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**The SDCS method: a new service design method for companies
undergoing a servitisation process**

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Master Thesis

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Dedicated to the memory of my beloved grandfather, Amadeu.

Abstract

To cope with economic crises, the fierce business competition and increasing challenges brought with it, companies have been demonstrating a growing interest in extending their service business. It is in this context that companies seek servitisation strategies, that is, develop the capabilities to add services to their traditional product offerings, as a way to increase value to the customers and to differentiate themselves from the competition. However, these companies that have been mostly product-centric, often lack methods and tools adapted to their context to succeed in deploying such strategy. In addition, there are several challenges related with assisting servitisation and no specific tool or method in the current literature indicated for services design in these situations. Moreover, the traditional service design process does not address how services should be managed once implemented.

Additionally, companies undergoing a servitisation process are commonly adopting another strategy as a way to expand their service offerings: the services modularisation. Through services modularisation, companies can develop more innovative offers that, through multiple combinations, allows them to offer a wider services portfolio. However, the literature on service modularisation is still scarce, lacking the necessary guidelines and knowledge for companies to adopt this strategy in practice. Thus, the present work seeks to cover the identified research gaps, through the development of a new (S)ervice (D)esign method for (C)ompanies undergoing a (S)ervitisation process: the SDCS, often also referred in this project as the artefact. SDCS, besides providing all the concrete inputs and insights needed for companies to implement a new service, also includes activities dedicated to service modularisation and a phase of continuous improvement for service management.

Following the principles of the Design Science Research (DSR) methodology, this project consists of three main steps: the understanding of the environment for the SDCS development, the design of SDCS and the evaluation of SDCS. As a methodology that aims to understand organizational phenomena by developing and evaluating artefacts that can solve organizational problems, first, a literature review was performed in the most relevant topics for the new method development, followed by the development and application of the artefact in a company undergoing a servitisation process. Yet, while the literature review provided the knowledge foundations for the development of SDCS, the development and application of the artefact were supported by a qualitative study consisting of semi-structured one-to-one interviews with the employees of the company in question to further understand the new method environment and identify its requirements. Hence, both literature review and qualitative research served as the inputs for the artefact development.

Next, and once SDCS was designed, it was applied in the company to the development of a new modular service, in order to evaluate its usability and relevance. The application of the SDCS involved the use of the software NVivo12 for qualitative data analysis and service design tools such as customer value constellation (CVC), service system architecture (SSA) and service experience blueprint (SEB).

Resumo

Para lidar com as crises económicas, a competição acirrada no mercado e seus crescentes desafios, as empresas vêm demonstrado um interesse cada vez maior em ampliarem seus negócios de serviços. É nesse contexto que as empresas buscam estratégias de servitização, ou seja, desenvolver as capacidades necessárias para agregarem serviços às suas ofertas tradicionais de produtos, como forma de aumentar o valor para os clientes e se diferenciarem da concorrência. No entanto, essas empresas majoritariamente centradas em produtos, muitas vezes carecem de métodos e ferramentas adaptadas aos seus contextos para obterem sucesso na implementação de tal estratégia. Além disso, há vários desafios relacionados com a servitização e nenhuma ferramenta ou método específico na literatura atual indicada para o desenho destes serviços. Também, o processo tradicional de desenho de serviços não aborda como os serviços devem ser geridos depois de implementados.

As empresas em processo de servitização, muitas vezes também adotam uma outra estratégia como forma de expandir suas ofertas de serviços: a modularização de serviços. Através desta estratégia, as empresas podem desenvolver ofertas mais inovadoras que, por meio de múltiplas combinações, permitem oferecer um portfólio de serviços mais abrangente. No entanto, a literatura sobre modularização de serviços ainda é muito escassa, faltando as diretrizes e conhecimentos necessários para que as empresas adotem essa estratégia na prática. Assim, o presente trabalho busca abranger as lacunas de pesquisa identificadas, através do desenvolvimento de um novo método de desenho de serviços para empresas em processo de servitização: o SDCS, muitas vezes também referido neste projeto como artefacto. SDCS, para além de fornecer todos os insumos e insights concretos necessários para as empresas implementarem um novo serviço, também inclui atividades dedicadas à modularização de serviços e uma fase de melhoria contínua para a gestão dos mesmos.

De maneira a seguir com os princípios da metodologia *Design Science Research (DSR)*, este projeto consiste em três etapas principais: o entendimento do ambiente para o desenvolvimento do SDCS, o desenho do SDCS e a aplicação do SDCS. Como uma metodologia que visa compreender os fenómenos organizacionais, desenvolvendo e avaliando artefactos que possam resolver problemas organizacionais, primeiramente foi realizada uma revisão de literatura nos temas mais relevantes para o desenvolvimento do novo método, seguida do desenvolvimento e aplicação do artefacto em uma empresa em processo de servitização. Ainda, enquanto a revisão da literatura forneceu os fundamentos do conhecimento necessários para o desenvolvimento do SDCS, o desenvolvimento e aplicação do artefacto foi sustentado por um estudo qualitativo que consistiu em entrevistas individuais semiestruturadas com os funcionários da empresa em questão para melhor entender o ambiente do novo método e identificar seus requisitos. Assim, tanto a revisão da literatura quanto a pesquisa qualitativa serviram como insumos para o desenvolvimento do artefacto.

Em seguida, e uma vez que o SDCS foi desenhado, ele foi aplicado na empresa para o desenvolvimento de um novo serviço modular, a fim de avaliar sua usabilidade e relevância. A aplicação do método envolveu o uso do software NVivo12 para análise qualitativa de dados e ferramentas de desenho de serviços, como *customer value constellation (CVC)*, *service system architecture (SSA)* e *service experience blueprint (SEB)*.

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List of abbreviations

B2B - *Business to Business*

B2B - *Business to Customer*

CS - *Customer Service*

CVC - *Customer Value Constellation*

DSR - *Design Science Research*

IESS - *International Conference on Exploring Service Science*

KLS - *Körber Logistics Systems*

KPI - *Key Performance Indicators*

MINDS - *Management and Interaction Design for Service*

NPS - *Net Promoter Score*

PM - *Predictive Maintenance*

PSS - *Product-Service Systems*

SB - *Service Blueprint*

SD4VN - *Service Design for Value Networks*

SDCS - *Service Design method for Companies undergoing a Servitisation process*

SEB - *Service Experience Blueprint*

SLA - *Service Level Agreements*

UI - *User Interfaces*

VOC - *Voice of the Customers*

1 Introduction

In times of economic crisis, which many countries often face, the demand for products become stagnated, turning products less attractive (Martín-Peña and Bigdeli, 2016). That said, and in order for companies to still compete in the market, it becomes crucial to implement service-led growth strategies (Kowalkowski, Windahl, Kindström and Gebauer, 2015). It is in this context that the concept of servitisation emerges. Servitisation can be defined as adding services to products (Baines, Lightfoot, Benedettini and Kay, 2009) and is often seen as a way to increase the value to the customers and differentiate the offer from the competitors (Martín-Peña and Bigdeli, 2016).

The reason for companies to extend their service business usually proceeds along three lines: financial, marketing and strategic opportunities (Gebauer, Friedli and Fleisch, 2006). According to Anderson and Narus (1995), companies can enhance their profits by using services more effectively to meet customers' requirements. Thus, they can increase their customer portfolio, gain more business and consequently reduce the costs of providing the services. Neely (2008) mentions that large firms, measured in both numbers of employees and revenues, are more likely to engage in servitisation efforts than smaller firms. In addition, there tend to be more servitised firms in highly developed economies than in industrialising economies.

With servitisation, several other related topics emerges, in which one particularly relevant is modularisation. Commonly defined as the decomposition of an object into its components to recombine them into other customised alternatives (Salvador, 2007), with the increasing importance and appreciation of services by the companies, the concept of modularisation has also been extended to services. Hence, aiming to offer customers a wider services portfolio by increasing services variety, companies have been adopting modularisation strategies as a way to sustain their services business expansion (Freije, de la Calle, and Larrinaga, 2018).

However, there are many challenges inherent to the concepts of servitisation and services modularisation when applied in practice. Supporting servitisation in product-centric companies can be very challenging as it requires reconstructing their organisational structures, including cultural change, internal communication, retaining service expertise and promoting inter-department collaboration (Zhang and Banerji, 2017). West and Gaiardelli (2016) also state that companies in servitisation process may face financial challenges, as they are usually required to spend money in new infrastructure, physical assets and knowledge during the first stages of servitisation. However, despite all these challenges and the advances in the service research field, there is still no specific method or tool indicated for services implementation (Overkamp and Holmlid, 2016). Besides, the literature on service modularisation is still scarce, and a comprehensive review, surrounding the main aspects related to its application, has not yet been explored (de Mattos, Fettermann and Cauchick-Miguel, 2019; Geum, Kwak, and Park, 2012).

Taking these challenges into consideration, companies that intend to expand their service business, need to have the knowledge on the appropriate methods and tools to apply in order to have better chances of succeeding with servitisation. Thus, the present work aims to fill these gaps by proposing the (S)ervice (D)esign method for (C)ompanies undergoing a (S)ervitisation process (SDCS), in which the last part of the work presents the application of the proposed

method in the design of a new modular service within a company currently undergoing a servitisation process: Consoveyo.

1.1 Project background

Consoveyo is a system integrator company that designs and builds turnkey solutions for its customers' intralogistics applications such as automated storage, handling, internal transport, picking and order fulfilment (Consoveyo, 2019). With customers all over the world, including countries such as Portugal, Spain, Italy, France, Bulgarian and Check Republic, Consoveyo has only Business Customers (B2B), that is, the exchange of products and services are made between companies, rather than to final customers.

Consoveyo's products cover a wide range of loads divided in three main categories: Light Loads, Unit Loads and Heavy/ Oversized Loads. The products are highly customised to every customer's specific requirements according to the load to be carried, container type, size or weight. That said, the main products offered by Consoveyo are: stacker cranes, miniloads, shuttles, automated guided vehicles, rail guided vehicles, overhead monorail vehicles and conveyors (Consoveyo, 2019). All the products are entirely designed and assembled within the company and are built in accordance with safety standards and guidelines, in a way to provide easy handling and access to parts for maintenance, as well as optimized energy consumption and low noise level. As a system-integrator company, besides providing the products Consoveyo also provides the software responsible for controlling and managing the products. This way the company is responsible for the "whole solution".

In relation to its history, the company was originally part of the Efacec group before being acquired in 2015 by the German technology group Körber and is now part of the logistics business area (KLS), along with several other companies. The umbrella brand unites the companies in three different business units: Aberle and Consoveyo (systems integration), Langhammer and Riantics (product solutions), Aberle Software, DMLogic, HighJump, Inconso, Cirrus Logistics and Voiteq (software). To facilitate the understanding, Körber's Group structure is shown in Figure 1, with detail to the structure of the logistics area.

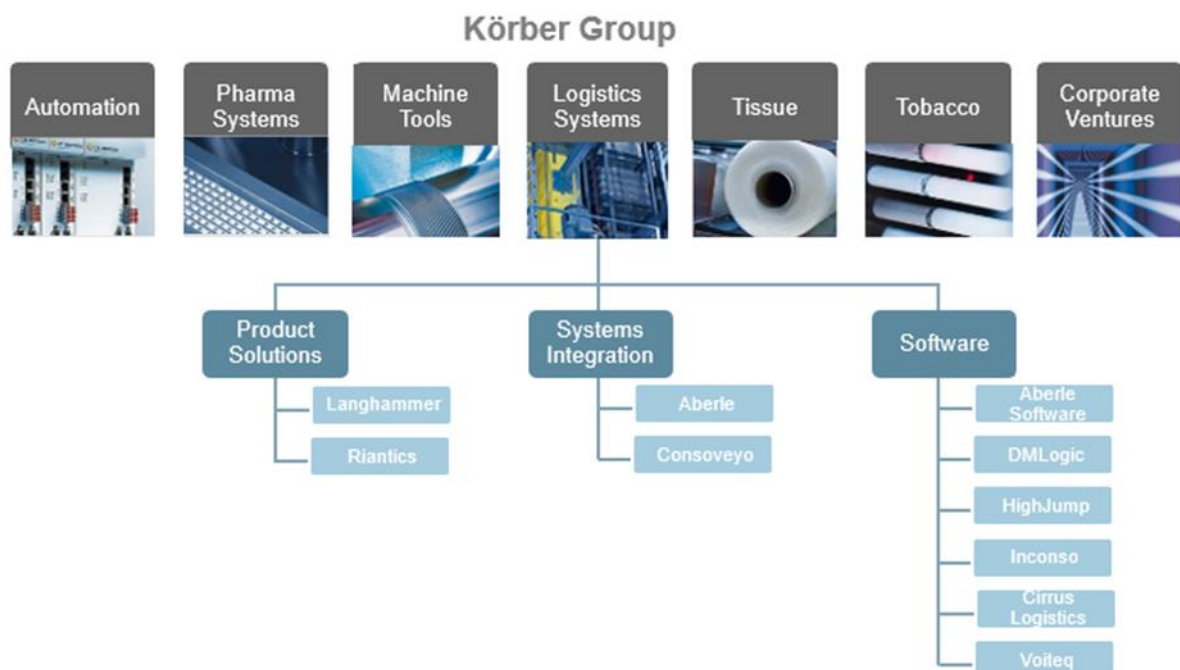


Figure 1 - Körber's Group structure

It is worth emphasising, however, that at the time of its acquisition, Consoveyo was a company focused on the development of intralogistics equipment, with a quite limited portfolio of services. Besides, the acquisition of the company by the German group caused enormous growth in the company in terms of the number of employees. With approximately 30 employees at the time of its acquisition, the company has now a team of more than 200 people after three years. With this, the company had high investments and more than quintupled its total sales turnover, in which services still account for a very small portion of total sales: only 15%. Aware of services potential and by knowing that customers are increasingly looking for a combined product-service offering, Körber Group has the ambitious strategy that services account for 40% of total sales by 2025. Thus, with one of Consoveyo's strategic goals being to "expand service business", the company seeks to revisit and expand its service portfolio by developing new, flexible and customised offers through the perspective of modularisation.

1.2 Research objectives

The main objective of the present work is to define a new (S)ervice (D)esign method for (C)ompanies undergoing a (S)ervitisation process: the SDCS method. This method seeks to provide companies that are in a servitisation process the necessary tools not only for the development but also to the implementation of a new service, since the existing literature is still focused on the early phases of service development and very vague regarding its implementation, with no specific method or tool for this purpose.

Thus, and once companies undergoing servitisation often adopt modularisation strategies to broaden their service offerings, SDCS seeks to provide companies with the necessary knowledge to apply modularisation in practice, by illustrating the application of the method on the development of a new modular service. It is worth noting that the literature on service modularisation is still very scarce.

Lastly, and by understanding that the fierce competition between companies raises new challenges, the SDCS method aims to help companies in the pursuit of services excellence by adding a new stage, not addressed by the traditional service design process: the service management stage. This stage is focused on the continuous improvement of services after their implementation, through which companies can improve their service performance and consequently increase customers satisfaction.

1.3 Report outline

The present work is structured as follow: the first chapter introduces the project background, its motivations, objectives and the company in which the project was developed. Next, the second chapter covers the literature review on the relevant topics for a better understanding of the research context.

The third chapter describes the research methodology, specifying how the study was conducted, including the chosen research method and the sequence of activities performed for achieving the initial objectives. The fourth chapter, in its turn, starts by presenting how data was collected and analysed for the artefact (SDCS) development, followed by its conceptual framework and each stage of the method described in detail, including its main activities and expected

objectives. Next, it presents the results obtained with the application of the method in each stage for the development of a new modular service in the company.

Finally, the fifth chapter concludes this report, highlighting the main conclusions from the artefact application and suggesting potential future topics to be developed.

2 Literature Review

This section presents the state of the art of some of the most relevant topics for the present work. Following the objectives of this study, this literature review covers the topics related with servitisation, modularisation and the application of the methods and tools from service design and design thinking in the design of new services.

Thus, the first and second topics introduce the concepts of servitisation and modularisation as a way for companies to expand their service business and develop reused, customised offers. Next, the third and fourth topics, present the design thinking process as the basis for designing new and innovative products and how its concepts can be applied in the services field.

2.1 Servitisation and Product Service-System (PSS)

Over the last few decades the global economy has witnessed a significant increase in the importance of services, while the importance of products has declined (Berry, Shankar, Parish, Cadwallader and Dotzel, 2006). Coined by Vandermerwe and Rada (1988), the term servitisation is now widely recognised as the process of creating value by adding services to products (Baines et al. 2009). With the growing interest of companies in extending their service business (Gebauer, 2007), there is increasing research on this subject. By the time Baines et al. (2009) concluded their research, there were already 60 papers published directly on this subject and at least 90 closely related. The growing interest in servitisation is also reflected in the increasing amount of conference presentations (Kowalkowski, Gebauer, Kamp and Parry, 2017).

Manole and Bier (2018) state that the term servitisation means more than increasing a company's service business orientation and adding services to its portfolio, but also encompasses the transformation from product-centric to customer-centric approach. For Ruiz-Alba, Soares, Rodríguez-Molina and Frías-Jamilena (2019), servitisation strategies are only successful when companies engage in the co-creation of design and delivery of services, or in other words, if service propositions are in fact adjusted to customers' needs. However, this may require a lot of effort, since in order to do so, a company must reconfigure its resource base, organizational capabilities and structure; redefine its mission and update its routines, norms and values (Kowalkowski et al., 2017). Nevertheless, when well applied, servitisation can provide several benefits to manufacturing companies (Tan et al., 2019). Gebauer, Gustafsson and Witell (2011) state that service differentiation that is, when companies differentiate their services from competitors (Zhang, Wang and Yang, 2018), stimulates innovation as it reduces customers' perceived purchase risks and therefore helps to generate more customers who are willing to try new products or services. Thus, by providing differentiated services, organizations create additional value to customers and undergird their competitive advantage (Opresnik and Taisch, 2015).

It is worth noting that there are several research communities related to servitisation, in which the difference arises in the motivation and geographical origin of the research communities. Product-Service Systems, a concept of Scandinavian origin, is particularly close to servitisation (Baines et al., 2009). Seen by many companies as a way to enhance competitiveness and simultaneously foster creativity (Tukker, 2004), Product-Service Systems (PSS) can be defined as a marketable set of products and services that are combined to fulfil a user's need (Goedkoop,

Van Halen, Te Riele and Rommens, 1999) or as Baines, Lightfoot, Evans and Neely (2007) define, a market proposition that extends the traditional functionality by incorporating additional services. Baines et al. (2009), as a finding of their study, concluded that through servitisation a company can innovate its capabilities and processes to better create mutual value by selling Product-Service-System instead of just products. As examples of PSS leaders are Xerox and Canon, with their ‘pay per copy’ lease and take back programmes (Baines et al., 2007).

Neely (2008) mentions three research communities related with servitisation: product-oriented Product-Service Systems, use-oriented Product-Service Systems and result-oriented Product-Service Systems. Tukkey (2004) explains that while in the product-oriented PSS category the company’s business model is mainly directed to the sales of products, in the use-oriented PSS category the product still represents a central-role, but belongs to the provider, in which the product stays available for users in other forms and sometimes shared between them. Lastly, in the result-oriented PSS category, the client and the provider agree on a result, with no pre-determined product involved. Yang, Xing, and Lee (2010) emphasise that this last category has the highest level of service content, as providers sell functions to customers instead of products. Sun, Chai, Pi, Zhang and Fan (2017) stress that the customers need no longer just a physical product, but the functions provided by the company’s offering of product and service: the PSS.

The adoption of PSS can therefore bring several benefits to companies by attaching additional value to products, fostering innovation and improving relationship with customers (Mont, 2000). The service component of the PSS approach brings more flexibility, with the addition of new functionality to better meet the customers’ needs. Thus, PSS is seen by many customers as synonymous to customisation and better quality (Baines et al., 2007). It is worth pointing out that Product-Service-Systems are also usually related to environmental benefits. That is because the adoption of PSS leads to decrease the total amount of products produced as it introduces alternative scenarios of product use (e.g. sharing/renting/leasing) (Mont, 2002).

However, Martinez, Bastl, Kingston and Evans (2010), identify five main challenges that companies should consider when moving from being a product-oriented organisation to a product-service oriented organisation. The first one is related with a change of culture, in which companies need to embrace the product-service culture and develop a passion for service in order to meet the customer expectations. Second, the author emphasises that the integrated offering that the company will deliver includes a greater number of touchpoints, and therefore also a greater personal contact with the customer than previously. When under stress, this may lead companies to revert to a focus on product. That is why, to realize PSS, companies need to change their organizational process and capabilities. For last, there is the challenge of strategic alignment which involves a common language and mindset within the organisation, allowing the service provider to “think like a customer”. In addition, Nguyen, Schnürmacher and Stark, R. (2014), points out the need of new supporting methods and tools to cope with these challenges.

