth. Newer contact channels are not integrated completely, leading to information inconsistency and differences in service quality.

The design evaluation is performed based on expert validation. Experts commented the Axiomatic Design artefact that was transformed in a flow chart, which described all functions of the Axiomatic Design. The expert validation is done in a workshop setting, we could interactively gather feedback from the experts.
flected against the company’s archival information, which resulted in that the tangible aspect was removed since a customer service provides very little tangible evidence to the customer. The efficiency aspect is added to the CAs, as this came forward from the empirical evidence. The last added CA is found in customer service literature. Completely integrating all channel activities creates integrated customer data. This enables the customer service organisation to serve the customers better and increase the efficiency (Gans et al., 2003; Mitchell, 2007). This need is driven from the customer service organisation and is included in the CAs as a consistent customer view.

The six CAs had to be transformed into FRs. The customer service system has several functions to handle a contact, but also has five contact channels. Because we needed a starting point, we made the initial assumption that each contact channel has different functional components. Therefore, we created the first-level decomposition of the functional domain into the five contact channels, as displayed in figure 3.

The DPs that tell us how the FRs are satisfied were initially created per first-level function. However, the DPs between the channels differ only a little and most DPs are exactly the same. We restructured the Axiomatic Design, so that the FRs satisfying by the same DP also had this coupled interaction. The Axiomatic Design now contained of five first-level functions according to the five contact channels. The physical domain contained five first-level, generic DPs that interacted with all channels and one group of DPs that interacted with specific contact channel functions. Figure 4 shows the mapping of the first-level FRs and the DPs. Creating the generic DP integrates the contact channels almost completely in the physical domain, but creates a coupled design when the more decomposed elements of the functional and physical domain are included. The Independence Axiom is not satisfied by this design.

By further decomposing the functional domain, it appeared that all channels contained of generic functions. Not all channels made use of all functions, because some channels had automatised functions while at other channels agents processed these functions manually. Channel differences were present in the starting and ending of handling a contact, since some channels have specific features. The higher level functions are all the same between the channels. This resulted in a decoupled Axiomatic Design as illustrated in figure 5. Table 1 shows the hierarchically decomposition of the functional and physical domain, with the description of the FRs and DPs as used in our study.

The final design resulted in a single customer service design where all contact channels were included in the design. Required resources were mapped on the functional design in such way that the influence of the chosen contact channel was minimum. Customers choosing the one channel might experience a differences as long as the are fundamental to the channel, such as the physical evidence of a written email or letter versus a telephone conversation. The content of the contact can be related to information about the core services or to actions that are required because the customer has personalised needs. Personalised
needs are common in services, since the heterogeneity of services make that all customer have slightly different needs. In our case, the actions are mostly related to subscriptions to the service and actions that follow from the usages of the service. All these actions were treated in a common way in the final design, not depending on the contact channel.

5. Evaluation
We evaluated the design based on three criteria: validity, utility and efficacy (Gregor & Hevner, 2013; Palmius, 2007). For this, we used expert validation. The experts present at the workshop included an expert on the design of customer contact centres, as the expert leaded many projects to improve customer contact centres in the Netherlands. Besides, we included expertise on the operational management of the customer service department of our case, with three roles: optimising the overall performance, optimising the daily performance and managing a team of operational agents. The expert validation workshop validated our design, as all of the six highest level FRs were discussed. Their feedback contained no missing elements in the functions. Because all six functions are validated individually, we take the validity of our design as true. The expert validation only offers face validity, but we were not able to implement the design and test it in a real environment, because of the large impact and effort it takes to implement the design.

The Axiomatic Design was not the only artefact presented in the workshop. A derivative artefact that maps the customer service system design (the Axiomatic Design) on the organisation was also discussed. The utility of this artefact was valued high, as it inspired the organisation in solving directions for their issue. The design is therefore assessed as useful, as the organisation uses it to design their new organisational structure. This also reveals something about the efficacy of the design. The Axiomatic Design artefact has to be translated in understandable artefacts for decision makers. We performed this task, but not for a 100%. We suggested some further elaboration on issues of hierarchical structures in the organisational design. Therefore, we evaluate the efficacy criterion not entirely as satisfied. However, the design in general is useful and therefore evaluated positively.