When it comes to the PSS implementation itself, many authors have proposed different processes and frameworks (see e.g. Yang, Xing, and Lee, 2010; Barquet, de Oliveira, Amigo, Cunha, and Rozenfeld, 2013; Kimita, Watanabe, Hara, and Komoto, 2015; Kowalkowski, and Kindström 2009). For example, Aurich, Fuchs and DeVries (2004) propose implementing PSS by integrating product design and service design. The author defends that Product-Service-Systems consist of mutually related physical and non-physical components and therefore it is

necessary to rethink product innovation strategies and corresponding product design. Morelli (2006) mentions that the existing tools and methods available to the designers are mostly product focused. However, while the development of physical features of a product is based on the technological and mechanical characteristics, the service components of PSS increases the challenges. In this context, the methods and tools applied in service design and presented in the last topic of this section as well as the SDCS method can be very helpful.

2.2 Services Modularisation

Companies in a servitisation process often seek modularisation as a way to broaden their service offerings and therefore sustain their services business expansion (Freije et al. 2018). Salvador (2007) defines modularisation as decomposing an object into its components to recombine them into other customised alternatives. Thus, the independence between the components allows designers to more easily create a wide variety of offers using a smaller set of components (Gershenson and Prasad, 1997), leading many companies to adopt modularisation to increase their portfolio variety (Björk and Hällfors, 2015). In the products field, Nepal, Monplaisir, Singh and Yaprak (2008) emphasises that the modular design, with standardised model and simple product architecture, also helps to improve product reliability and maintainability. In addition, it allows companies to efficiently manage and develop complex products and systems into simpler subsystem without them compromising the system's integrity. Besides, it reduces order lead-times and sustains economies of scale (Kusiak and Huang, 1996).

Accordingly, with the increasing importance and appreciation of services by the companies, the concept of modularisation has also been extended to services. It comes a new and emerging research area: services process modularisation (Tuunanen, Bask, and Merisalo-Rantanen, 2012). Tuunanen and Cassab (2011, p.342) define service process modularisation as “the systematic combination of service encounter processes known to both the customer and the firm that generates new, customisable service packages of increased utility to the customer”. The authors also highlight that service process modularisation is a way of increasing the company's market impact by developing innovative offerings that can be reused and vary from the existing service processes. Moreover, the authors defend that modularity can influence new service adoption.

Pekkarinen and Ulkuniemi, P. (2008) introduce the 3D concept of modularity. According to them, for a company to develop modular services it must build an architecture that follows the 3D of modularity, composed of three subsystems of modularity elements: modular service offering, modular process and modular organization. Rahikka, Ulkuniemi and Pekkarinen (2011) define service module as the smallest service unit that can be individually offered to a customer or as a part of a service offering that creates value to the customer. A modular process on the other hand is defined as the indivisible service process step essential for making available the service module or offering, and for last the organizational modularity is defined as the organization sub divisions (teams, units, firms, etc.) that through coordination create value to the customers. In Rahikka et al. (2011) study, the authors used these three elements to analyse how modularity can influence the customer value perception. However, although concluding that the three subsystems of modularity had a positive influence on customer's value perception, the authors emphasise that the service module can be very problematic. This is because, differently from the products, a service module's content can be changed throughout the process

customisation and since all processes involved in service delivery depend on the service module definition, in case the service module content changes, the processes also need to change.

In this context, Böttcher and Klingner (2011) propose four steps to define a well-established service module. According to the authors, the first step is to structure an unstructured set of service modules by using a graph. Next, within this graph and by using rules, logical and temporal inter-dependencies are specified. Then, based on these logical rules, a customer can choose from the structure set of service modules and, based on the temporal rules, the process chain implemented. These last rules define when a service module must be executed. Figure 2 exemplifies the steps proposed by the author.

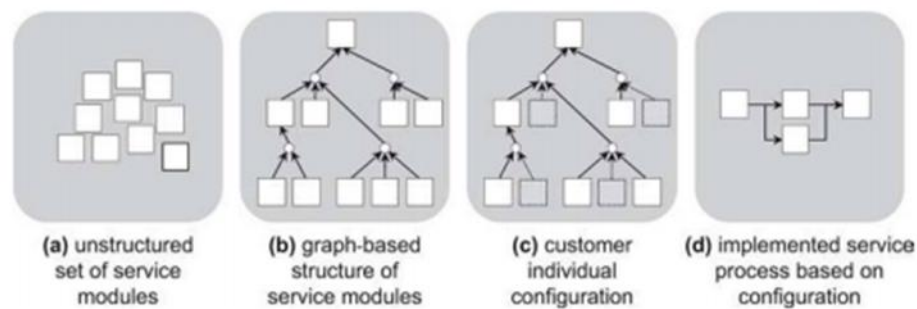


Figure 2 - Steps for structuring service modules (source: Böttcher and Klingner, 2011)

Baldwin and Clark (2003), on the other hand, state that to achieve modularity, designers must divide the information into two categories: visible design rules and hidden design parameters and that modularity is only beneficial if the division is made in a very precise, unambiguous and complete way. That said, the visible design rules are those establish in an early stage of the design process and communicated broadly to all involved people while the hidden parameters are those that do not affect the design outside of its module, and by that are more flexible to changes and do not need to be communicated to other module design teams.

Hence, modularisation seems to be a promising approach to deal with the increasing complexity of service portfolio and how to enable standardisation and individualisation at the same time (Böttcher and Klingner, 2011). However, when compared to the literature on the products field, the literature on service modularisation is still very scarce, and a comprehensive review, surrounding the main aspects related to its application, has not yet been explored (de Mattos, Fettermann and Cauchick-Miguel, 2019; Geum, Kwak, and Park, 2012). Besides, the application of modularity in the design of a Product-Service System (PSS), addressed in this last topic, is also not much studied, even with servitisation being a differentiating factor and promising strategy in many companies (Larsen, Andersen, Nielsen and Brunoe, 2018).

2.3 Design Thinking

The fierce business competition and constant advancement of technology makes it necessary for companies to develop original solutions and develop a new set of skills in order to be globally competitive (Shute and Becker, 2010). Thus, in order for companies to sustain

servitisation and services modularisation strategies it is crucial for them to be aware of the existing theories and practices to create innovative and competitive offerings. In this context the concept of design thinking is presented. According to Bonini and Sbragia (2011), design thinking emerges as a model of innovation with high potential to generate differentiated results for the organizations that seek market leadership, since it offers methods of investigation and development of solutions highly focused on the users.

This is how design thinking has been so successful: it seeks the development of innovations in the way of thinking of a designer, or, as Brown (2008, p.2) states it “uses the designer’s sensibility and methods to match people’s needs with what is technologically feasible and what a viable business strategy can convert into customer value and market opportunity”.

The design thinking concept was created by the IDEO company (Brown, 2008). The company that originally did traditional design work for business started receiving many unconventional design requests in the years 2000: a new type of design work was necessary. This was later called design thinking (Brown and Wyatt, 2010). The concept is very well known for fostering a creative and innovative culture, in which prototyping and brainstorming are centrepieces. Together with the empathy with users and tolerance for failure, these design thinking principles help developing a responsive and flexible organizational culture (Kolko, 2015).

For Brown and Wyatt (2010), the design thinking process should be thought as a system of overlapping spaces, that not always are undertaken sequentially: inspiration, ideation and implementation. In the inspiration phase, the authors suggest that the design thinkers become embedded in the lives of the people they are designing for in order to fully understand their needs. Yet, in the ideation space, the team should summarise the main insights that were collect in the previous space that can lead to solutions or opportunities for change. In the last space, implementation, is where the best ideas from the ideation space are developed into a product, through prototyping. Braha and Reich (2003) describe the design thinking process as being iterative, exploratory and sometimes even chaotic.

During the design thinking process, however, designers engage in several different cognitive processes (Razzouk and Shute, 2012). Kolodner and Wills (1996) specify these processes as: preparation, assimilation and strategic control. In the preparation process, designers should, through problem reformulation and reinterpretation of ideas, identify what is relevant and what they should focus on. The assimilation process, on the other hand, involves observing the design environment to identify the responses to the proposed solution, such as feedback from experiments with prototypes. Last, the strategic control process is about the many decisions the designers must take over the course of the design.

Being a relatively new concept, design thinking can take many forms according to the nature of the products developed, the company culture or even the processes implemented. However, organizations should not fall back on known formulas, instead they should adapt according to what fits better the company (Martin, 2009).

2.4 Service Design Process, Methods and Tools

While design thinking can be seen as a methodology that aims to solve business problems through innovation in the products field, service design is about the systematic application of design thinking and other design methodologies and principles in the services field (Holmlid

and Evenson, 2008). The difference is rather in the specific set of methods and tools that service design uses than in the design process itself (Stickdorn, Hormess, Lawrence and Schneider, 2018).

With the growing of services, and the companies' understanding of the importance of offering their customers a value proposition instead of a single product, authors have developed over the years several service design methods. However, although each method has its particularities, they commonly recognize the first step as being an exploration and understanding the customers' needs and the last one as delivering the customers a solution (Foglieni, Villari and Maffei, 2018). Thus, they follow the service design process composed by four stages: exploration, ideation, reflection and implementation (Stickdorn et al. 2018), which is meant to be highly iterative and non-linear (Menor, Tatikonda and Sampson, 2002). Some of the most relevant tools and methods that can be applied in each stage of the service design process are presented next.

The first stage, exploration, consists of a deep study of the customer experience. Meyer and Schwager (2007), define customer experience as the internal and subjective response that customers have to any direct or indirect contact with a company. A good customer experience though is not measured on the number of features on offer but embedding the fundamental value proposition in offerings' every feature (Patrício and Fisk, 2013). Therefore, some of the methods and tools that can be used in the first stage of the service design process, exploration, are research data, personas and customer journey mapping.

Research data is one of the core tools of service design (Stickdorn et al., 2018), and consists of any information that is collected, observed or even created to answer the research objectives (Surkis and Read, 2015). It is used to understand people and their behaviour regarding a service and helps the design team to build a solution from a user-centred perspective (Stickdorn et al., 2018). Raw data can be obtained by several ways, such as questionnaires, interviews, content analysis, observation and focus groups (Birmingham and Wilkinson, 2003). Also, in the service design exploration stage, the stakeholders can be represented in two ways: first, by creating a stakeholder map, that illustrates all stakeholders and their influence in order to allow the comparison between them; secondly by creating personas (Holmlid and Evenson, 2008). The persona method is a branch of the user-centric design method and proceeds with service development by designing virtual users and assuming them as users (Hosono, Hasegawa, Hara, Shimomura and Arai, 2009). This way personas help to improve communication about the target users within the design team and other stakeholders and increase focus on the needs of target users (Miaskiewicz and Kozar, 2011). Lastly, the customer journey mapping allows to visually represent the sequence of events through which customers interact with the service provider during the entire service provision (Rosenbaum, Otalora and Ramírez, 2017).

After having a deep understanding of customer experience, it is time for the project team to generate and develop as many ideas as possible in the ideation stage (Brown, 2008). However, in service design, ideas are just a starting point of a bigger process. They need to be generated systematically, massively, considering that the value lies not on the ideas themselves but on their outcomes (Stickdorn et al., 2018). Consequently, the new ideas help on the development of new service concepts. The development of the service concept brings a deep level of details as it covers the decisions from each component of the service, from major decisions to minor decisions, and therefore organizations should be careful to ensure that decisions are taken consistently and focused on delivering the right service to target customers (Goldstein,

Johnston, Duffy and Rao, 2002). At this stage several methods and tools that can be applied, namely customer value constellation, service system architecture and service experience blueprints.

The first step for generating new ideas is brainstorming. In the classic brainstorming sessions, a small group of people discuss new solutions to existing problems or conceptual solutions for new problems (White, Wood and Jensen, 2012). There are two core principles: deferred judgement and quantity breeds quality. That is, in brainstorming all ideas are accepted and no criticism is allowed, as it restrains the creative process. Besides, a lot of ideas should be generated as it increases the chances of a successful solution (Geschka, 1996). After that, a selection process takes place to identify the most promising ideas so that the service concepts can be developed. The development of the service concepts starts with the design of the customer value constellation (CVC), in which all the service offerings of a given activity are represented as well as the interrelationships between them that enable customers to co-create their value constellation experience (Patrício, Fisk, Falcão e Cunha and Constantine, 2011). Hence, it is possible to identify which activities are related to those that value the most to the customer and therefore require more attention: identifying these activities is important to transform customers from never-a-customer to always-a-customer (Nenonen, Rasila, Junnonen and Kärnä, 2008). Once all activities are identified it is time to design the service system with the service system architecture (SSA), which depicts the main tasks that the customers need to perform to achieve the expected result of an activity (Patrício et al., 2011). The service experience blueprint (SEB) diagram, is then used to design each concrete service encounter specified in the SSA. The SEB maps the actions of the participants in the service encounters (moments of interaction between the organization and the customer) both in the frontstage and backstage (Patrício and Fisk, 2013). It is worth noting, however, the difference between service experience blueprint (SEB) and service blueprint (SB). Despite some features in common, as for example line of visibility and line of interaction, the SEB method was specifically developed for multi-interface service experiences whereas the SB was developed to map single-channel service delivery (Patrício, Fisk and Falcão e Cunha, 2008). Thus, the choice of the method to apply lies on the nature of the service to be provided.

After ideas are generated and the service concepts of the most promising ones designed, it comes to prototyping the service experience, in the reflection stage. Nevertheless, it is worth noting that unlike products that can be prototyped in a way which people can hold the object and get the real feeling, service prototypes need to be experiences of the interaction with the multiple points (Polaine, Løvlie and Reason, 2013). Blomkvist and Holmlid (2012) present several challenges in service prototyping as opposed to products prototyping. Even though, some tools can facilitate and be very useful in the prototyping of services, namely: videos, mock-ups and storyboards. Videos prototypes are a powerful tool that can be very helpful in bridging the gap between abstraction and detail in the design process at the same time as facilitates the communication among members of multidisciplinary design teams (Mackay, Ratzer and Janecek, 2000). There are also several mock-up tools online that help sketching and illustrating the service idea. The mock-ups are very popular artefacts that can be easily created by stakeholders, that helps sketching the possible user interfaces (UI) (Rivero et al., 2010), and consequently facilitating the understanding of the requirements (Ricca, Scanniello, Torchiano, Reggio and Astesiano, 2010). Finally, the storyboards can help the project team to better understand the touchpoints, as they visually represent each step through illustrations, photos and sketches (Stickdorn et al., 2018).

In the last stage of the service design process, implementation, the service is finally offered to the customers. It is important to note that the implementation of a service design project can be very complex since it may involve many different fields, such as, change management for the elaboration of new procedures and processes; software department, for the development of apps and software related activities or even engineering and product development in case of being necessary to produce physical objects (Stickdorn et al., 2018). Yet, the available literature focuses mainly on the initial stages of the service design process: exploration and ideation. That said, there is little literature on how the services can be prototyped (Blomkvist and Holmlid, 2012) and successfully implemented (Overkamp and Holmlid, 2016), with no specific tool or method indicated for the implementation stage. Besides, and according to the guidelines proposed by Harland et al. (2018), there should be a principle of continuous improvement in the service development process which is not addressed by the traditional service design process. Despite of that, the several methods and tools presented in this topic in the previous stages of service design can be very helpful for companies to develop new service offerings and sustain their servitisation strategies. Thus, Figure 3 summarises the methods and tools proposed for each service design stage.

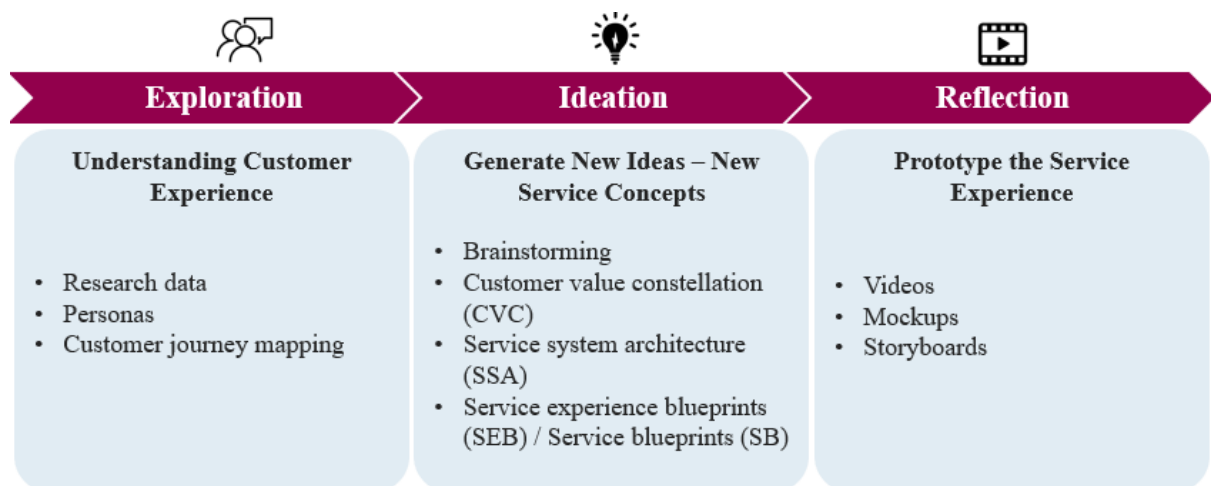


Figure 3 - Service design methods and tools for each stage of the service design process

3 Methodology

This chapter presents the research methodology applied in this project. It starts with a brief explanation of design science research, followed by the considerations that led to choosing this methodology as the most appropriate for the objectives of this study and the sequence of activities performed for achieving them.

3.1 Design Science Research (DSR)

With its roots in information systems discipline, design science research (DSR) has emerged in recent years as a way to ensure rigor and relevance in prototyping research projects (Weber, 2010). Originally positioned as a technology-oriented methodology, design science attempts to create things that serve human purposes, in which products are assessed against criteria of value or utility (March and Smith, 1995). In other words, DSR is a methodology that aims to understand organizational phenomena by developing and rigorously evaluating artefacts that can solve organizational problems (Greenfield, 2013). Such artefacts may be constructs, models, methods or instantiations (March and Smith, 1995). Thus, since the present project consists in developing a method to solve an organizational problem: companies still lack on the necessary knowledge, methods and tools imposed by servitisation; the DSR was considered the most appropriate methodology.

According to Tuunanen, Baskerville and Beck (2017), DSR can be seen as a combination of three related subfields. The first one, science of design, focuses on creating new artefacts, which have never been proposed before; the second subfield, design theory research, focuses on the development of theories regarding the creation of new or improved system; and the last subfield, design research, focuses on studying how designers can conduct design activities in practice. Peffers, Tuunanen, Rothenberger and Chatterjee (2007) state that DSR should follow a six-step process: problem identification and motivation, definition of the objectives for a solution, design and development, demonstration, evaluation, and communication. However, this process should be iterative as a way of searching the most adequate design. It is about the search for the best, optimal design to discover an effective solution to a problem (Hevner and Chatterjee, 2010).

According to Teixeira, Patrício, and Tuunanen, (2018), the iterative process of conceptualization and validation of the DSR methodology can lead to some advances in the fields of service design and service research. The authors state that the artefacts MINDS (Management and Interaction Design for Service) (see Grenha Teixeira et al., 2017) and SD4VN (Service Design for Value Networks) (see Patrício, de Pinho, Teixeira and Fisk, 2018) are among the first articles, published in scientific journals, that explore the creation of a service design artefact by using DSR.

Hevner (2007), however, proposes a design science research process less linear than the one proposed by Peffers et al. (2007), which consists in three main cycles: the relevance cycle, the design cycle and the rigor cycle. In the relevance cycle the requirements (problems and opportunities) are presented and the artefact is evaluated in a field testing following specified criteria. The rigor cycle on the other hand presents the grounding foundations that is, the scientific methods theories and engineering methods that add rigor and robustness to the artefact. Last, the design cycle, is the main piece of a design science research project as it

consists of the continuous improvement of the artefact, with the refining of the artefact according to its evaluation and stakeholders' feedback.

3.2 Method used in the project

Therefore, this study focuses on developing a new service design method (the artefact) capable of supporting service design in companies undergoing servitisation, following the process of DSR proposed by Hevner (2007). Thus, the relevance cycle used as inputs the requirements from a qualitative approach conducted with the organization's employees in order to better understand the environment in which the artefact was developed. Differently from a quantitative study, where the researcher should derive hypotheses from the literature review and test them, in a qualitative study, the researcher should use insights and information from the literature review as a context knowledge (Flick, 2018). Thus, in a qualitative study, the researcher should be in direct contact with the studied situation, in order to try to understand the phenomena according to the own perception of the participants (Godoy, 1995). Consequently, Atieno (2009) defends that if the purpose of the study is to construct a theory or a theoretical method that reflects reality rather than the researches own perception, a qualitative approach should be applied. Subsequently, and still in the relevance cycle, the developed artefact was empirically tested at Consoveyo in order to be evaluated.

On the other hand, the literature review performed on section 2 provided the research gaps and theoretical support important for the rigor cycle. Besides, it provided the foundations for keeping the necessary methodological rigor in the data collection performed in the relevance cycle. Still in the rigor cycle, the current document and an article (Appendix F) to be submitted were elaborated, adding new knowledge to the knowledge base. Thus, based on the relevance to the environment and the acquired knowledge base, the developed artefact is constantly refined at the design cycle.

To facilitate the understanding, Figure 4 illustrates the sequence of activities performed in this study.

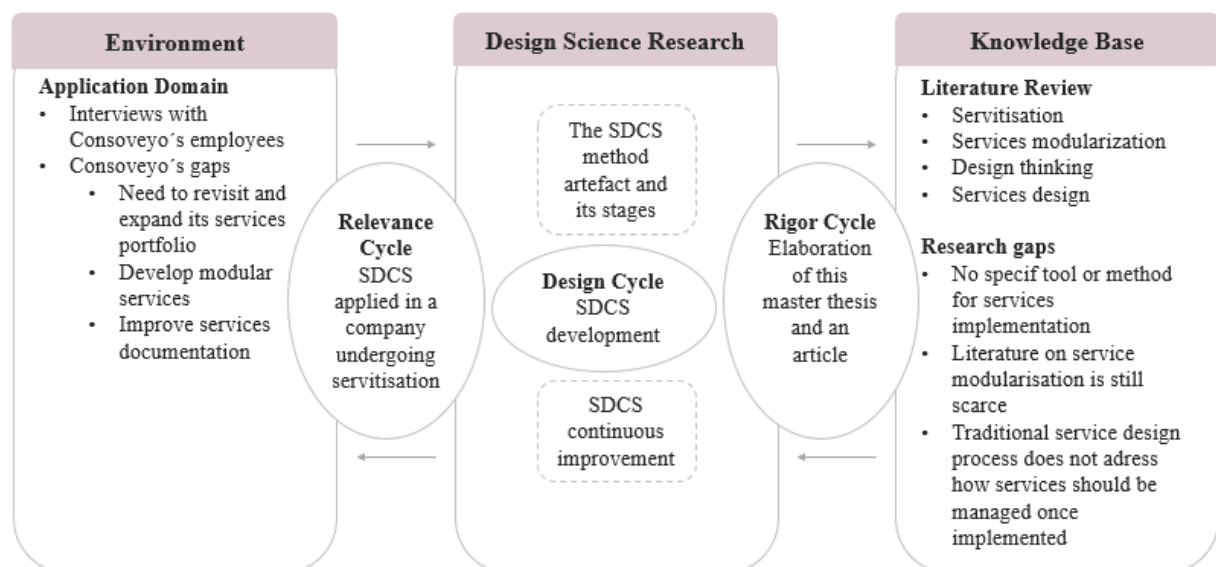


Figure 4 - Project methodology

4 The SDCS method

4.1 Understanding the environment: Performing a qualitative research to collect SDCS requirements

4.1.1 Sample characterisation for the development of the SDCS method

As mentioned in the previous topic, the primary method of data collection for the development of the SDCS method was semi-structured, one-to-one interviews conducted with internal stakeholders (Consoveyo's employees). The semi-structured interviews, although use guidelines for predetermined topics, also allow for unanticipated responses and issues by using open-ended questioning (Tod, 2006). The focus in this kind of interview is on allowing the interview to tell his own opinion about the subject rather than having answered a series of structured questions (Ryan, Coughlan and Cronin, 2009). Thus, semi-structured interviews are a well-suited data collection technique for the exploration of the perception and opinions of participants regarding complex and even sensitive issues (Barriball and While, 1994).

The purpose of the interviews in the present study is to better understand the organizational environment, as well as the requirements that should be taken into consideration when designing the method. These, together with the performed literature review, will serve as the basis for the SDCS development. Thus, the interview script used to conduct the interviews can be found in Appendix A.

In total, 15 interviews were performed during one month, with an average duration of 40 minutes, and in two different languages: Portuguese and English, since the participants included both employees from Consoveyo (11 employees) and from other KLS companies (4 employees), as the company's future goal is to have a unique service portfolio among the different KLS companies. The interviews with sister companies' employees were held by telephone due to geographical constraints, while all interviews with Consoveyo's employees were conducted in person at the company's headquarters in Porto, Portugal. It is worth mentioning that the interviewees had diverse roles in the company, from the operational to the strategical level; and experience as company's employees, ranging from 30 years to 1 year. Also, in order to allow a rigorous data analysis, the interviews were recorded whenever authorised by the participants. To be able to do so, an informed consent form was distributed to each one of the interviewees, according to their native languages (Appendix C and D). Below is a summary of the metadata information, regarding the performed interviews.

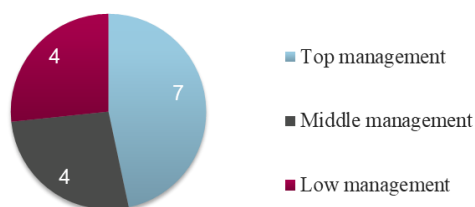


Figure 5 - Employees by job function



Figure 6 - Time as company's employee

The data collected in the interviews was transcribed and inserted in the NVivo12 Software for coding, as presented in the following topic.

4.1.2 Data collection for the development of the SDCS method

The interviews with Consoveyo's employees began by addressing the process of servitisation and instigating what would be, in the view of the interviewees, the main difficulties and opportunities encountered in this process. Thus, the most mentioned difficulties by the employees were poor service strategy, lack of human resources and having a product-oriented mindset. These are in line with the difficulties highlighted by Kowalkowski et al. (2017) presented in the literature review on the large internal effort required to restructure the organization for servitisation and the need of culture change mentioned by Martinez et al. (2010). It is also worth mentioning that regarding the poor service strategy, it was emphasised the lack of a service development model, which confirms the relevance of this study. Another difficulty mentioned by the employees, was the fact that the services offered by the company are limited to the number of equipment that the company has installed in the customers, since the company's services are product-related and not pure services. Hence, below are summarised the most relevant difficulties, followed by the number of employees that mentioned them and some of their comments. Please note that the number of respondents who mentioned a particular aspect and the number of employees interviewed presented in the tables is not necessarily the same since an employee may have mentioned more than one aspect or even have not mentioned any.

Table 1 - Major difficulties related to servitisation mentioned by employees

Challenges	# of Employees	Comments
- Lack of human resources	6	"We are living a transition phase, in which we have a set of projects that are absorbing more than half of the resources of the services. These are projects under warranty that do not allow us to bill."
- Limited installed base	4	"Our services depend on our installed base. That is, we normally sell our services to customers that did a project with us and therefore have our equipment. It's not impossible, but unlikely to sell many services on equipment manufactured by the competition."
- Poor service strategy	4	"In general, what we are missing is a "service development model". I had this before in a small operation and I am used to having this in physical product development. But I haven't seen that for service offerings."
- Product-oriented mindset	3	"The projects are our core-business, to ensure the project and win customers we often offer discounts on services."

The mentioned opportunities by the employees are also aligned with those highlighted in the literature review. By transforming from a product-centric to a customer-centric approach (Manole and Bier, 2018), the interviewed employees see servitisation as an opportunity to act more proactively and add services to the portfolio that really fulfil customers' need, consequently increasing customer satisfaction. Some employees also see it as an opportunity to increase full-service offerings, that is, having a very wide services portfolio in order to be responsible for all services in the customer. Below are summarised the most relevant

opportunities, followed by the number of employees that mentioned them and some of their comments.

Table 2 - Major opportunities related to servitisation mentioned by employees

Opportunities	# of Employees	Comments
- Review services portfolio	6	“To sell more services we need to add new services to our portfolio. Selling only the current services is no longer enough, it is necessary to think about new ones.” “If we only offer the standard services, we do not cause any excitement, however if we offer something new, different from the competition, then we can retain customers.”
- Increase customer satisfaction	5	“Adding new services will expand the business, I talk about top line growth, but it will also make us a more attractive service provider. With a wider portfolio, we will be able to meet more of the customers’ requirements and therefore increase customer satisfaction.”
- Increase full-services offerings	5	“One opportunity is to have full-service offerings, so that we are responsible for all the services in the customer (maintenance, hotline, resident service, operation, etc.). In this way the client has only one focal point of contact, which is us.”
- Act proactively	4	“One of the great opportunities is that if we already do these numbers in a reactive way when we begin to proactively do, we only have improvements. And this I would say is our greatest opportunity.”

Next, employees were asked about the performance of the current services and raised some general criticisms, that is, criticisms that are common to more than one service offered by the company. These were mostly problems related with the lack of knowledge of Consoveyo’s technicians and with the internal definition of processes and procedures, besides the lack of modular contracts. Below are summarised the most relevant services criticism, followed by the number of employees that mentioned them and some of their comments.

Table 3 - General criticisms mentioned by employees

Services criticism	# of Employees	Comments
- Technicians lack knowledge	5	“One difficulty we have encountered is the limitation of people available in the market with adequate experience. In the company the knowledge is retained in few people with many years of company.”
- Lack of modular and standard contracts	2	“Regarding the contracts we have with customers, the impression is that we do not have a standard

		contract, they vary greatly according to the customer. We do not have established service packages.”
- Lack of standard documentation	2	“At the service documentation level, we have only a general maintenance manual, which also creates some difficulties, especially when technicians are not experienced. We need to improve our service documentation.

Since the SDCS will be applied in the development of a new service, employees were also asked about their opinion regarding the possibility of Consoveyo developing one of the services from a list of services previously established by the interviewer. These previously defined services are presented in Table 4 as well as their explanations.

Table 4 - Services suggested by the interviewer

Services	Services Explanation
Predictive maintenance	Predict when equipment failure might occur and prevent its occurrence by performing maintenance.
Obsolescence management	Proactive end-of-life management with suitable alternatives, seeking to warn the customer in case the part is becoming obsolete and therefore needs to be replaced.
Inspections & audits	Inspection services including detailed reports with customised plan for maintenance or modernization, ranging from the replacement of individual components to the complete refurbishment of the entire installation.
Audio-visual technologies	Using audio-visual technologies, such as smart glasses, to support commissioning and maintenance activities.
Web shop (E-commerce)	A web shop through which customers can login, have access to spare parts documentation and order the parts with a guaranteed time frame and at fixed prices
Training programs	Offer standard and customised training programs of several subjects, which can be performed either at the customers installation, at the company’s premises or even online as e-learning.

From the above-mentioned services, the interviewed employees find that predictive maintenance, obsolescence management and web shop (e-commerce) would be the services to add more value to the company’s portfolio. However, the technical complexity with developing these services were considered very high. Regarding the predictive maintenance, some employees warned that the service could be very costly given the need to add sensors to equipment. However, the company could more easily access the necessary information and therefore establish the predictive maintenance service, while the other two services would require a very high internal effort in terms of structuring documentation.

4.1.3 Data analysis for the development of the SDCS method

The interviews with the employees highlighted the requirements that need to be considered in the SDCS design. The first one concerns the lack of knowledge from technicians and the lack

of standard documentation. Once the service documentation is very generic and simple, the technicians' learning is harmed, which directly impacts the quality of the service performed and customer satisfaction. Thus, it is essential that the SDCS focuses on improving and preparing service documentation.

Besides, employees mentioned the lack of modular and standard contracts. In order to define such contracts, it is essential to identify all services features and possible services paths so that service modules can be set. The contracts can then be established based on the different service modules, with the customer choosing the one that best fits to his needs. Still, in order for Consoveyo to establish these service packages it is once again necessary to improve service documentation, besides defining pricing strategies for the different contracts' options. Thus, the SDCS must also have activities for this purpose.

Yet, it is worth mentioning that the employees mentioned that one of the biggest servitisation opportunity is for the company to act more proactively. Therefore, when it comes to choosing the service to be developed with the support of SDCS, both predictive maintenance and obsolescence management could be a good option for reaching this purpose, once they are about proactively advising the customer and acting prior to an eventual problem.

4.2 Designing the artefact: Presenting the SDCS method and its stages

Following the process of DSR proposed by Hevner (2007) and after further understanding the artefact's environment and its requirements, this section proceeds with the design of the artefact: the design cycle. The main objective of the suggested artefact is to establish a new service design method capable of assisting companies undergoing a servitisation process: the SDCS method. For the creation of the artefact, the results of the interviews (environment) and literature review (knowledge base) were used as inputs (see Figure 4).

The SDCS method is composed by 5 main stages: exploration, development, pilot, implementation and service management. While the first 4 are based on the stages of the service design process, the 5th stage is an addition to the traditional service design process and based on the principles proposed by Harland et al. (2018). As in the service design process, the SDCS begins by understanding the customer experience in the exploration stage, followed by the design of the service concept in the development stage (ideation stage in the service design process). The pilot stage from SDCS, however, differs from the reflection stage of the service design process in the sense that the service is not prototyped but piloted on a real client. Nevertheless, the objective of visualising the service prior to its implementation remains the same. Next, SDCS presents the implementation, which is little addressed in the service design process, and adds the service management stage for the services' continuous improvement. Figure 7 illustrates SDCS conceptual framework.

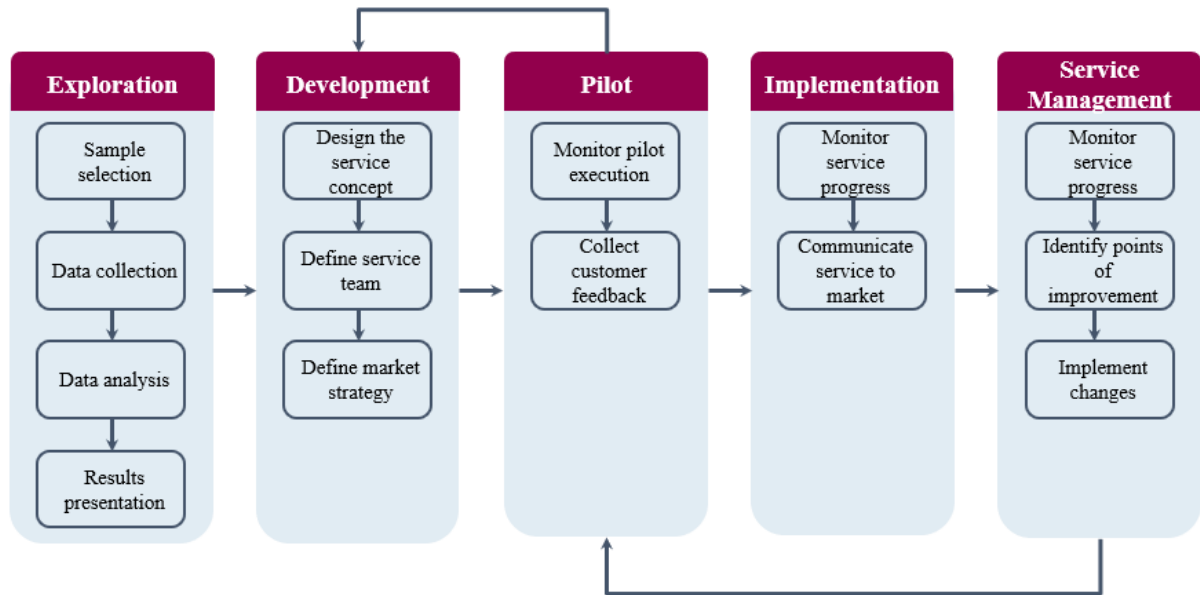


Figure 7 - SDCS conceptual framework

The first stage, exploration, is about understanding the customer experience. As stated by Meyer and Schwager (2007), not all touchpoints are of equivalent value to the customers and therefore the company needs to understand what adds more value in the customers perception in order to develop a solution that really fulfil customers' needs. Besides, it is about hearing the voice of the customers (VOC) in order to capture their requirements (Gaskin, Griffin, Hauser, Katz and Klein, 2010), which is also featured in the relevance cycle of the DSR (see Figure 4).

In the following stage, development, is where the service concept will be designed, in which the subsequent choice of the team that will be responsible for the service execution as well as the marketing strategy will be adapted according to the defined service concept. The service concept should illustrate the desired service, its elements, that the company aims to reach with the service development (Almqvist, 2018). For Goldstein et al. (2002), for a service to be successful it is critical that the service concept be designed during the service design and development. That is because once the service concept is designed, it can serve as the driver for the other decisions that can emerge throughout the service design process.

After the service concept being developed and the service team and market strategy defined, it is time to pilot the service with predefined customers. This phase is closely related with one of design thinking's principles: tolerance for failure. According to the design thinking concept, employees should have their space to fail and learn from its failure, as it is rare to get things right at the first time (Kolko, 2015). Thus, with SDCS, the services should be piloted, and the customers' feedback collected, in order to make the necessary adjustment before spending more internal effort in the next stage: implementation. Hence, the need of future rework is reduced, and the chances of service success increased.

Regarding the implementation stage, there is still very little literature review with no specific tool or method (Overkamp and Holmlid, 2016). SDCS intends to cover this gap through the proposal of a stage that consists in the preparation of the necessary material for the service and the communication to the market of the new service. According to Ait El Houssi, Morel and

Hultink, (2004), having well-defined communication strategies facilitate the consumer understanding the key benefits of the new offer. Consequently, it is expected that more customers adhere to the new offer.

For last, SDCS introduces a new stage, service management, which is not mentioned by the traditional service design process. According to Harland et al. (2018), in the service development process there should be a culture of continuous improvement, which should strive for perfection by comprising performance measure. Performance measurement is important for both finance control and greater organizational transparency. SDCS includes this stage as not only a way to measure service performance but also as an iterative stage, to the extent that points of improvement are identified and implemented and then piloted in specific customers to later enter the market and be expanded to other customers. This is also in line with the design cycle proposed by Hevner (2007), as it will promote continuous improvement to the design of the new service.

The following topics intend to explain each of the SDCS stage with further detail: figures 8 to 12 illustrate how each stage of the method is structured, in which in the column on the left are the actors and the grey boxes represent the entities that participate in each activity. Thus, the service owner should be the focal point of internal contact in relation to the service in question while the service design team is the department/people responsible for new services development in the organization. It is worth mentioning, however, that the entities must be adapted according to each company setting.

It also can be noticed that the development and implementation stages, have the customers represented in figures 9 and 11 respectively, even though there is no activity attributed to them. This is due to the highly industrial environment in which this work was developed, wherein most customers do not have the necessary technical knowledge to participate in these respective phases. However, it was decided to keep them represented in the framework so that it can be adjusted to other scenarios.

4.2.1 Stage 1: Exploration

Stage 1 of the SDCS method, exploration, has the same objective of this stage in the service design process: understand the customer experience. The goal is to understand the features that add value to the service value proposition in the perception of the customers. Thus, this stage consists of 4 main sequential steps: sample selection, data collection, data analysis and results presentation, illustrated in Figure 8.