6. Discussion
Our study shows that the Axiomatic Design method is applicable on customer service sys-
tem design. The typical problems related to customer service system, as multiple contact channels and supporting multiple core services are handled in the design. The Independence Axiom is satisfied in the design, resulting in an acceptable design in terms of the Axiomatic Design. The multi-channel services integration problem can be tackled, at least when applied in a customer service organisation. This opens up possibilities to create an organisational structure that coops with the allocation of the operational activities. Because of the structured design, such an allocation can be done efficiently and makes it possible to introduce a great amount of flexibility in the customer service organisation.

The design method is novel for service system design. Although the founder of the Axiomatic Design method included organisational designs in his list of applicable areas (Suh, 1995), a literature review containing 63 papers did not include any service system related application (Kulak et al., 2010). Traditional service system design methods focus primarily on the interface of customer / company. We do not deny the importance of this interface in services, but the focus of a customer service organisation is slightly different. Customer service as a department contributes only partially to the total service experience of the core service. A customer contact centre is very focused on the operational processes. Due to the large share of human capital in the total expenses, there is a constant trade-off between efficient allocation of resources and providing a high quality service. This focus on operations make that the traditional service design methods are less useful for the design of customer service systems. Pure contact centre literature does provide general methods to deal between the trade-off, but is not directed on the design of a specific organisation. The Axiomatic Design appeared to be useful in creating a organisation specific design, taking into account the trade-offs of a customer contact centre.

The research goal to apply a design method that enables us to integrate multiple core services provided via multiple channels is achieved. All channels and services are integrated in one design. This enables the organisation to minimise information inconsistencies between channels and opens opportunities to create a complete view of their customers by integrating all contact data. Before these opportunities are realised, the applications and IT systems used should be harmonised. A channel and core service independent design assumes that all unique function in the design is supported by an unique IT system. The single design makes it possible to introduce a structure of how to manage the operational workforce. From operational management perspective, the entire customer service organisation can be controlled in a holistic way.

We encountered two issues in our research that are worth addressing them. The largest issue contains the validity of our analysis. We did validate the analysis via an expert workshop. In this workshop, the method and approach were explained and the analysis was discussed in detail per function block. This was very valuable and served both as validation for the analysis, but also as confidence boost of the design. A more interactive analysis, where expert feedback is included in an earlier phase of the design, might helped us better. The positive side of our used approach is that we used the same workshop to design a specific system of how to manage the employability of the agents at the customer service organisation. Validating the analysis at an earlier time would probably help us better in the design stage, but splitting up the two activities into two workshops could be harder to realise since it demands quite some time from the experts. A second issue was the data available for analysis. Although the CRM data covered the most activities, as the desired need of integrated data was not fulfilled yet, some channels were not covered by the CRM system. We did include these channels, but the combined data set was created by first categorising the activities based on the CRM data and later adding the other data. This caused that the other data had to fit the structure of the CRM data, which required some wider interpretation of the data. We recommend future
researcher to prevent this issue by first preparing all data, before categorising the complete data set.

Due to our limited time, we only focussed in the analysis and design on the most performed activities in the customer contact centre. As a result, not all activities are included in the design. The design could be biased to the most performed activities which are, because of their oft-recurring character, be better optimised in the current situation. Less occurring activities might therefore require different functions than the ones we identified.