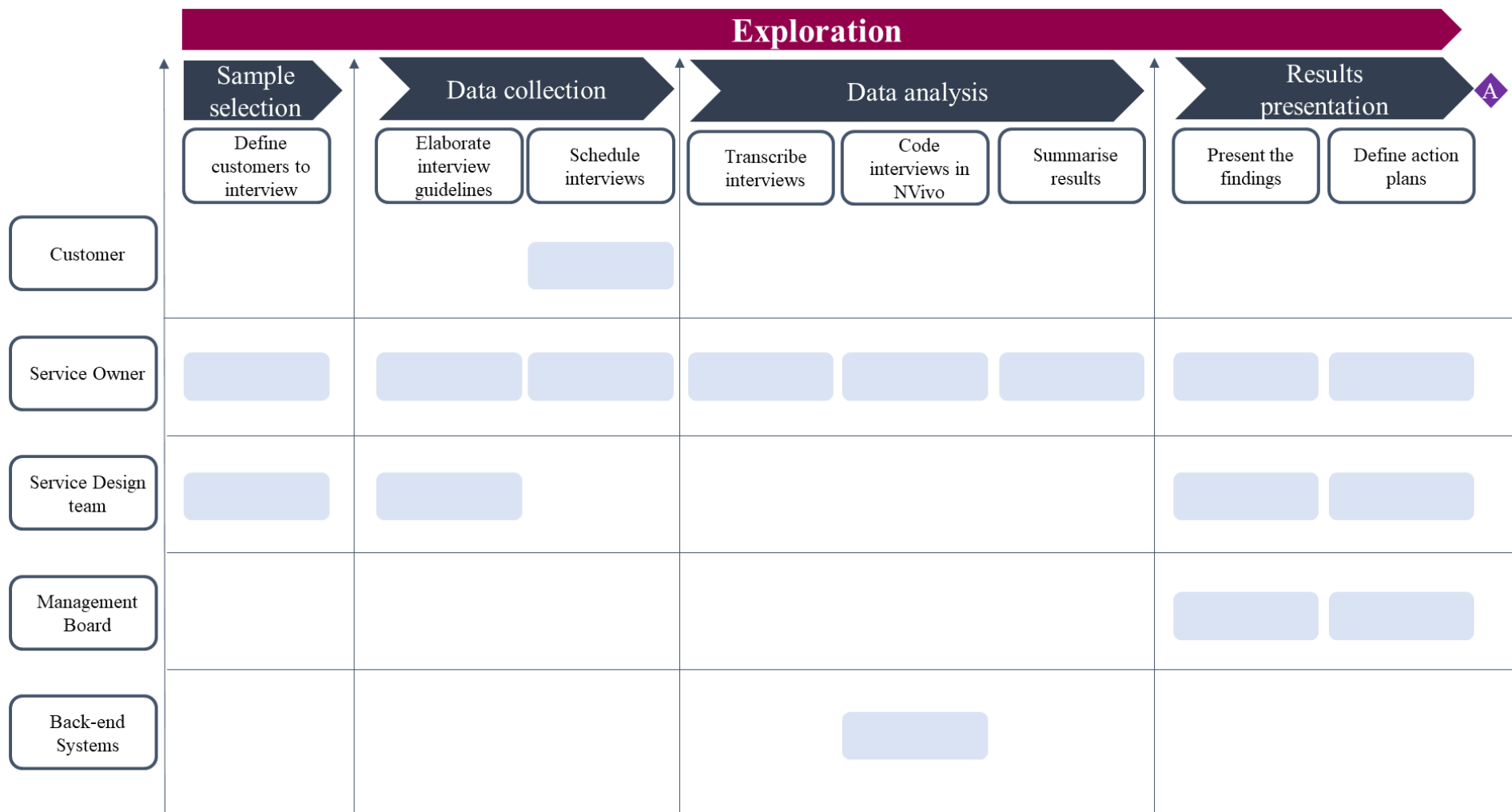


Figure 8 - Exploration stage of SDCS

The first step of this stage, sample selection, consists in defining the customers to interview. When selecting the customers to interviews, there should be a great deal of diversity, whether in size, in geographies, in industry segments or in time as the company's customers, in order to be able to evaluate the most diverse and rich points of view. The samples for qualitative studies are generally much smaller than those used in quantitative studies and therefore the sample size may vary according to the organization's size and number of customers. Customers should be interviewed until theoretical saturation is achieved, meaning, when more data does not lead to new information and relevant insights (Mason, 2010).

After the sample being selected, the script for conducting the interviews is elaborated and the meeting with the customers scheduled in the data collection step. Since SDCS was elaborated in an industrial environment, the services are mostly very technical, making the interviews much more complex. Therefore, for contexts like this, SDCS recommends that the interviews follow a semi-structure approach, there is, with a pre-defined guideline that allows dialogue in the interview, but flexible enough for the order of the questions to be switched and able to generate spontaneous, in-depth answer from the customers (Kallio, Pietilä, Johnson, and Kangasniemi, 2016). The goal is to make the customers feel as comfortable as possible, in order to collect the maximum of information.

Once all information is collected, transcribed and coded in a software for qualitative analysis, such as NVivo, the data should be analysed as presented in topic 4.1.3. As stated by Basit (2003), the analysis of qualitative data can be arduous, since it is not a fundamentally mechanical or technical activity. That said, using a software for coding the data is crucial to allow the researcher to really connect to the data and be able to understand the phenomenon in an easier way and generate meaningful conclusions.

Finally, the results presentation consists in a workshop with the most relevant people of the company for the service development, in which the findings are presented, and actions plan defined and prioritized. This is important as communicating the results should be the first step before thinking about possible solutions and serve as way to motivate employees to support the strategy (Husain, 2013). Besides, it also helps to change the company's mindset: from product to service. Hence, given the amount of resources available in the organization and the number of developed action plans, it may be necessary to prioritize them.

The milestone of the exploration stage, represented in Figure 8 with letter A, is the prioritization of the action plans, which may consist on improvements in current services or development of new services. In case of improvement in current services, the following stage should be service management.

4.2.2 Stage 2: Development

In the development stage the goal is to elaborate all the essential service features necessary for piloting it. This stage may be considered the heart of the SDCS, since any future service changes need to be reflected in this stage as well. Thus, it consists of 3 main sequential steps: design the service concept, define service team and define market strategy, illustrated in Figure 9.

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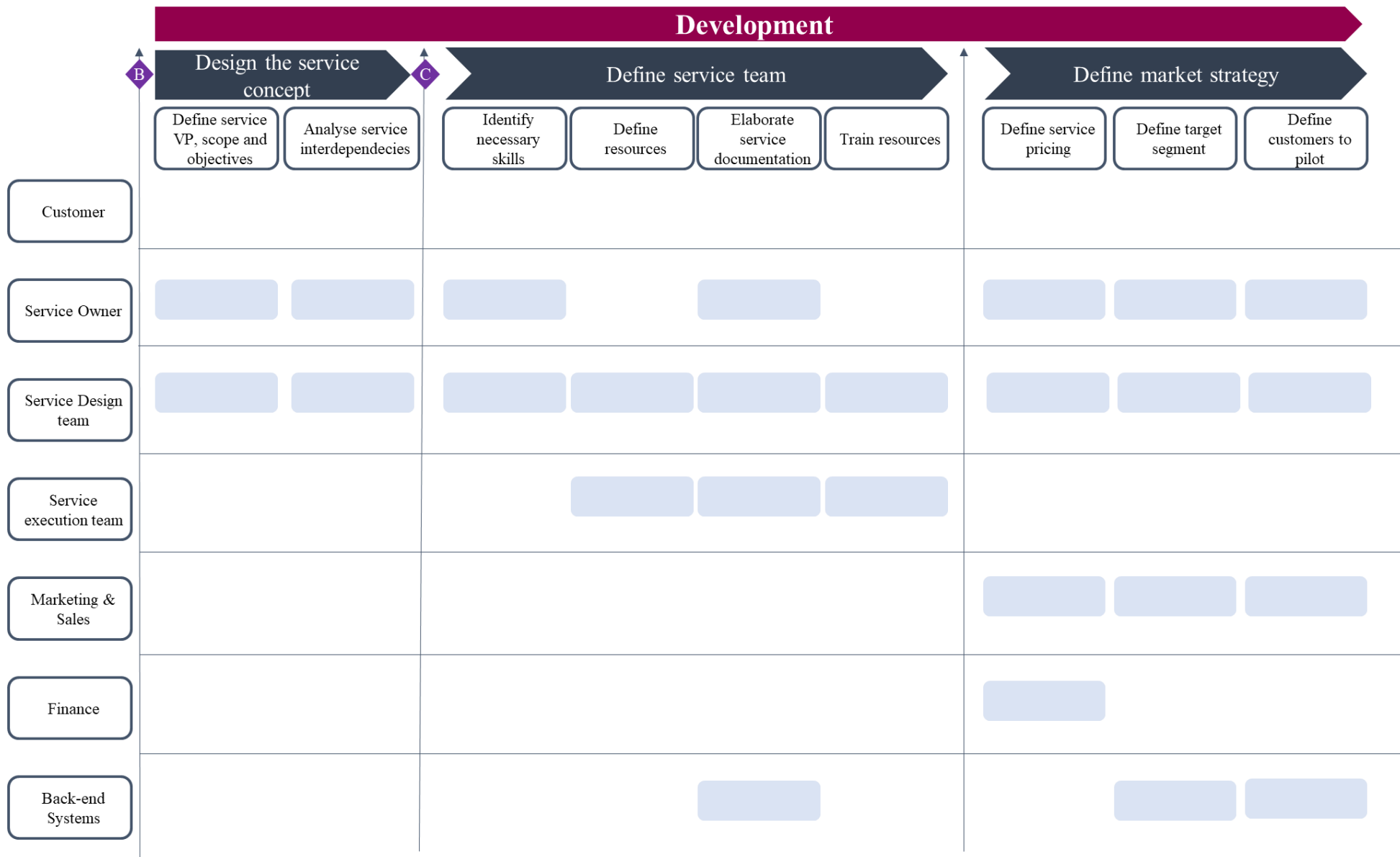


Figure 9 - Development stage of SDCS

To assist in this stage, the SDCS suggests that the team begins by elaborating the customer value constellation model (CVC), represented in Figure 9 with letter B. This will help the team to design the service concept, as being defined the new service value proposition, its scope and objectives as well as analysed if there may be any interdependencies with other existing services. As stated by Hudadoff (2009), the value proposition is the most important tool in marketing, as it delivers a concise and supportable statement of the offering's value and it provides a differentiation in the eyes of the customer when compared to other competitors. Thus, the service concept can be defined as “the way in which the organization would like to have its services perceived by its customers, employees, shareholders and lenders” (Heskett, 1986 p.16). In other words, it is about defining the essential elements of the service so it can be available for sales, marketing, development and delivery (Fitzsimmons and Fitzsimmons, 1999). Also, part of this activity is the analysis of dependencies and impact that this new service can cause in other already existent services so that the necessary adjustments can be made. Following this activity there should also be designed the service system architecture (SSA) (letter C in Figure 9), for a better understanding of all main activities and organizational departments involved in the service provision (see section 2.4).

Once the overall departments are identified, it is time to define the service team, that is, those that will be somehow responsible for the service execution. It is important to identify the necessary skills for performing the service and choose the resources based on these skills. Next, the service's documentation, should be elaborated with all the steps involved in the service provision before the training take places. It is worth emphasising that defining the service team and service documentation is crucial, once companies in servitisation process were not used to performing these activities before and therefore it is a way to ensure that all people involved are aware of their responsibilities and that the services are developed as planned. The appropriate documentation format, however, may vary according to the service, being for example a very detailed technical manual or service experience blueprints (SEB) (see section 2.4) that detail each main activity involved in the service provision. When preparing the documentation, and following the steps suggested by Böttcher and Klingner (2011) (Figure 2), the service team should list all the service features and analyse the rules and logical dependencies between them to propose new service modules. Thus, it may be necessary to establish one service documentation for each service module. Preparing the service's documentation is important to remedy the lack of knowledge of the service execution team, being these opportunities mentioned by the employees in the interviews regarding the servitisation process (see Table 2).

At this moment the service is almost ready to be tested, missing only the definition of the marketing strategy: pricing and target segments. Learning how to make sales more profitable is the key for achieving sustainable growth in revenue, market share and company value. However, being able to define an effective pricing is the harvest element from marketing (Nagle and Müller, 2017). That is because not all customers are willing to pay the same for the service or value the same features equally. The marketing strategy should be defined by the marketing and sales team with the support of the finance team, and latter informed to the service owner and design team, with information being recorded in back-end systems. Thus, it is important to define some criteria and segment them in order to choose the customers to whom the company intends to offer the service. Later, some customers within the target segment, should be chosen to pilot the service on the next stage. It is advisable to pilot the service in a maximum of 3 customers. This is because from this number on the customers' suggestions tend to repeat

themselves, besides it is important to keep the dynamism of the pilot phase and not make it too extensive.

4.2.3 Stage 3: Pilot

Once all the service features are designed it is time to pilot the service. The goal in this stage is to collect the customers' feedback and promote continuous improvement until the service is ready to enter the market. By that, this stage consists of 2 main sequential steps: monitor pilot execution and collect customer feedback, illustrated in Figure 10.

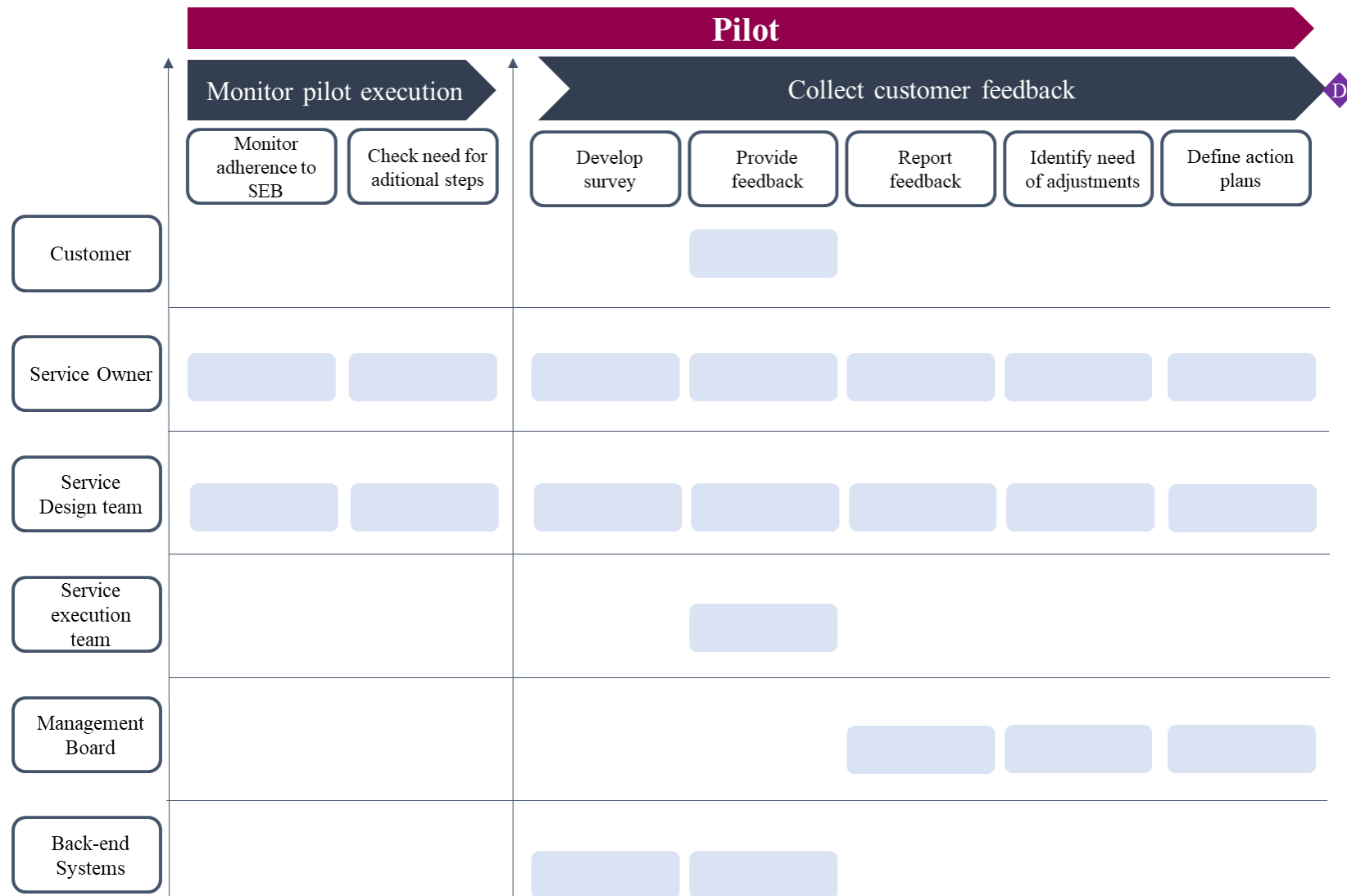


Figure 10 - Pilot stage of SDCS

This stage is based on the reflection stage of the service design process, however instead of prototyping the service experience, the service is piloted on a client. This is because in highly industrial environments and services of technical scope, prototyping can be quite difficult and abstract, failing to fulfil its main role of visualising the services prior to their implementations. Thus, while the service is being executed at the chosen customers, the service owner together with some of the people from the service design team, should be monitoring the pilot execution in order to identify if the service is being executed as defined or if any additional steps might be necessary and the service documentation adjusted. A pilot test is a way to confirm whether the proposed method or instruments are inappropriate or too complicated (Van Teijlingen and Hundley, 2001).

Hence, in order to identify opportunities for improvement, SDCS proposes that a survey be developed to be completed by the customers. The surveys should be elaborated by the service owner, validated by the service design team, and may be designed through available online platforms to facilitate the responses analysis. However, it is very important to keep the survey short, with only essential, very clear questions and, in case questions contain technical terms, provide specific wording definition (Fowler, 2013).

Customer feedback should then be presented by the service owner to the service design team and to the management board to identify any adjustment needs and consequent action plans. If the action plans are defined, the team must return to the development stage in order to implement the necessary adjustments. Thus, the service enters in a continuous improvement cycle in which the service only goes to the following stage, implementation, if no further improvement opportunities are detected through pilot customers feedback.

At the end of the pilot stage, the service owner should prepare a document with the lessons learned and main findings of the piloting experience, as indicated in Figure 10 with letter D.

4.2.4 Stage 4: Implementation

There is still very little literature review regarding the implementation of a new service. Thus, for the elaboration of this stage, the inputs from the interviews were used. The employees claimed, as illustrated in Table 3, the lack of standard documentation and modular/standard contracts. Due to the lack of standard documentation, each performed service varies greatly according to the customer and, with the lack of standardisation, it is difficult to maintain control of the quality of the service. Therefore, and aiming to solve the mentioned problems, SDCS proposes that the implementation stage be divided into 2 sequential steps: complete service documentation and communicate service to market, illustrated in Figure 11.

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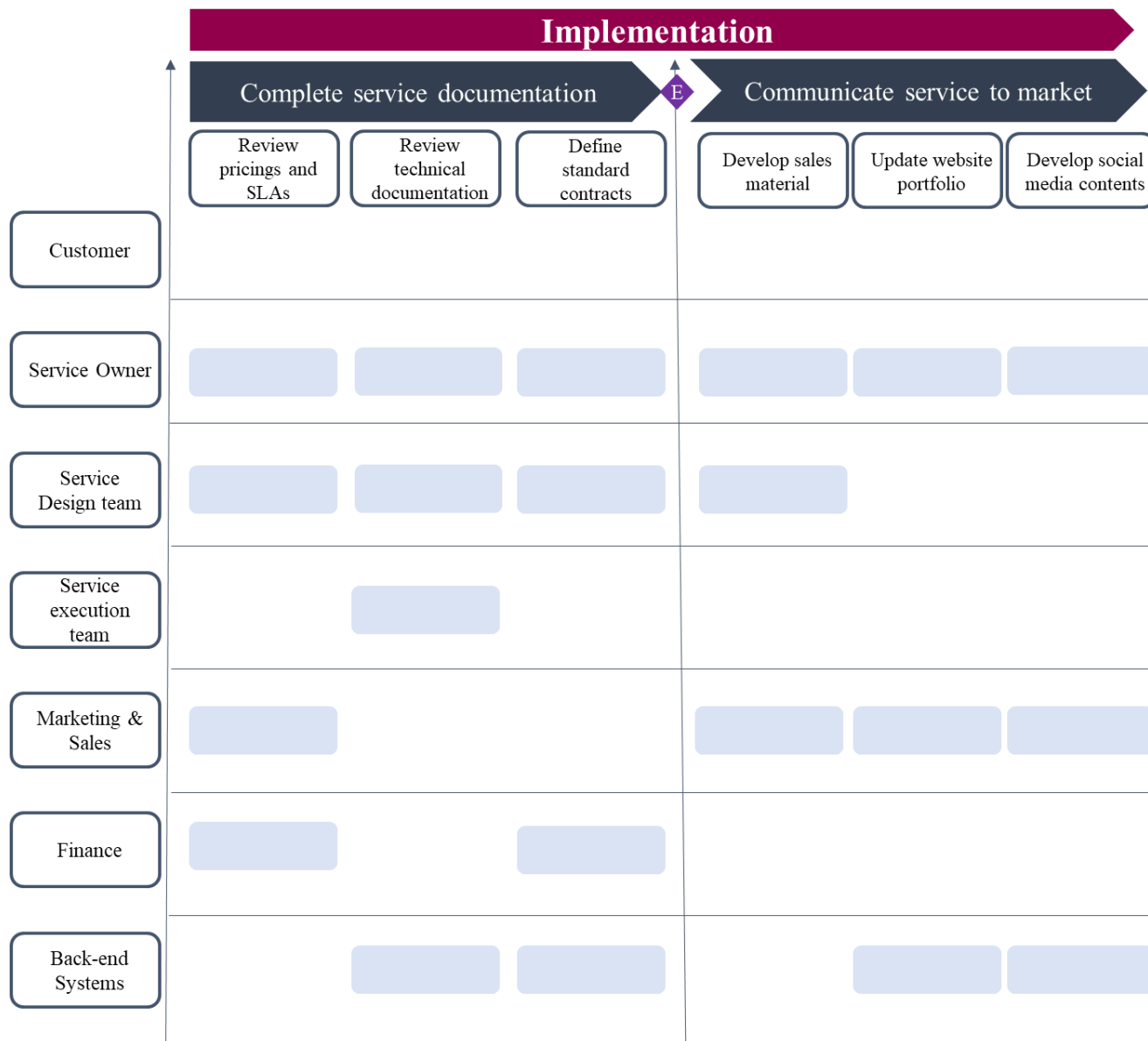


Figure 11 - Implementation stage of SDCS

With the first step, complete service documentation, the pricing strategies defined in the development stage must be reviewed and given as finalised so that the standard contracts can be defined. These should include the same people as in the previous stages: the marketing and sales team together with the finance team should review the pricing and inform the service owner and service design team. Besides, service level agreements (SLA) should be defined, as a way to set boundaries and align expectations with the customers. The service technical documentation should also be reviewed to ensure that it contains all the necessary information for the service to be performed with the expected quality. In order to do that, it is essential that the service execution team be consulted since they are the ones who will perform the service and therefore should be able to go through the document without any doubts. By that, it is expected to reduce the problems of the technicians' lack of knowledge, as reported in the interviews.