We recommend two directions for future work. First, the current approach of applying Axiomatic Design on a customer service system can be completed by adding the Information Axiom in the design. This requires to state the FRs and DPs in ranges, so the probability of a DP satisfying a FR can be expressed. Including the Information Axiom makes the design approach fit better the Axiomatic Design, because multiple acceptable design solutions can then objectively be compared and the best solution will come forward. A second future work direction could be widening the scope of customer service systems to service systems in general. We think that applying Axiomatic Design on service systems can be successful, especially when the functions of a service are divided among several units or department within the service organisation. We expect that an optimal service design according to Axiomatic Design will imply how the service organisation should be structured: what unit delivers what service element and what resources are needed. Clearly divided activities with corresponding responsible units will, in our eyes, maximise the awareness and leads to better services. From our case study, we see two characteristics that a service system should posses in order for Axiomatic Design to be useful. First is enough complexity in the service system, so the analytical method is appropriate for the system. The complexity can then be structured and decoupled by the Axiomatic Design method. Second, our case study shows a high level of standardisation in the processes. This makes it possible to generalise on functions and create hierarchies. We think that these two characteristics are required before Axiomatic Design can be applied on service system design, but we encourage future work to explore on this.

Concluding, our research applied the Axiomatic Design on a customer service system. The traditional problems of such systems as integrating multiple contact channels and integrating the support of multiple core services are dealt with in the design, by creating generic functions that are present in all services. The service elements that differ per channel are combined in one function, while the differences in the core service do not require different functions but do require different resources. The organisational design based on Axiomatic Design opens possibilities to better control the contact centre and deliver more efficient and higher quality customer service.

Acknowledgement
We want to thank our supervisors from the Delft University of Technology for guiding us in the research process. We are also grateful to the people at the customer service department NS Klantenservice of the Dutch railways, for giving us the room to learn the detailed situation and providing information on what problems they encounter.

References


### Table 1: Hierarchy design decomposition of the customer service system describing the functional and physical elements.

<table>
<thead>
<tr>
<th>FRs</th>
<th>Description</th>
<th>DPs</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>FR1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>Pre-sorting paper mails</td>
<td>DP1</td>
<td>Sort paper-mails</td>
</tr>
<tr>
<td>12</td>
<td>Classifying indirect contacts</td>
<td>DP2</td>
<td>Classify incoming indirect contacts</td>
</tr>
<tr>
<td>FR2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>21</td>
<td>Starting a conversation (telephone)</td>
<td>DP3</td>
<td>Basic skills &amp; knowledge telephone channel</td>
</tr>
<tr>
<td>22</td>
<td>Starting and ending a conversation (live chat)</td>
<td>DP4</td>
<td>Basic skills &amp; knowledge live chat channel</td>
</tr>
<tr>
<td>23</td>
<td>Reading the message (social media)</td>
<td>DP5</td>
<td>Basic skills &amp; knowledge social media channel</td>
</tr>
<tr>
<td>FR3</td>
<td>Directly providing information</td>
<td></td>
<td></td>
</tr>
<tr>
<td>FR4</td>
<td>Identifying the customer</td>
<td></td>
<td></td>
</tr>
<tr>
<td>FR5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>S1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>S11</td>
<td>Directly executing an action (without e-mail)</td>
<td>S11</td>
<td>Common action via SAP CRM</td>
</tr>
<tr>
<td>S12</td>
<td>Directly processing contact inc. action (e-mail)</td>
<td>S12</td>
<td>Specialistic action e-mail</td>
</tr>
<tr>
<td>S13</td>
<td>Directly processing contact (social media)</td>
<td>S13</td>
<td>Social media reputation management skill</td>
</tr>
<tr>
<td>S2</td>
<td>Directly transferring call to specialist (telephone)</td>
<td>S2</td>
<td>Specialistic actions CRM</td>
</tr>
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<td>S3</td>
<td>Providing help to agents as mentor</td>
<td>S3</td>
<td>Provide help to agents as mentor</td>
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<tr>
<td>S4</td>
<td></td>
<td>S4</td>
<td></td>
</tr>
<tr>
<td>S41</td>
<td>Creating a notification for the second line (without social)</td>
<td>S41</td>
<td>Create notification 2nd line</td>
</tr>
<tr>
<td>S42</td>
<td>Creating a notification for the second line (social)</td>
<td>S42</td>
<td>Notification to other NS departments</td>
</tr>
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<td>FR6</td>
<td>Recording contact details</td>
<td>DP6</td>
<td>Register customer contact (CRM)</td>
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