Once the pricing strategies, SLAs and technical documentation are completed, standard contracts can be elaborated. These contracts can follow the logic of modularisation, with specific SLA and pricing for each service module defined previously in the development stage. The modular contracts are the milestone from the complete service documentation step, indicated with letter E in Figure 11.

With all the service documentation complete, it is time to communicate the new service to the market. The first activity in this step should be for the service owner together with the service design team provide the sales team all the service information, so that they are able to approach customers and sell them the new service, and for this it is important that they fully understand all the features involved in the service provision and that any questions are withdrawn at this time. Next, the marketing material should be elaborated. Although the main responsible for doing such activity should be the marketing and sales department, they may need to contact the service owner and design team for any additional information and for contents validation.

4.2.5 Stage 5: Service Management

According to Harland et al. (2018), there should be a principle of continuous improvement for the management and development of service organization and their processes. Thus, the authors propose a phase called aiming for perfection, which consists of three main principles: the implementation of a measurement and control system for the service, the systematization of change and the systematization of further development of the service organization. Hence, this phase of Harland et al. (2018) was used as inputs for the development of the service management stage of the SDCS, which consists of 3 main steps: monitor service progress, identify points of improvement and implement changes, illustrated in Figure 12.

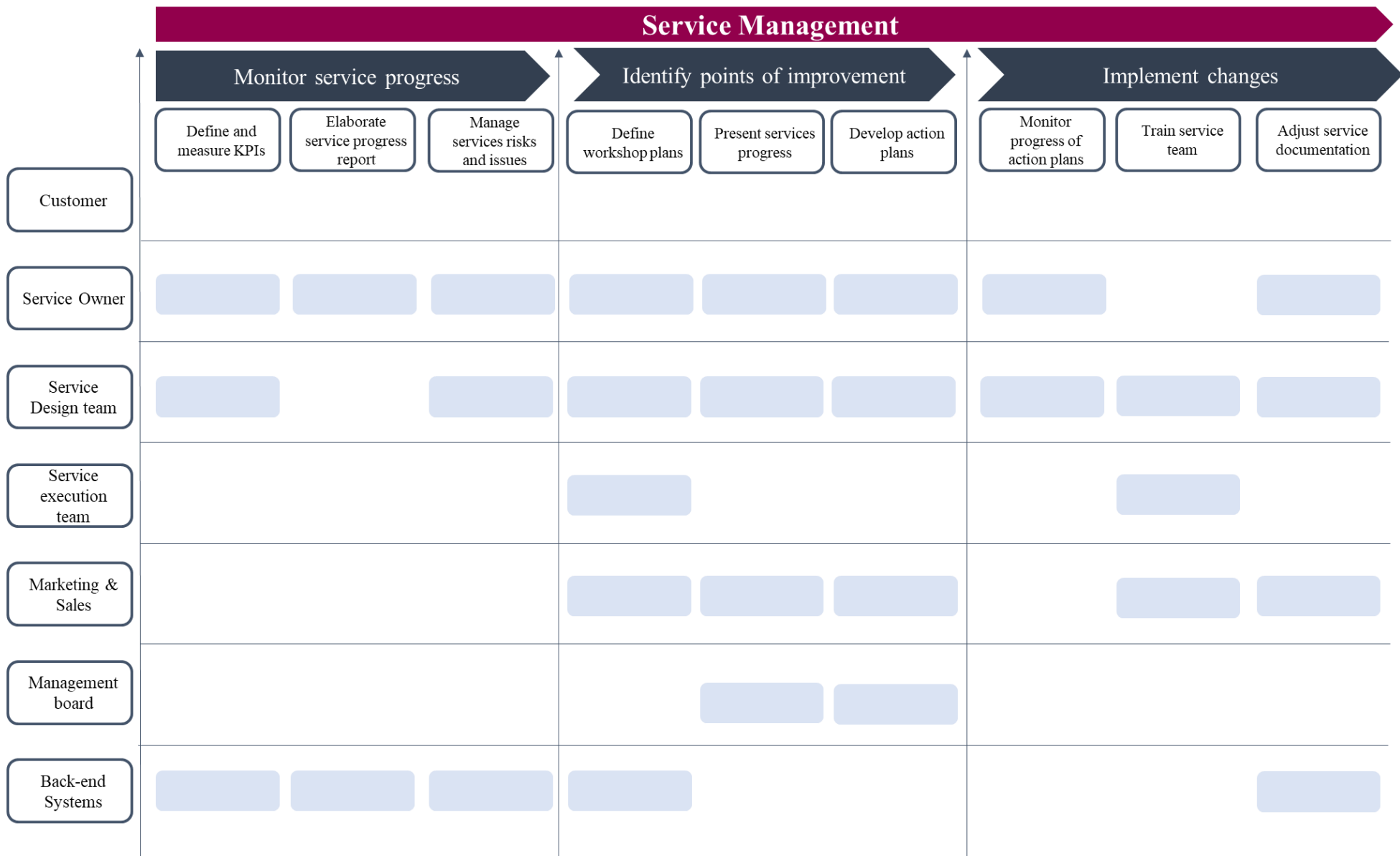


Figure 12 - Service management stage of SDCS

With respect to the first principle, the authors argue that having a structured performance management system is important to track whether the defined strategic objectives are being achieved. In this sense, and to comply with this principle, SDCS proposes the first step of the service management stage named monitor service progress. In this step, the service owner together with the service design team should define KPI's to each of the services. Ideally, these KPI's should be automatically calculated with information from the management system and therefore updated in real time in the back-end systems. A service progress report should also be elaborated by the service owner and reported to all interested parties, with the analysis of results and main highlights. Next, the service owner and the service design team should review the service progress report to identify some possible risks and problems and how to mitigate them.

Once the service is monitored, and according to the results, it may be time to promote some changes. This is the second step of the service management stage, identifying points of improvement, in line with the second principle stated by Harland et al. (2018). According to the authors, after a new service is launched to the market, some changes must be quickly identified and implemented effectively and efficiently. They add that these change requirements might come as a result from the performance management system, customer requirements, market changes, among others. Accordingly, this step of SDCS proposes workshops, where the results obtained of the services performance are presented by the service owner and action plans. It is worth mentioning that for the service performance analysis, both the service progress report elaborated in the previous step and the results of satisfaction surveys sent to the customers should be considered. Ideally it is suggested that customer satisfaction surveys be sent regularly, as a transactional feedback, following the Net Promoter Score (NPS) methodology.

For last, the identified points of improvement should be implemented in step 3 of SDCS: implement changes. According to the third principle of Harland et al. (2018), at this moment further development should be systematised for the service organization to increase its maturity level. SDCS believes that the overall organization's maturity level can be increased through a greater maturation of each offered service. Thus, the 3rd step of the service management stage proposes that the service owner, with the help of service design team, monitor the progress of the action plans elaborated in the previous step to ensure that they occur as planned. Once completed, the respective service design team members should provide appropriate training to the service execution team and marketing and sales, as they have direct contact with customers and need to know the changes. Finally, all changes made must be reflected in the services documentation and saved in the internal systems. At this moment the service must then return to the pilot stage until no further need for changes is detected before being implemented in other customers.

4.3 Evaluating the artefact: Applying the SDCS method in a company undergoing a servitisation process

Once the SDCS was developed, and following the principles of DSR, the method was applied in a company undergoing a servitisation process: Consoveyo. This application is crucial to evaluate the method's usability and relevance, so that it can be applied by other companies undergoing servitisation. Thus, the following topics present the results obtained with the application of the method in each stage.

4.3.1 Stage 1: Exploration

4.3.1.1 Sample selection

For the sample selection, Consoveyo's service owner met with some elements from the service design team in order to analyse some potential customers to interview and get their contacts. For confidentiality reasons, customers names cannot be disclosed.

It is worth emphasising that from the 23 customers contacted only 13 answered or agreed to participate (11 from Portugal, 1 from Spain and 1 from Netherlands). There was also a concern to diversify the customers interviewed as much as possible: customers of different sizes, different coverage (multinational and local), different cultures, different time as a Consoveyo customer (new and old customer) were interviewed. In total, 5 customers were interviewed in person, those who were located near Consoveyo or who were available to receive the project team at their premises, while the other interviews were held by telephone. The interviewed customers also had the most diverse functions within their companies, such as engineering managers, maintenance directors and general managers. Below is a summary of the sample characteristics.

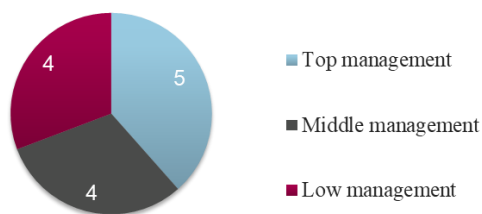


Figure 13 - Customers by job function



Figure 14 - Customers by industry segment

4.3.1.2 Data Collection

For the data collection, the primary method used was semi-structured one-to-one interviews, in which the script can be found in Appendix B. The interviews were conducted for one month, with an average length of 45 minutes, and in three different languages: Portuguese, English and Spanish, given the customers' several nationalities. Also, and as recommended by SDCS, the interviews were recorded whenever authorised by the participants. Thus, an informed consent form was distributed to each one of the interviewees, according to their native languages (Appendix C, D and E).

4.3.1.3 Data analysis

The data collected in the interviews was transcribed and inserted in the NVivo12 Software for data analysis, as presented in this topic. Thus, interviews with the customers started by addressing their main problems. They mentioned that the high impact of downtime that is, when their equipment is unavailable for use, and the demand seasonality are the major problems they face on their day to day activities. It is important to note, however, that from the 13 customers interviewed only 5 mentioned problems, while the others said they do not face any specific problems currently. Hence, due to the small number of customer responses and the heterogeneity of responses, conclusions should be analysed with caution. Thus, Table 5 presents

the most relevant problems mentioned by customers followed by the number of customers that mentioned them and their comments.

Table 5 - Major problems mentioned by customers

Major customers problems	# of Customers	Comments
- High impact of downtime	3	“The impact of a downtime in an equipment in our warehouse is very significant in terms of our customers’ satisfaction, with the possible delay of the order delivery. Yet, a downtime in the whole system, as we had two months ago, is equal to loosing 100.000 euros per day.”
- Demand seasonality	2	“In the summer things are always very complicated, the whole organization is working to the maximum and if there is any problem during a day of the week, the whole week is ruined. In our case we have to attend very high volumes and if we are not able to deliver our products, we have lost sales, as the customer will buy from our competitors.”

Next, the same new services suggested by the interviewer to employees (see Table 4) were also presented to the customers, as a way to collect their feedback and analyse if one of these services should be included in the services portfolio. Hence, those that customers found more relevant, that is, that would add more value to the service portfolio, were both predictive maintenance and obsolescence management, with 5 customers mentioning each. Although employees consider high the technical complexity involved in developing both services (predictive maintenance and obsolescence management), obsolescence management was considered slightly more difficult (see section 4.1.2). This is mainly because this service would require much internal effort in terms of documentation while in predictive maintenance the necessary information can be easier to access. Yet, 2 customers said that the most relevant service would be the use of audio-visual technologies, while only 1 customer mentioned the web shop as most relevant. This is mainly because customers find the use of audio-visual technologies an innovative service as a way to embrace Industry 4.0 technologies, but not crucial, and they are more concerned with the delivery time of the spare parts rather than having a web shop to order them. No customer mentioned as most relevant the services of technical key account, inspections and audits or training programs. Some of the customers comments regarding these possible new services are presented below, in Table 6.

Table 6 - Most relevant service mentioned by customers

Most relevant service	# of Customers	Comments
- Predictive maintenance	5	“If you can generate automatic reports and can make suggestions to us based on these reports, I think it's a great idea!”
- Obsolescence management	5	“Fantastic! Sometimes malfunctions can happen and there are no substitutes in the market. So, having you know exactly what is installed and making the

		control of it is fantastic! We never thought about it before, but I think it would be a very positive proposal.”
- Audio-visual technologies	2	“I think it would be another level of maintenance, we would be your remote eyes, I think it would be a very positive, innovative service.”
- Web shop (E-commerce)	1	“It would be perfect, very relevant. We lose some time in identifying parts, as we do not have the knowledge.”

From the customers interviews it is important to note that both the services they mentioned as the most important, predictive maintenance and obsolescence management, are related to the most mentioned problem: high impact of downtime. Hence, even customers who did not mention having downtime problems value services that somehow minimize the chance of downtime to the maximum.

In addition, it is possible to see from customers’ comments that they value services in which the company can act more proactively, warning them of problems before they even happen. This is in line with that obtained from interviews with company’s employees (see section 4.1.3).

4.3.1.4 Results presentation

After coding the collected data, a workshop was conducted with Consoveyo’s top management in order to present the results and define next steps, which could concern of both improvements in current services and inclusion of possible new services. At Consoveyo, the department responsible for developing and executing services is the Customer Service. Thus, the workshop included the head of customer service and maintenance operations manager, representing the service design team; the service portfolio manager engineer, representing the service owner and the chief sales officer, representing the management board; as recommended by SDCS. The team analysed some possible new services to be included in Consoveyo’s portfolio and defined action plans. Thus, some possibilities of new services emerged from the workshop: obsolescence management, inspections and audits and predictive maintenance. The first one, obsolescence management, was mentioned as one of the most relevant services by the customers, however the team believes that the implementation of this service would require a very high internal effort and it is not possible to be developed at the moment due to the lack of internal resources. Regarding the service of inspections and audits, on the other hand, the team believes that it would not require that much internal effort and could bring a significant revenue to Consoveyo as customers, once have an automatic warehouse, need to fulfil safety requirements for legal purposes. Thus, Consoveyo could provide this service as a way to ensure that customers meet these requirements. However, the interviewed customers did not show much interest in this service. Finally, the predictive maintenance service was also mentioned as one of the most relevant service to customers, and the team believes that although it involves a certain complexity and may increase the price of the service due to adding sensors to the equipment, the team believes that it can drive competitiveness to Consoveyo’s portfolio, once most competitors either offer it or seems to be studying it. Therefore, taking all the mentioned points into consideration, the team chose to develop the predictive maintenance service within the scope of this work. However, once this service is implemented, the inspections and audits service will start to be developed.

4.3.2 Stage 2: Development

4.3.2.1 Design the service concept

To begin the discussion of the service concept, and following SDCS, a workshop was scheduled with some key people for the service development: the head of the customer service, head of the IT department, besides the IT junior engineer and IT planning process controller. Prior to the workshop the project team elaborated a sketch of the customer value constellation (CVC) model, which was discussed and refined at the workshop (Figure 15). It is noteworthy that the coloured boxes represent the company's concept of the predictive maintenance service while the grey boxes are extended service offerings, which may be currently offered to customers by other companies or even by Consoveyo in a future moment.

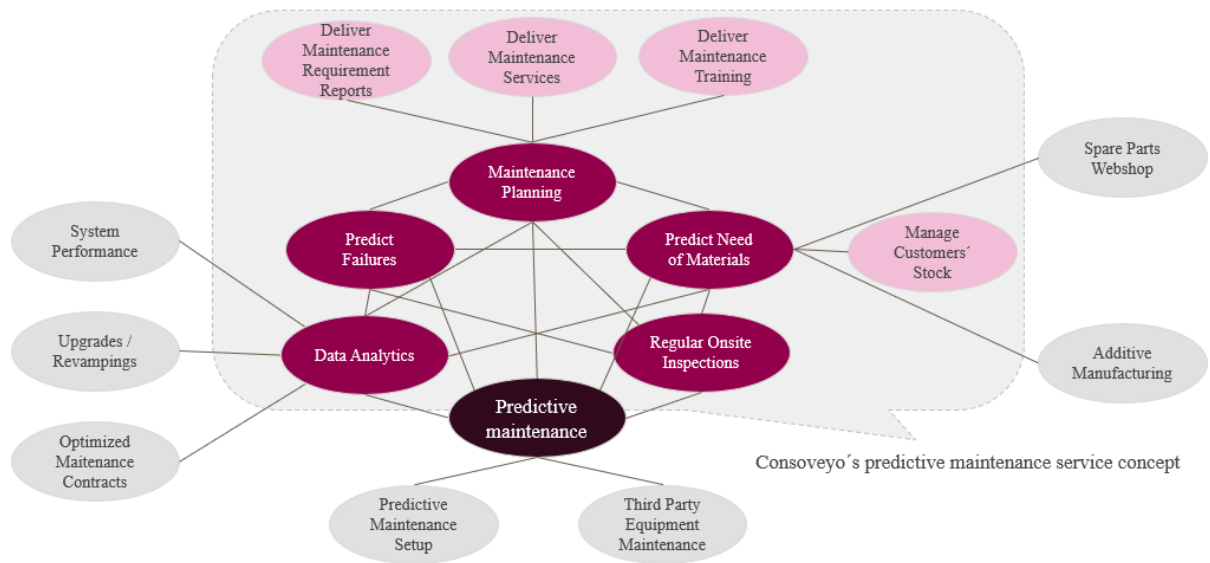


Figure 15 - Consoveyo's service concept positioning in the Customer Value Constellation for predictive maintenance

In the model, with the darker colour is the predictive maintenance itself, followed by the classical and improved service offerings with lighter colours. While the classical service offerings are standard to the predictive maintenance service, the improved service offerings are already an extension to the service which Consoveyo aims to deliver, differently from the extended service offerings which will not be performed by the company at the moment, as explained previously.

It is worth mentioning that predictive maintenance can be performed either digitally or manually. In the first case, the information is digitally collected through sensors in the equipment and triggers alerts automatically, which is the main objective of Consoveyo. However, for customers where it is not possible to install the sensors there is also the option to perform the predictive maintenance through regular onsite inspections, although this is a scenario that the company wants to avoid. In this case, Consoveyo's technicians collect the data of customers' equipment manually at their premises. Thus, although data collection is done differently, and once predictive maintenance allows the identification of potential problems

prior to failures occurrences, both digital and manual predictive maintenance allows to predict the need of materials, predict failures and improve maintenance planning.

Regarding the materials prediction, once the need to replace a part is detected in the predictive maintenance, the part needs to be purchased. Thus, depending on the customer maintenance plan, Consoveyo can be responsible for the purchase and management of spare parts. It is worth mentioning that the company, as a system integrator, does not manufacture anything, instead is responsible for designing and assembling solutions. Hence, at the moment the parts can only be bought via traditional ways, in which the company contacts a manufacturer, however the idea is that in the future customers parts can be produced by Consoveyo through additive manufacturing or even customers purchase the parts directly through a web shop. Yet, the prediction of failures and need of material also contribute to better maintenance planning, that is, to schedule when maintenance needs to be performed. The maintenance, however, can be performed both by Consoveyo's technicians or internally by the customers' technicians. In the last scenario, the company may offer training services or maintenance requirements reports that help guiding customers' technicians while they are doing maintenance activities.

For last, the predictive maintenance service allows the company to perform historical data analyses through data analytics and suggest customer recommendations that can range from small improvements in system performance as well as exchange or update of entire equipment. In addition, data analytics also allows Consoveyo to offer optimized contracts, in the sense of identifying the ideal frequency for performing preventive maintenance when combined with predictive maintenance. Data analytics, however, is not feasible when predictive maintenance is done manually, requiring much internal effort once information is not automatically recorded in the system. There are also other two service offerings that the company could eventually add to the predictive maintenance service. The first one is for Consoveyo to only do the setup of customers' installations, that is, analyse the equipment and install the right sensors so that the digital information can be collected, but once the need of an intervention is detected, the maintenance itself is not done by Consoveyo; and the second which is performing predictive maintenance in equipment developed by a third party.

After having designed the CVC, the team proceeded with the following activities proposed by SDCS for the service concept design: define service value proposition, scope and objectives and analyse service interdependencies. These were also initially defined by the project team and validated in the workshop.

The service value proposition is a statement that answers why the customer should do business with the company, emphasising the main benefits that he can get from it. Thus, with Consoveyo's predictive maintenance service, it is possible to avoid unplanned outages, to ensure equipment availability and to increase equipment lifetime.

Regarding the service scope, it is worth noting that initially, Consoveyo's predictive maintenance service will only be performed on specific equipment designed by the company and the selection of these equipment will be done together with the customer.

In order to collect the equipment data, Customer's Service mechanical engineers should analyse all features that need to be verified for each equipment, according to the preventive maintenance checklist. Once all features are identified, Customer's Service automation engineers should then analyse and suggest the most appropriate sensor type and its location for each equipment. Next, sensors must be placed in all equipment in which predictive maintenance will be performed.

A dashboard will be available with real time information of the equipment and respective sensors. Consoveyo will design a proposal for a dashboard, however, and whenever technically possible, it can be modified according to the customer's requirements. Nevertheless, once the final design is approved by the customer, any eventual change request will be charged separately. The accesses to the dashboards follow the logic of the modularisation, varying according to the plan chosen by the customer, as specified below:

- Dashboard basic plan – 2 users
- Dashboard super plan – 5 users
- Dashboard premium plan – unlimited

Once again following the logic of modularisation, there are different predictive maintenance plans, in which the actions and responsibilities of those involved after the detection of the need for intervention varies according to the plan chosen by the customer. The different plans as well as a brief description of the difference between them are presented below.

- PM Bronze plan – customer is responsible for scheduling maintenance with Consoveyo's technicians, or doing maintenance internally, and for spare parts management.
- PM Silver plan – Consoveyo is responsible for contacting the customer and for scheduling maintenance. Customer is responsible for spare parts management.
- PM Gold plan – Consoveyo is responsible for contacting the customer, for spare parts management and for scheduling maintenance. In this plan Consoveyo must guarantee availability for intervention within 24 hours.
- PM Platinum plan – Consoveyo is responsible for everything mentioned in the gold plan plus the customer has a spare parts package established in the contract and does not need to purchase them individually.

Therefore, it is worth emphasising that service pricing varies according to the number of sensors needed for the equipment and the plans chosen by the customer, both dashboard and predictive maintenance plans.

Regarding the service objectives, predictive maintenance is a condition-based technique, in which maintenance is done when a potential failure is detected, leading to several benefits. Once maintenance is done prior to failure, there is less need for corrective and preventive maintenance, reducing the costs with maintenance. Hence, and as the main objectives, predictive maintenance reduces the chances of downtime and therefore improves system availability and increases equipment efficiency.

With less breakdowns, operations activities also tend to flow better and by that indirectly increases company's revenue. Besides, with the effective assessment of failures, it is possible for the company to know in advance which parts need to be purchased and in which quantity, avoiding unpleasant surprises.

In addition, with predictive maintenance's digital collection of data and dashboards, real-time information is available full-time to the right people, increasing transparency and helping in the decision-making process. Lastly, the predictive maintenance service creates safer conditions for all involved in the handling of equipment, as equipment work optimally, and can even

increase sales of existing services or leverage the development of new ones, such as spare parts and training services in Consoveyo's scenario.

Regarding the analysis of the service interdependencies, on the other hand, the team concluded that the predictive maintenance service interferes with preventive and corrective maintenance services, besides spare parts and training programs. Thus, the periodicity of preventive maintenance or the number of hours of corrective maintenance specified in the contracts may have to be adjusted once the customer also contracts the predictive maintenance service. In addition, the predictive maintenance service can increase the spare parts sales revenue and the need of training from customers, which may justify the development of the training service in the future.

Next, following SDCS, the team developed the service system architecture (SSA), as illustrated in Figure 16.

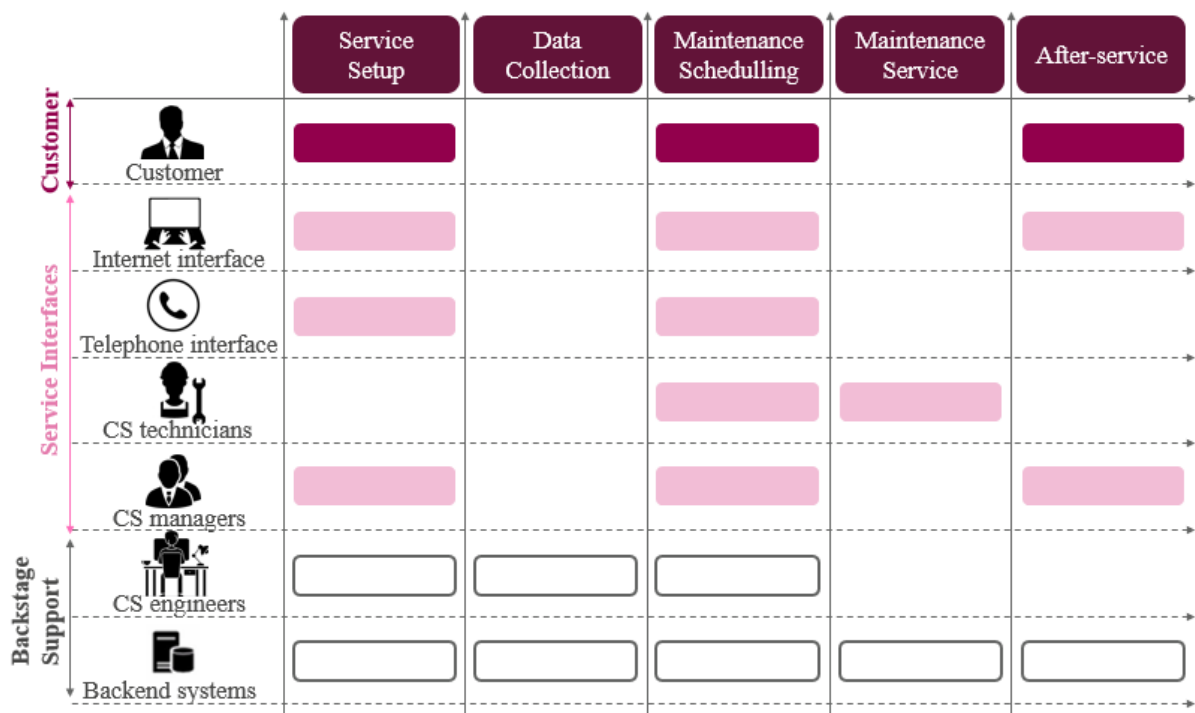


Figure 16 - Service System Architecture for predictive maintenance

On the left of the model are represented the main people involved in the service provision, both those that interface with the customer (service interfaces), and those that work internally in Consoveyo (backstage support). The top row indicates the main activities involved in performing predictive maintenance while the other boxes indicate who participates in each activity.

Thus, the setup activity refers to when the customer contacts Consoveyo, via the internet, telephone or even through the Customer Service managers, requesting the predictive maintenance service. The Customer Service (CS) engineers, mechanical and automation, then need to define the parameters to be measured and complete the service setup, which involves recording the information in the backend systems. Next, in the data collection activity, the equipment information is processed by the system and the dashboards trigger alerts, monitored by CS engineers. Once a potential failure is detected, it is necessary to schedule the maintenance

in the next activity. This activity varies according to the plan hired by the customer and can be performed either by the customers' internal technicians or by Consoveyo technicians. When done by Consoveyo, the maintenance technicians go to the customer and perform the service, always consulting and registering the information in the backend systems. Finally, a satisfaction survey is sent to the customer in the after-service activity.

4.3.2.2 Define the service team

Still in the workshop, and in the next step of the development stage, the team defined the main skills necessary to perform the service as well as the specific people that will be involved in the service provision. The main skills needed for the job functions are as follows:

- Customer service maintenance technicians – the technicians, to perform the interventions detected by the predictive maintenance, need the same skills as to perform other types of maintenance (preventive and corrective). No technicians will be chosen specifically for this service, instead they need to have the skills to perform any type of maintenance. However, it is essential that the technicians comply with safety procedures and policies and have a good relationship with the customer. In addition, a junior technician should always be accompanied by a technician with more experience.
- Customer service operation technicians - in cases of customers with resident services, in addition to the maintenance technicians, the operation technicians are also located in the customer. Thus, in order to perform predictive maintenance, these technicians need good analytical skills to analyse the dashboard information and perform first level interventions when necessary.
- Customer service engineers – the engineers involved in this service need to have in-depth knowledge of the equipment to be able to indicate the correct location of the sensors, as well as to define the ideal parameters. They also need data analytics skills, to develop and interpret the dashboards.
- Service owner - needs to have in-depth knowledge of the service concept in question. Must have direct contact with the engineers and technicians of the customer service team, in order to always promote the continuous improvement of the service. Must have marketing skills to participate in the definition of communication strategy and pricing of the service, besides communication skills to talk with customers in a professional and transparent way.

With regards to the service documentation, the team chose the service experience blueprint (SEB) as the most appropriate documentation. This is because the predictive maintenance service is mostly automated, requiring little human interference and when potential failure is detected, technicians must follow the technical manuals of other types of maintenance: preventive and corrective. Thus, no additional documentation is required.

There should be one SEB for each activity depicted in the SSA. However, for the purposes of exemplification and due to time restriction for the execution of this work, only one activity will be detailed: maintenance scheduling. The choice of this activity was due to its greater degree of complexity and because it is the only one that involves all the actors. Thus, it concerns the scheduling of a maintenance service with Consoveyo once a potential failure is detected. However, and following the logic of modularisation, the tasks and their respective responsible

vary according to the customers' predictive maintenance (PM) plan (see 4.3.2.1): bronze, silver, gold and platinum. It is worth mentioning that the team followed the suggestions from Böttcher and Klingner (2011), by listing all predictive maintenance service features and defining the service modules that through rules and logical dependencies could be structured as processes, being elaborated an SEB for each PM plan.

Thus, in the most basic PM plan, the bronze plan, the customer is responsible for analysing the alerts generated by predictive maintenance and starting the process for scheduling maintenance. Thus, he must first analyse whether the predictive maintenance reports indicate the need to exchange parts. If negative, he should contact Consoveyo to schedule the maintenance and if positive, he must check if he has the part in stock. Then again if positive he must separate it, update stock information in his internal system and contact Consoveyo to schedule the maintenance. If negative, he must contact Consoveyo to purchase the part.

It is worth emphasising that Consoveyo does not manufacture parts, instead purchase them from suppliers. Thus, the purchase process begins with customer service (CS) engineers requesting quotation from suppliers so that a proposal can be elaborated internally and presented to customers. This process is subject to some waiting points: the suppliers take an average of 2 to 3 days for parts quoting and the time to prepare the proposals takes on average of 2 to 3 days. In addition, the proposal may not please the customer, being this is a potential failure point. Next, when the customer analyses the proposal, he may decide whether to purchase the part with Consoveyo or with some other third party. In both cases there is the waiting time for receiving the parts. After receiving the parts, and if the customer has his own team of technicians, he may choose to end the process. Otherwise, he contacts the company for maintenance scheduling. At this moment there is another waiting point, in which availability for intervention varies according to customer and Consoveyo agenda compatibility and contractual SLAs. This is also a potential failure point because if the date indicated does not please the customer, he may be dissatisfied and decide not to do maintenance with the company, ending the process. Instead, in case the customer decides to do maintenance with Consoveyo, the process ends with the execution of the service by the company's technicians with consequent elaboration of the maintenance report. However, the quality of the service performed may also not please customers, being this another potential point of failure.

Yet in the silver plan, there is little change from the previous plan: activities, waiting and failure points remain the same. However, the process is started by Consoveyo that should be responsible for analysing the predictive maintenance alerts and scheduling the maintenance with the customer.

With respect to the gold plan, besides Consoveyo being responsible for analysing the alerts and contacting the customer, the company is also responsible for managing spare parts and guarantee availability for intervention within 24 hours, eliminating one of the waiting points. Thus, the customer is only contacted in this plan for the purchase decision. It is noteworthy that, unlike classic service design projects, which prioritizes the value co-creation through active customer participation, in a highly industrial environment such as Consoveyo's, service is more valued as less interaction and responsibility the customer has.

Finally, in the platinum plan, besides the features of the gold plan, the customer has a spare parts package established in the contract and therefore does not need to purchase them individually. Hence, this plan requires little interaction with the customers, in which they are

contacted only so the maintenance service can be scheduled. Consequently, waiting and failure points are reduced to a minimum.

Thus, all activities described from the different predictive maintenance plans, as well as the waiting and failure points, with letters W and F respectively, are illustrated from Figures 17 to 20.

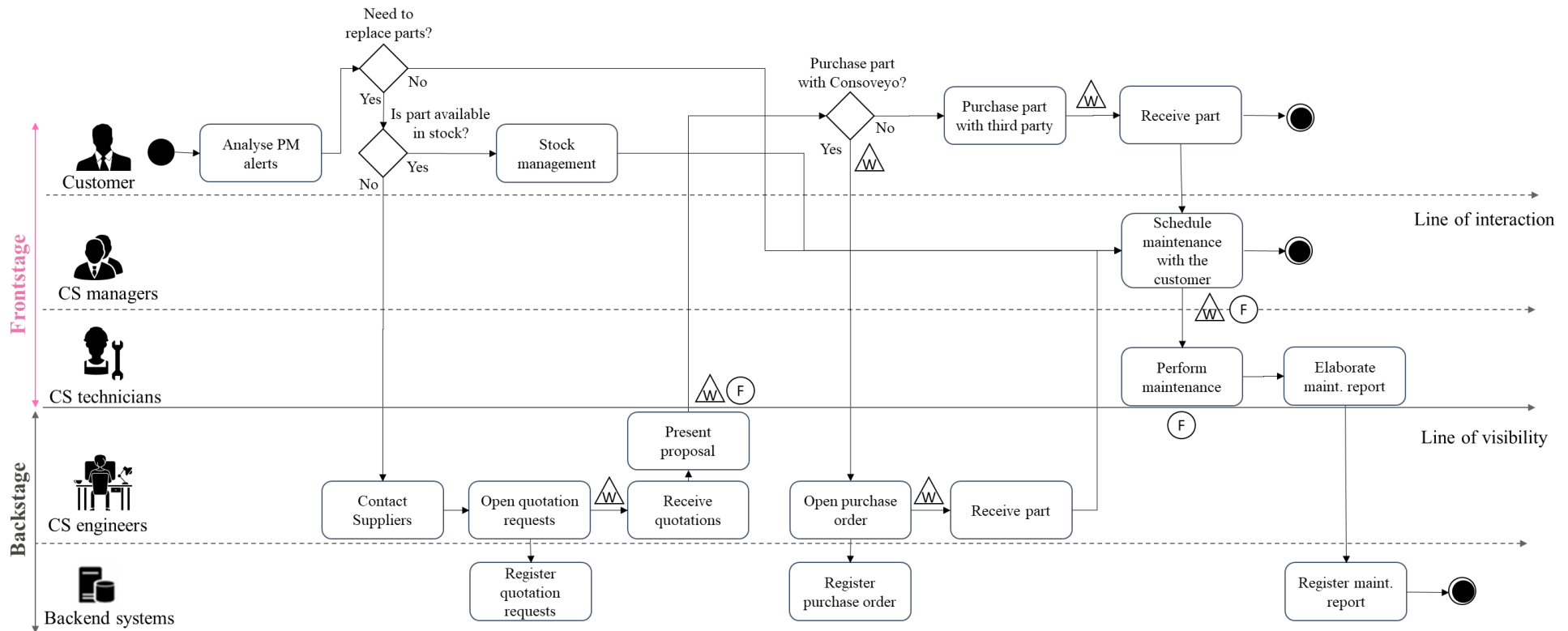


Figure 17 - SEB of the PM Bronze Plan

The SDCS method: a new service design method for companies undergoing a servitisation process

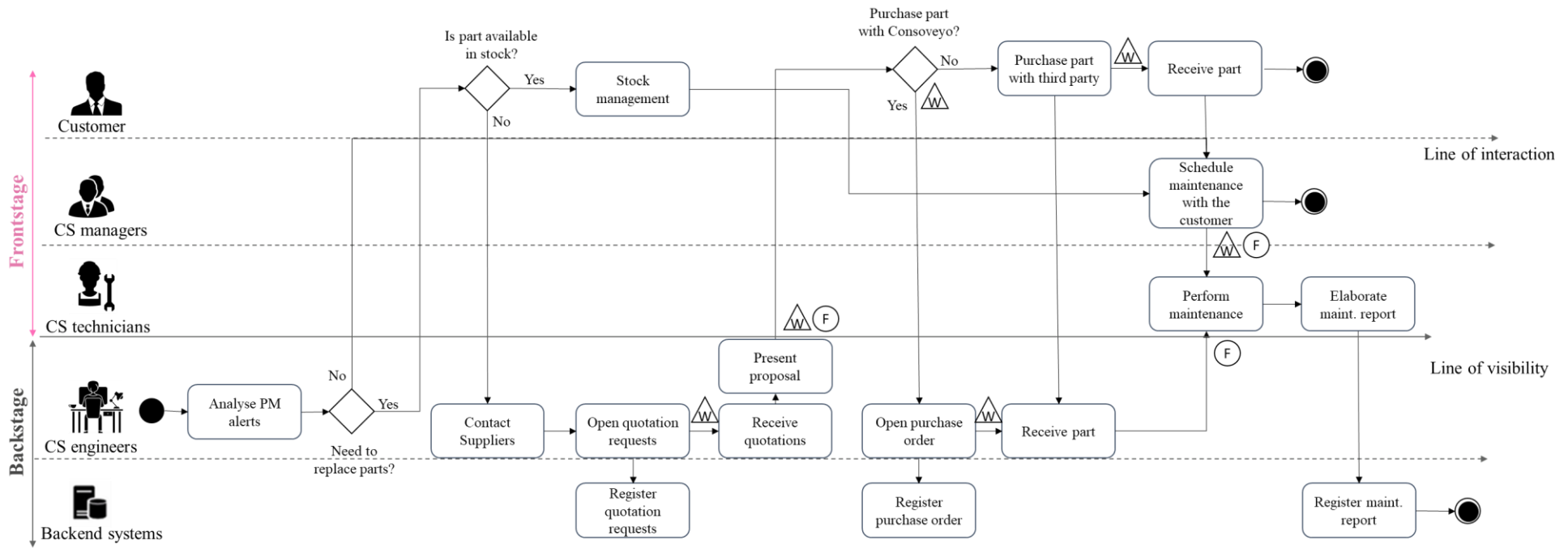


Figure 18 - SEB of the PM Silver Plan

The SDCS method: a new service design method for companies undergoing a servitisation process

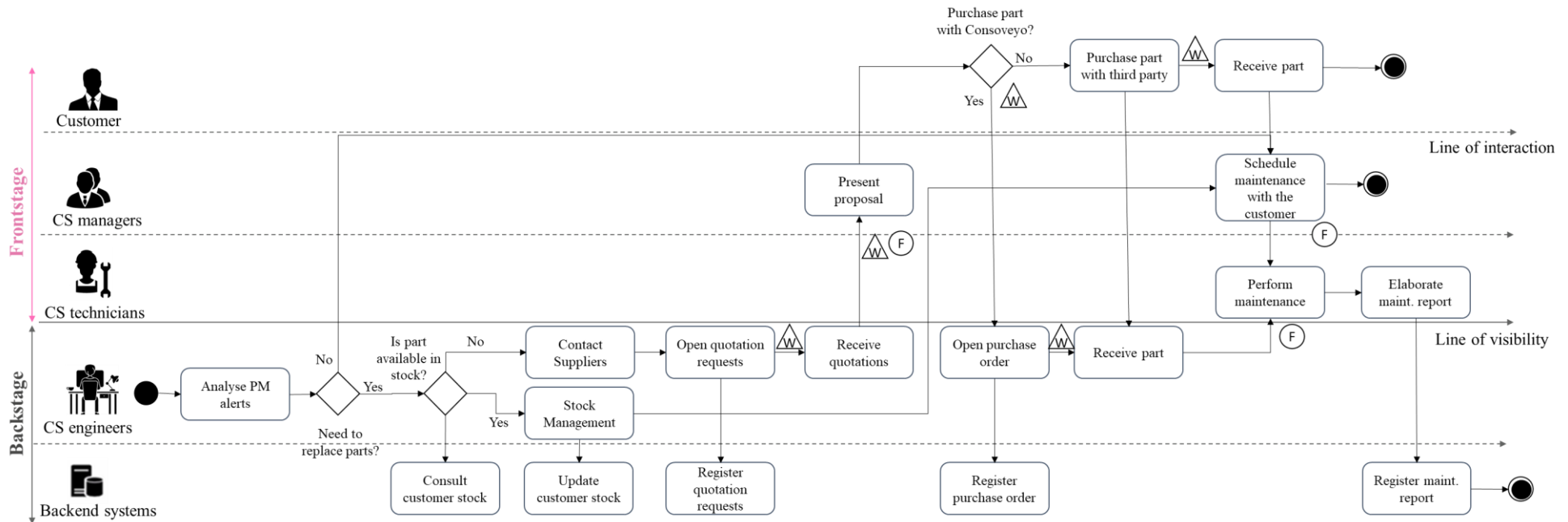


Figure 19 - SEB of the PM Gold Plan

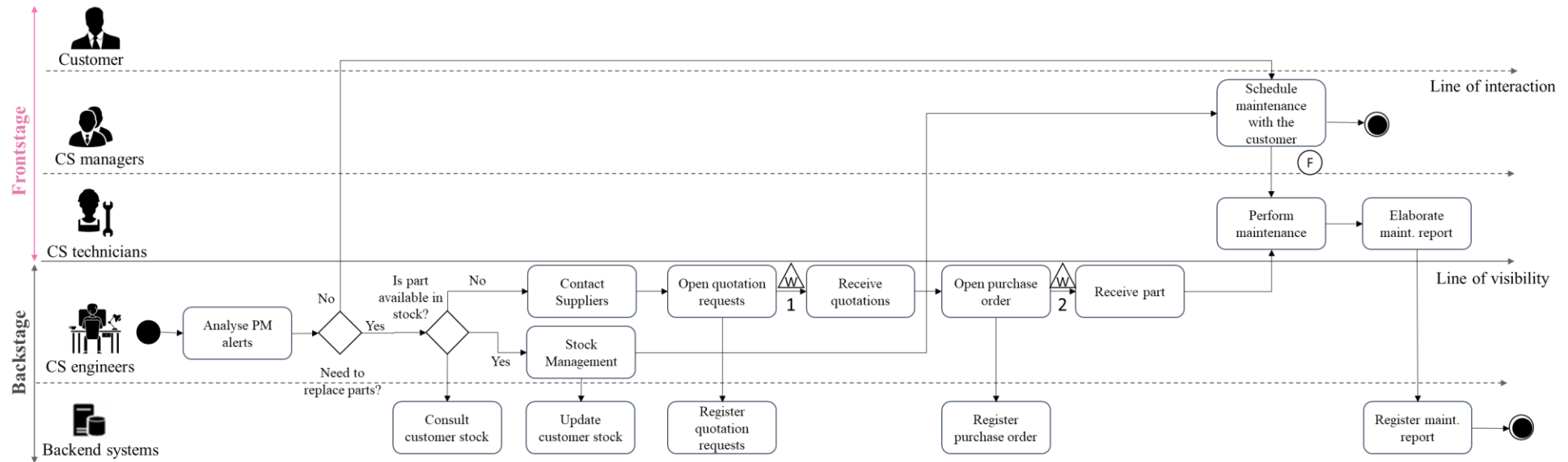


Figure 20 - SEB of the PM Platinum Plan

5 Conclusion and future research

The present project has aimed at defining a new service design method for companies undergoing a servitisation process, providing them the tools and knowledge for the design and implementation of a new service and continuous improvement of services. Besides, and once companies in servitisation process often seek to apply modularisation strategies to extend their service offerings, the project also sought to present how modularisation can be applied in the servitisation context.

To achieve this purpose, a literature review was performed in the most relevant subjects for the method development as well as a thorough study, following a qualitative research, with a company undergoing servitisation: Consoveyo. Thus, semi-structured, one-to-one interviews were carried out with the company's employees in order to better understand the organizational environment, as well as requirements that should be taken into consideration for the method design. These, together with the literature review, served as the inputs for the new method development: the SDCS method.

Hence, the literature review revealed that the existing literature on service design is much focused on the early phases of service development and very vague regarding its implementation, with no specific method or tool for this purpose. Besides, the service design process addresses only new services development, without specifying how they should be managed once implemented and the literature on service modularisation is still very scarce. The conducted interviews, in its turn, highlighted the employees' concern with improving service documentation, the poor service strategy and establishing modular contracts. Thus, all these aspects were considered for the design of the proposed SDCS.

Next, and following the principles of the chosen research methodology, Design Science Research, the method was applied in the design of a new service in Consoveyo, predictive maintenance, as a way to evaluate its usability and relevance. As the first phase of the method, exploration, customers were interviewed with regard to the new service development. At this point it is worth mentioning the most significant limitations to this study. The quality of the data collected varied according to customer availability and interest: many were more concerned with giving feedback on the service currently performed by the company than on the development of a new service. Besides, only 13 out of 23 customers contacted were willing to participate on the interviews and 1 customer did not allow for the interview to be recorded.

There are also some other limitations to this study which are worth mentioning. Due to time constraints to the conclusion of this work, it was not possible to apply all phases and steps of the proposed method, being applied only the first phase of the method (exploration) and partially the second phase (development). Also, the method was applied in only one company, in a B2B and highly industrial context. Consequently, the service that has been exemplified and developed in this project is very technical and, unlike classic service design projects, which prioritizes the value co-creation through active customer participation, in this service the less interaction and responsibility the customer has the better.

Therefore, and as suggestions for future studies, the method should be applied in more companies, with less industrial profile and preferably in companies with direct contact with final consumers (B2C). This will allow to identify if the customer should be involved in other activities not previously defined in the method or even if other activities should be included or

removed. Also, it will validate if the method can be generalised to other companies in servitisation process, or if it is only applicable in companies with similar profile to Consoveyo. In addition, it is suggested that all phases of SDCS be fully applied to the development of a new service and the service management phase be applied to the review and performance improvement of a service already implemented.

However, despite all the limitations and future study recommendations, it can be concluded that this project fulfilled the initial objective of defining a new service design method for companies undergoing a servitisation process: the method can be applied to both the development of new services and to Product-Service-Systems (PSS), bringing relevant academic contributions to the Service Design field and covering literature gaps. In addition, with the method application and detail of each performed activity, the project was able not only to establish the new method but to exemplify in practice how companies in servitisation process can apply it. Furthermore, the method also presents phases dedicated exclusively to the implementation and management of new services, subjects little or not addressed by the traditional service design process. Besides, it was possible to validate the challenges and opportunities for servitisation identified in the literature through the internal interviews and demonstrate in practice how service design can be applied to the development of modular services. It is also worth mentioning the relevance of the SDCS research contribution as one of the few methods that explores the creation of a service design artefact by adopting the DSR methodology, being the method disseminated both through the present work and an article (Appendix F) to be submitted to the International Conference on Exploring Service Science (IESS).

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APPENDIX A: Employees Interview Script

Socio-demographic data

Gender	
Academic background	
Job function	
Consoveyo employee since	

Questions

1. The company is currently trying to strengthen its services portfolio. What do you think of this process? In your perception, what are the biggest difficulties and opportunities?
2. What services do you think would be interesting to offer to customers?
 - a. Where these service ideas came from?
 - a. Which of the following services do you consider the most relevant to include in the Customer Service Portfolio? What about their complexity?

Service	Description	Relevance	Complexity
Preventive maintenance	Delivery of maintenance plans aligned with the customer's facility operating time and equipment maintenance requirements.		
Corrective maintenance	Remote and on-site support with short response times to support corrective maintenance activities.		
Predictive Maintenance	Predict when equipment failure might occur and prevent its occurrence by performing maintenance.		
Start-up assistance	Support to the operation of intralogistics systems.		
Resident services	Comprehensive on-site customer operation support service, including preventive, corrective maintenance and hotline support, as well as spare parts and consumables stock management according to the hired service levels.		
Spare parts	Provision and management of intralogistics system's spare parts guaranteeing minimal downtimes during our customers' daily operations.		
Obsolescence Management	Proactive end-of-life management with suitable alternatives, seeking to warn the		

	customer in case the part is becoming obsolete and therefore needs to be replaced.		
Web shop (E-commerce)	A web shop through which customers can login, have access to spare parts documentation and order the parts with a guaranteed time frame and at fixed prices.		
Hotline service	Hotline service supported by dedicated engineers (mechanical, automation and software), available 24 hours per day, 7 days per week, during the entire year.		
Inspections & Audits	Inspection services including detailed reports with customised plan for maintenance or modernization, ranging from the replacement of individual components to the complete refurbishment of the entire installation.		
Training Programs	Offer standard and customised training programs of several subjects, which can be performed either at the customers installation, at the company's premises or even online as e-learning.		
Audio Visual Support	Using audio-visual technologies to support commissioning and maintenance activities.		

3. Regarding Consoveyo's current service portfolio, would you suggest any improvements?
4. Would you like to mention any aspect not addressed in this interview?

APPENDIX B: Customers Interview Script

Socio-demographic data

Gender	
Academic background	
Job function	
Location	
Consoveyo customer since	

Questions

1. What do you do to manage your warehouse and internal logistics?
 - a. What goes well / what goes wrong in this management?
2. What do you value in an automated warehouse?
3. What kind of services would you like to be offered?
 - a. Where these service ideas came from?
 - b. What features/attributes of these services are the most valuable to you?
 - c. Which of the following services do you consider the most relevant and would like to have in your facility?

Service	Description	Relevance	Complexity
Preventive maintenance	Delivery of maintenance plans aligned with the customer's facility operating time and equipment maintenance requirements.		
Corrective maintenance	Remote and on-site support with short response times to support corrective maintenance activities.		
Predictive Maintenance	Predict when equipment failure might occur and prevent its occurrence by performing maintenance.		
Start-up assistance	Support to the operation of intralogistics systems.		
Resident services	Comprehensive on-site customer operation support service, including preventive, corrective maintenance and hotline support, as well as spare parts and consumables stock management according to the hired service levels.		
Spare parts	Provision and management of intralogistics system's spare parts		

	guaranteeing minimal downtimes during our customers' daily operations.		
Obsolescence Management	Proactive end-of-life management with suitable alternatives, seeking to warn the customer in case the part is becoming obsolete and therefore needs to be replaced.		
Web shop (E-commerce)	A web shop through which customers can login, have access to spare parts documentation and order the parts with a guaranteed time frame and at fixed prices.		
Hotline service	Hotline service supported by dedicated engineers (mechanical, automation and software), available 24 hours per day, 7 days per week, during the entire year.		
Inspections & Audits	Inspection services including detailed reports with customised plan for maintenance or modernization, ranging from the replacement of individual components to the complete refurbishment of the entire installation.		
Training Programs	Offer standard and customised training programs of several subjects, which can be performed either at the customers installation, at the company's premises or even online as e-learning.		
Audio Visual Support	Using audio-visual technologies to support commissioning and maintenance activities.		

4. What is your perception regarding the services offered by Consoveyo?
5. Would you like to mention any aspect not addressed in this interview?

APPENDIX C: Informed Consent – English Version

Informed Consent Form

Research Project: "Defining a service design strategy: a practical application in a technology company aiming to grow faster than the market".

You were asked to participate in this study conducted by Laís Said Souza Lima, within the scope of the Master's in Engineering Services and Management and the project with the company Consoveyo S.A. Please read the following information and clarify any questions you have before deciding or not to participate.

- This interview is voluntary. You have the right not to respond to any question and to finish the interview at any time for any reason.
- The information collected is confidential and will not use your name or any other specific reference relating to you.
- The interview will have to be recorded in order to allow a better and more agile understanding of the facts and to be referenced in the process under study. Your permission to record may be revoked at any time.

The information collected will be kept in a safe place until two years after the end of this study and then destroyed.

Please read and confirm,

() I understood the procedures described above, my doubts have been clarified and I agree to participate in this study. I will keep a copy of the form.

() I give permission for the interview to be recorded.

() I give permission for the information collected to be published for scientific purposes, without reference to the name or any information of the interviewee.

Name of Interviewee: _____

Signature Interviewee: _____ Date: _____

Signature Interviewer: _____ Date: _____

Please have my contact for any information:

Laís Said Souza Lima

Master's in services engineering and Management

Faculty of Engineering of University of Porto

Email: laissaidsoouza@gmail.com

APPENDIX D: Informed Consent – Portuguese Version

Formulário de Consentimento Informado

Projeto de Investigação: “Defining a service design strategy: a practical application in a technology company aiming to grow faster than the market”.

Foi-lhe pedido a participação neste estudo conduzido por Laís Said Souza Lima, no âmbito do Mestrado em Engenharia de Serviços e Gestão e do projeto com a empresa Consoveyo S.A. Leia por favor a informação que se segue e esclareça qualquer dúvida que tenha antes de decidir ou não participar.

- Esta entrevista é voluntária. Tem o direito de não responder a qualquer questão e terminar a entrevista em qualquer momento por qualquer razão.
- A informação recolhida é confidencial e não será usado o seu nome ou qualquer outra referência em concreto relativa à sua pessoa.
- A entrevista terá de ser gravada de forma a permitir uma melhor e mais ágil compreensão dos factos e para poder ser referenciada no processo em estudo. A sua permissão para gravar poderá ser revogada em qualquer momento.

As informações recolhidas serão guardadas em lugar seguro até dois anos depois do término deste estudo e depois serão destruídas.

Por favor leia e confirme,

() Eu compreendi os procedimentos acima descritos, as minhas dúvidas foram esclarecidas e concordo participar neste estudo. Ficarei com uma cópia do formulário.

() Dou permissão para a entrevista ser gravada.

() Dou permissão para que a informação recolhida seja publicada com objetivos científicos, sem referência ao nome ou a qualquer informação do entrevistado.

Nome do Entrevistado: _____

Assinatura Entrevistado: _____ Data: _____

Assinatura Entrevistador: _____ Data: _____

Por favor disponha do meu contacto para qualquer informação:

Laís Said Souza Lima

Mestrado em Engenharia de Serviços e Gestão

Faculdade de Engenharia da Universidade do Porto

Email: laissaidsoouza@gmail.com

APPENDIX E: Informed Consent – Spanish Version

Formulario de Consentimiento Informado

Proyecto de Investigación: " Defining a service design strategy: a practical application in a technology company aiming to grow faster than the market".

Se le pidió la participación en este estudio dirigido por Laís Said Souza Lima, en el marco del Máster en Ingeniería de Servicios y Gestión y del proyecto con la empresa Consoveyo S.A. Lea por favor la siguiente información y aclare cualquier duda que tenga antes de decidir o no participar.

- Esta entrevista es voluntaria. Usted tiene el derecho de no responder a cualquier pregunta y terminar la entrevista en cualquier momento por cualquier razón.
- La información recogida es confidencial y no se utilizará su nombre o cualquier otra referencia concreta relativa a su persona.
- La entrevista tendrá que ser grabada para permitir una mejor y más ágil comprensión de los hechos y para poder referirse en el proceso en estudio. Su permiso para grabar puede ser revocado en cualquier momento.

La información recopilada se guardará en un lugar seguro hasta dos años después de la finalización de este estudio y luego se destruirá.

() Comprendí los procedimientos descritos anteriormente, mis dudas se han aclarado y estoy de acuerdo en participar en este estudio. Me quedo con una copia del formulario.

() Doy permiso para que la entrevista sea grabada.

() Doy permiso para que la información recopilada sea publicada con fines científicos, sin referencia al nombre o a cualquier información del entrevistado.

Nombre del entrevistado: _____

Suscripción Entrevistado: _____ Fecha: _____

Suscripción Entrevistador: _____ Fecha: _____

Por favor, disponga de mi contacto para cualquier información:

Laís Said Souza Lima

Máster en Ingeniería de Servicios y Gestión

Facultad de Ingeniería de la Universidad de Oporto

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APPENDIX F: Article

The SDCS method: a new service design method for companies undergoing a servitisation process

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Abstract. To cope with the fierce business competition and increasing challenges brought with it, manufacturing companies have been demonstrating a growing interest in extending their service business. It is in this context that companies seek servitisation strategies, that is, developing the capabilities to add services to their traditional product offerings, to increase value to the customers and to differentiate themselves from the competition. Additionally, companies are commonly adopting another strategy as a way to expand their service offerings: the services modularisation. However, these companies that have been mostly product-centric, often lack methods and tools adapted to their context to succeed in deploying such strategy. Thus, the present article seeks to cover this gap, through the development of a new (S)ervice (D)esign method for (C)ompanies undergoing a (S)ervitisation process, by following the principles of the Design Science Research (DSR) methodology. The article presents the application of the SDCS method in a company undergoing a servitisation process.

Keywords: service design, servitisation, modularisation, design science research

1 Introduction

The demand for products often become stagnated, turning them less attractive [1]. That said, and in order for companies to still compete in the market, it becomes crucial to implement service-led growth strategies [2]. It is in this context that the concept of servitisation emerges. Servitisation can be defined as adding services to products [3] and is often seen as a way to increase the value to the customers and differentiate the offer from the competitors [1].

The reason for companies to extend their service business usually proceeds along three lines: financial, marketing and strategic opportunities [4]. According to Anderson and Narus [5], companies can enhance their profits by using services more effectively to meet customers' requirements. Thus, they can increase their customer portfolio, gain more business and consequently reduce the costs of providing the services. Neely [6] mentions that large firms, measured in both numbers of employees and revenues, are more likely to engage in servitisation efforts than smaller firms. In addition, there tend to be more servitised firms in highly developed economies than in industrialising economies.

Aiming to offer customers a wider services portfolio by increasing services variety, companies undergoing servitization efforts are also adopting modularisation strategies as a way to sustain their servitisation process [7]. Salvador [8] defines modularisation as decomposing an object into its components to recombine them into other customized alternatives. Thus, due to the independence between the components, designers can easily create a wide variety of offers using a smaller set of components [9].

However, there are many challenges regarding the implementation of servitisation and services modularisation efforts in companies. Supporting servitisation in product-centric companies can be very challenging as it requires reconstructing their organizational structures, including cultural change, internal communication, retaining service expertise and promoting inter-department collaboration [10]. West and Gaiardelli [11] also state that companies in servitisation process may face financial challenges, as they are usually required to spend money in new infrastructure, physical assets and knowledge during the first stages of servitisation. However, despite all these challenges and the advances in the service research field, there is still little guidance for companies to develop and

implement these strategies [12]. Besides, the literature on service modularisation is still scarce, and the main aspects related to its application, have not yet been explored [13, 14].

Taking these challenges into consideration, companies that intend to expand their service business, need to have appropriate methods and tools to support their servitization and modularization efforts. Thus, the present work aims to fill this gap by proposing the (S)ervice (D)esign method for (C)ompanies undergoing a (S)ervitisation process (SDCS). In the next section... the following section... and in the last part of the work presents the application of the proposed method in the design of a new modular service within a company currently undergoing a servitisation process.

2. Servitisation and Modularisation

Over the last few decades, the global economy has witnessed a significant increase in the importance of services, while the importance of products has declined [15]. Coined by Vandermerwe and Rada [16], the term servitisation is now widely recognised as the process of creating value by adding services to products [3]. Manole and Bier [17] state that the term servitisation means more than increasing a company's service business orientation and adding services to its portfolio, but also encompasses the transformation from product-centric to customer-centric approach.

For Ruiz-Alba et al. [18] servitisation strategies are only successful when companies engage in the co-creation of design and delivery of services, or in other words, if service propositions are in fact adjusted to customers' needs. However, this may require a lot of effort, since in order to do so, a company must reconfigure its resource base, organizational capabilities and structure; redefine its mission and update its routines, norms and values [19]. Nevertheless, when well applied, servitisation can provide several benefits to manufacturing companies [20]. Besides, through service differentiation that is, when companies differentiate their services from competitors, stimulates innovation as it reduces customers' perceived purchase risks and therefore helps to generate more customers who are willing to try new products or services [21,22]. Thus, by providing differentiated services, organizations create additional value to customers and undergird their competitive advantage [23].

Companies in a servitisation process often also seek modularisation as a way to broaden their service offerings and therefore sustain their services business expansion [7]. Modularisation is defined as decomposing an object into its components to recombine them into other customized alternatives [8]. Thus, the independence between the components allows designers to more easily create a wide variety of offers using a smaller set of components [9], leading many companies to adopt modularisation to increase their portfolio variety [24]. In the products field, the modular design, with standardised model and simple product architecture, also helps to improve product reliability and maintainability [25]. Besides, it reduces order lead-times and sustains economies of scale [26].

Accordingly, with the increasing importance and appreciation of services by the companies, the concept of modularisation has also been extended to services. Service module can be defined as the smallest service unit that can be individually offered to a customer or as a part of a service offering that creates value to the customer [27]. Thus, through service modularisation, companies can increase their market impact by developing innovative offerings that can be reused and can influence new service adoption [28].

Hence, modularisation seems to be a promising approach to deal with the increasing complexity of service portfolio and how to enable standardization and individualization at the same time [29]. However, when compared to the literature on the products field, the literature on service modularisation is still very scarce, and a comprehensive review, surrounding the main aspects related to its application, has not yet been explored [13, 14].

3. Service Design Process, Methods and Tools

Service Design is a framework that aims to design services that are useful, usable and desirable from the user perspective and efficient, effective and different from the provider perspective [30]. With the expansion of services, and the companies' understanding of the importance of offering their customers a value proposition instead of a single product, authors have developed over the years several service design methods. However, although each method has its own characteristics, they commonly recognize the first step as being an exploration and understanding the customers' needs and the last one as delivering the customers a solution [31]. Thus, they follow the service design process composed by four stages: exploration, ideation, reflection and implementation [32], which is meant to be highly iterative and non-linear [33]. Some of the most relevant tools and methods that can be applied in each stage of the service design process are presented next.

The first stage, exploration, consists of a deep study of the customer experience. [34], define customer experience as the internal and subjective response that customers have to any direct or indirect contact with a company. A good customer experience though is not measured on the number of features on offer but embedding the fundamental value proposition in offerings' every feature [35]. Therefore, some of the methods and tools that

can be used in the first stage of the service design process, exploration, are research data, personas and customer journey mapping.

After having a deep understanding of customer experience, it is time for the project team to generate and develop as many ideas as possible in the ideation stage [36]. However, in service design, ideas are just a starting point of a bigger process. They need to be generated systematically, massively, considering that the value lies not on the ideas themselves but on their outcomes [32]. Consequently, the new ideas help on the development of new service concepts. The development of the service concept brings a deep level of details as it covers the decisions from each component of the service, from major decisions to minor decisions, and therefore organizations should be careful to ensure that decisions are taken consistently and focused on delivering the right service to target customers [37]. At this stage several methods and tools that can be applied, namely customer value constellation, service system architecture and service experience blueprints [38].

After ideas are generated and the service concepts of the most promising ones designed, it comes to prototyping the service experience, in the reflection stage. Nevertheless, it is worth noting that unlike products that can be prototyped in a way which people can hold the object and get the real feeling, service prototypes need to be experiences of the interaction with the multiple points [39]. Even though, some tools can facilitate and be very useful in the prototyping of services, namely: videos, mock-ups and storyboards.

In the last stage of the service design process, implementation, the service is finally offered to the customers. It is important to note that the implementation of a service design project can be very complex since it may involve many different fields, such as, change management for the elaboration of new procedures and processes; software department, for the development of apps and software related activities or even engineering and product development in case of being necessary to produce physical objects [32]. Yet, the available literature focuses mainly on the initial stages of the service design process: exploration and ideation. That said, there is little literature on how the services can be prototyped [40] and successfully implemented [12], with no specific tool or method indicated for the implementation stage. Besides, and according to the guidelines proposed by [41] there should be a principle of continuous improvement in the service development process which is not addressed by the traditional service design process.

4. Methodology

With its roots in information systems discipline, design science research (DSR) has emerged in recent years as a way to ensure rigor and relevance in prototyping research projects [42]. Originally positioned as a technology-oriented methodology, DSR is a methodology that aims to understand organizational phenomena by developing and rigorously evaluating artefacts that can solve organizational problems [43]. Such artefacts may be constructs, models, methods or instantiations [44]. Thus, since the present project consists in developing a method to solve an organizational problem: companies still lack on the necessary knowledge, methods and tools imposed by servitisation; the DSR was considered the most appropriate methodology.

Hevner [45], proposes a DSR process which consists in three main cycles: the relevance cycle, the design cycle and the rigor cycle. In the relevance cycle the requirements (problems and opportunities) are presented and the artefact is evaluated in a field testing following specified criteria. The rigor cycle on the other hand presents the grounding foundations that is, the scientific methods theories and engineering methods that add rigor and robustness to the artefact. Lastly, the design cycle, is the main piece of a design science research project as it consists of the continuous improvement of the artefact, with the refining of the artefact according to the artefact evaluation and stakeholders' feedback.

Therefore, this study follows the process of DSR proposed by [45] to develop a new service design method capable of supporting companies undergoing servitisation efforts. As can be seen in Figure 1, the relevance cycle used as inputs the requirements from a qualitative approach conducted with the organization's employees in order to better understand the environment in which the artefact was developed. Subsequently, and still in the relevance cycle, the developed artefact was empirically tested at a company undergoing a servitisation process in order to be evaluated.

On the other hand, the literature review provided the research gaps and theoretical support important for the rigor cycle. Besides, it provided the foundations for keeping the necessary methodological rigor in the data collection performed in the relevance cycle. Still in the rigor cycle, the current article was elaborated, adding new knowledge to the knowledge base. Based on the relevance to the environment and the acquired knowledge base, the developed artefact is constantly refined at the design cycle. The following section presents the artifact develop by this design cycle.

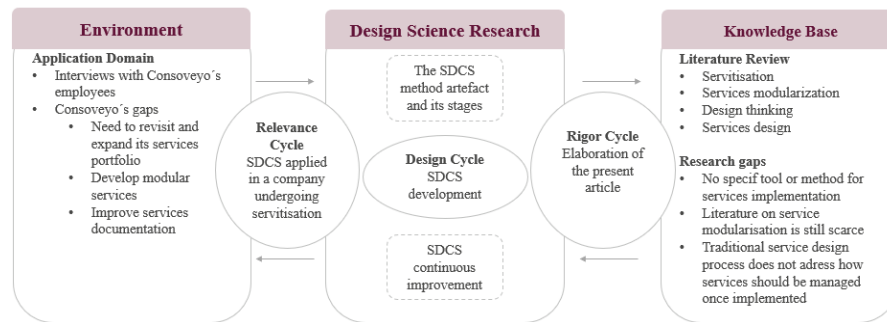


Fig. 1. Project methodology.

5. The SDCS Method

Following the process of DSR proposed by [45] and after further understanding the artefact's environment and its requirements, this section proceeds with the design of the artefact: the design cycle. The main objective of the suggested artefact is to establish a new service design method capable of assisting companies undergoing a servitisation process: the SDCS method. For the creation of the artefact, the results of interviews with employees from a company undergoing a servitization effort (environment) and literature review (knowledge base) were used as inputs.

In total 15 interviews were performed, with the data being fully transcribed in the NVivo software and analysed according to the principles of qualitative analysis [46]. Interviews highlighted the need for improving and preparing service documentation and the wish for modular and standard contracts.

The SDCS method is composed by 5 main stages: exploration, development, pilot, implementation and service management. While the first 4 are based on the stages of the service design process, the 5th stage is an addition to the traditional service design process and based on the principles proposed by [41]. Figure 2 illustrates SDCS conceptual framework.

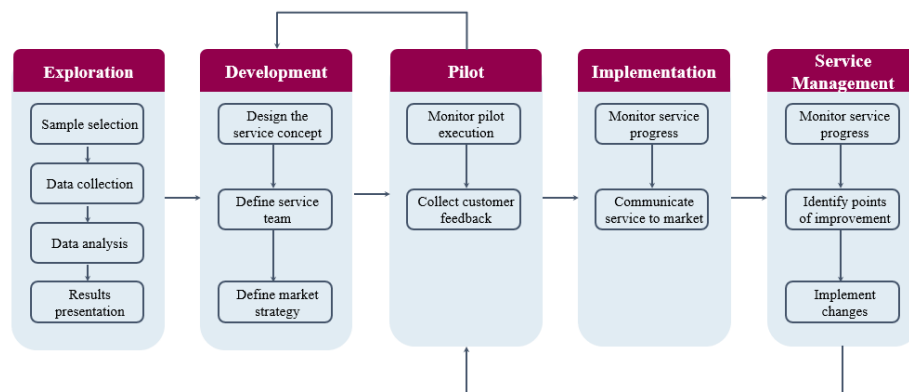


Fig. 2. SDCS conceptual framework.

The first stage, exploration, has the same objective of this stage in the service design process: understanding the customer experience. The goal is to understand the features that add value to the service value proposition in the perception of the customers. Thus, this stage consists of 4 main sequential steps: sample selection, data collection, data analysis and results presentation. The first step of this stage, sample selection, consists in defining the customers to interview. When selecting the customers to interviews, the sample should be as diverse as possible and customers should be interviewed until theoretical saturation is achieved, meaning, when more data does not lead to new information and relevant insights [47]. After the sample being selected, the script for conducting the interviews is elaborated and the meeting with the customers scheduled in the data collection step. Next, the data should be fully transcribed into a software for qualitative analysis such as NVivo and analysed according to the principles of qualitative analysis [46]. Finally, following service design participatory approach and the need to communicate a service mindset to product-oriented companies, the results presentation consists in a workshop with the most relevant people of the company for the service development, in which the findings are presented, and actions plan defined and prioritized. The milestone of the exploration stage is the prioritization of the action

plans, which may consist on improvements in current services or development of new services. In case of improvement in current services, the following stage should be service management.

In the following stage, development, the goal is to elaborate all the essential service features necessary for piloting it. Thus, it consists of 3 main sequential steps: design the service concept, define service team and define market strategy. To assist in this stage, SDCS suggests that the team begins by elaborating the customer value constellation model (CVC). This will help the team to design the service concept, as being defined the new service value proposition, its scope and objectives as well as analysed if there may be any interdependencies with other existing services. These activities are important to align the team's expectations with respect to the service in question in addition to identifying possible changes in other existing services caused by the development of the new service. Next, there should also be designed the service system architecture (SSA), for a better understanding of all main activities and organizational departments involved in the service provision. Once the overall departments are identified, it is time to define the service team, that is, those that will be somehow responsible for the service execution. It is important to identify the necessary skills for performing the service and choose the resources based on these skills. As highlighted by the initial qualitative study, the next step involves the elaboration of the service's documentation, with all the steps involved in the service provision before the training take places. The appropriate documentation format, however, may vary according to the service, being for example a very detailed technical manual or service experience blueprints (SEB) [35] that detail each main activity involved in the service provision. Preparing the service's documentation is important to remedy the lack of knowledge of the service execution team, being these opportunities mentioned by the employees in the interviews regarding the servitisation process. At this moment the service is almost ready to be tested, missing only the definition of the marketing strategy: pricing and target segments. The marketing strategy should be defined by the marketing and sales team with the support of the finance team, and latter informed to the service owner and design team. Thus, it is important to define some criteria and segment them in order to choose the customers to whom the company intends to offer the service. Later, some customers within the target segment, should be chosen to pilot the service on the next stage.

In the pilot stage, the goal is to collect the customers' feedback and promote continuous improvement until the service is ready to enter the market. By that, this stage consists of 2 main sequential steps: monitor pilot execution and collect customer feedback. This stage is based on the reflection stage of the service design process, however instead of prototyping the service experience, the service is piloted on a client. Thus, while the service is being executed at the chosen customers, the service owner together with some of the people from the service design team, should be monitoring the pilot execution in order to identify if the service is being executed as defined or if any additional steps might be necessary and the service documentation adjusted. A pilot test is a way to confirm whether the proposed method or instruments are inappropriate or too complicated [48]. Customer feedback should enable the identification of any adjustment needs and consequent action plans.

Regarding the implementation stage, there is still very little literature review to support it (adicionar referências). Thus, for the elaboration of this stage, the inputs from the interviews were especially important. Therefore, and aiming to solve the problems mentioned by the employees, SDCS proposes that the implementation stage be divided into 2 sequential steps: complete service documentation and communicate service to market. In the first step, all the documentation elaborated in the previous stages should be reviewed and the service level agreements (SLA) defined, so that the standard contracts can be elaborated. These contracts can follow the logic of modularisation, with specific SLA and pricing for each service module defined previously in the development stage. With all the service documentation complete, it is time to communicate the new service to the market by connecting with the sales and marketing team.

The last stage, service management, is based on the principles proposed by [41]. These authors propose a phase called aiming for perfection, which consists of three main principles: the implementation of a measurement and control system for the service, the systematization of change and the systematization of further development of the service organization. Hence, this phase of [41] was used as inputs for the development of the service management stage of the SDCS, which consists of 3 main steps: monitor service progress, identify points of improvement and implement changes. With respect to the first principle, the authors argue that having a structured performance management system is important to track whether the defined strategic objectives are being achieved. In this sense, and to comply with this principle, SDCS proposes the first step of the service management stage named monitor service progress. In this step, the service owner together with the service design team should define KPI's to each of the services. A service progress report should also be elaborated by the service owner and reported to all interested parties, with the analysis of results and main highlights. Once the service is monitored, and according to the results, it may be time to promote some changes. This step of SDCS proposes workshops, where the results obtained of the services performance are presented by the service owner and action plans. It is worth mentioning that for the service performance analysis, both the service progress report elaborated in the previous step and the results of satisfaction surveys sent to the customers should be considered. Lastly, the identified points of improvement should be implemented in step 3 of SDCS: implement changes. Thus, the 3rd step of the service management stage proposes that the service owner, with the help of service design team, monitor the progress of the action plans elaborated in the previous step to ensure that they proceed as planned.

5.1 Evaluating the artefact: Applying the SDCS method in a company undergoing a servitisation process

Once the SDCS was developed, and following the principles of DSR, the method was applied in a company undergoing a servitisation process. This application is crucial to evaluate the method's usability and relevance, so that it can be applied by other companies undergoing servitisation.

For the sample selection, the service owner met with some elements from the service design team in order to analyse some potential customers to interview and get their contacts. In total, 13 customers were interviewed (11 from Portugal, 1 from Spain and 1 from Netherlands), in which 5 customers were interviewed in person, while the other interviews were held by telephone.

The data collected in the interviews was fully transcribed and inserted in the NVivo12 Software for data analysis. In the interviews, customers mentioned that the high impact of downtime that is, when their equipment is unavailable for use, and the demand seasonality are the major problems they face on their day to day activities. Yet, regarding the new service to be developed by the company, customers found both predictive maintenance and obsolescence management equally important.

Thus, a workshop was conducted with the company's top management in order to present these results and define next steps. Hence, the team chose to develop the predictive maintenance service once they found it less complex than the obsolescence management, besides adding competitiveness to the company's service portfolio. To begin the discussion of the service concept, and following SDCS, a workshop was scheduled with some key people for the service development, in which the service owner presented the CVC model (Figure 3). It is noteworthy that the coloured boxes represent the company's concept of the predictive maintenance service while the grey boxes are extended service offerings, which will not be offered by the company at the moment.

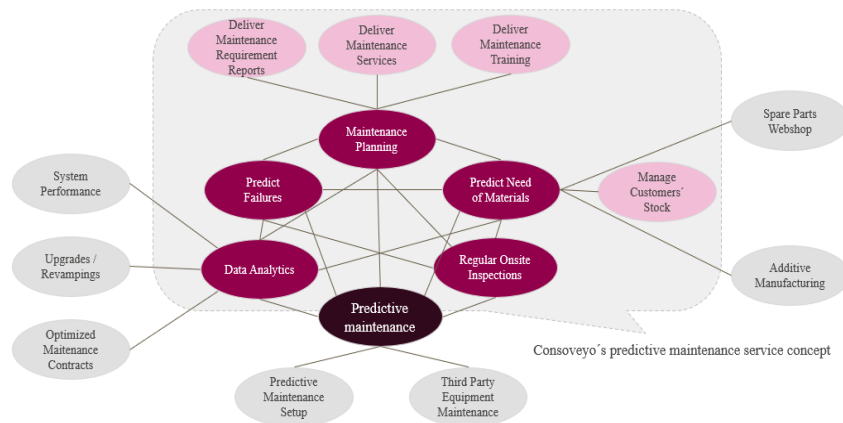


Fig. 3. Service concept positioning in the Customer Value Constellation for predictive maintenance.

Following SDCS, the team then proceeded with the definition of the service value proposition, scope, objectives and analysed service interdependencies. However, since the results of these activities apply only to the company in question they will not be presented in this document. Instead, it will be presented activities that use some service design tool.

Next, the team developed the service system architecture (SSA), illustrated in Figure 4, in which on the left of the model are represented the main people involved in the service provision, both those that interface with the customer (service interfaces), and those that work internally in the company (backstage support). The top row indicates the main activities involved in performing predictive maintenance while the other boxes indicate who participates in each activity.

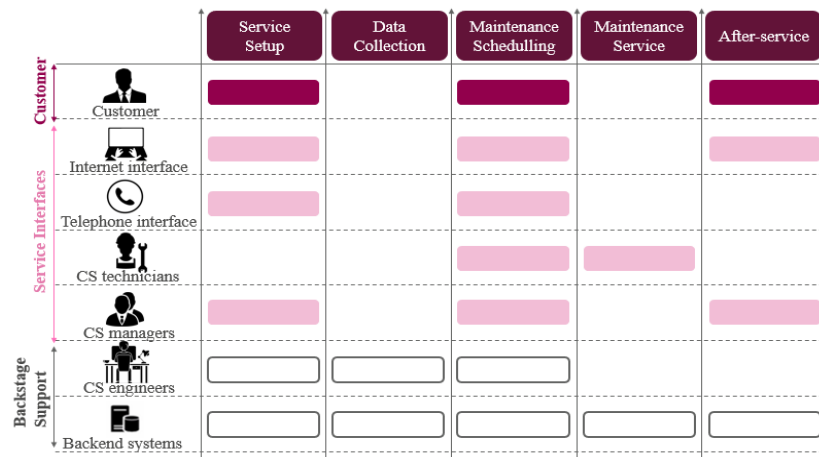


Fig. 4. Service System Architecture for predictive maintenance.

Still in the workshop, and in the next step of the development stage, the team defined the main skills necessary to perform the service as well as the specific people that will be involved in the service provision, followed by the elaboration of the service documentation. The team chose the service experience blueprint (SEB) as the most appropriate documentation. This is because the predictive maintenance service is mostly automated, requiring little human interference and when potential failure is detected, technicians must follow the technical manuals of other types of maintenance: preventive and corrective. Thus, no additional documentation is required.

There should be one SEB for each activity depicted in the SSA. However, for the purposes of exemplification, only one activity will be detailed: maintenance scheduling, which concerns the scheduling of a maintenance service with the company once a potential failure is detected. However, and as previously mentioned, the tasks and their respective responsible vary according to the customers' predictive maintenance plan: bronze, silver, gold and platinum. It is worth mentioning that the team listed all predictive maintenance service features and defined the service modules, being elaborated an SEB for each plan. However, due to size constraints, only the SEB for the platinum plan will be illustrated, below.

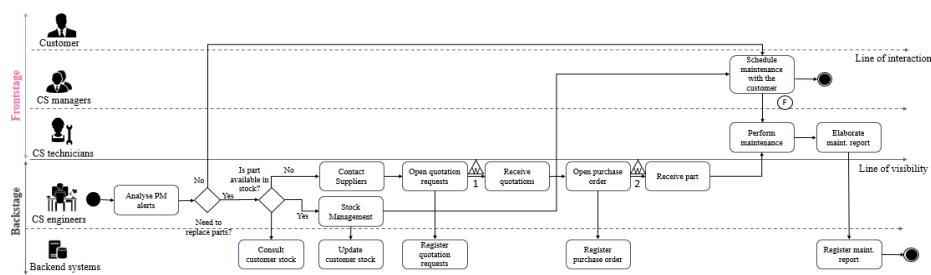


Fig. 5. SEB of the Platinum Plan.

It is worth mentioning that the activities demonstrated are specific to the service in question and according to the context of the company being studied. However, it is possible to visualize that in the most advanced plan, illustrated in Figure 5, there is almost no interaction with the customer, which is expected from a highly industrial environment. For classic service contexts however, the value co-creation through active customer participation is prioritized.

Once the different SEB were elaborated, the resources identified for the execution of the service, the maintenance technicians in the case of the company in question, received the appropriate training. Next, the team defined the pricing and target segments in which the company wishes to focus as well as the pilot customers. During the pilot phase it was possible to identify if the SEB reflected the reality and make the necessary adjustments. Furthermore, from the pilot customers feedback, opportunities for improvement were identified and actions plan prioritized. It is worth emphasising that these improvements needed to be completed for the service to move to the next stage: implementation. Next, all the service documentation was revised, including the pricing

strategies previously defined and the modular contracts developed in accordance with the different service modules identified. Finally, the Marketing and Sales team developed the sales and social media contents so that the service could be finally communicated to the market. Hence, the service now enters into a continuous improvement philosophy, in the service management stage.

6. Conclusion

This research aims at defining a new service design method for companies undergoing a servitisation process, providing them the tools and knowledge for the design and implementation of a new service and continuous improvement of services. Besides, and once companies in servitisation process often seek to apply modularisation strategies to extend their service offerings, this research also sought to present how modularisation can be applied in the servitisation context.

Following a DSR approach, to ensure the relevance and rigor of the new method, a literature review was performed in the most relevant subjects for the method development as well as a thorough study, following a qualitative research, with a company undergoing servitisation.

Hence, the literature review revealed that the existing literature on service design is much focused on the early phases of service development and very vague regarding its implementation, with no specific method or tool for this purpose. Besides, the service design process addresses only new services development, without specifying how they should be managed once implemented and the literature on service modularisation is still very scarce. The conducted interviews, in its turn, highlighted the employees' concern with improving service documentation, the poor service strategy and establishing modular contracts. Thus, all these aspects were considered for the design of the proposed SDCS. Next, the method was applied in the design of a new service for a company undergoing a servitisation process.

While this method is already being applied in a company, other applications should ensue to further evaluate and improve the method. However, this research offers a first approach to propose and define a new service design method for companies undergoing a servitisation process. In addition, with the method application and detail of each performed activity, the project was able not only to establish the new method but to exemplify in practice how companies in servitisation process can apply it. Furthermore, the method also presents phases dedicated exclusively to the implementation and management of new services, subjects little or not addressed by the traditional service design process. Besides, it was possible to validate the challenges and opportunities for servitisation identified in the literature through the internal interviews and demonstrate in practice how service design can be applied to the development of modular services. It is also worth mentioning the relevance of the SDCS research contribution as one of the few methods that explores the creation of a service design artefact by adopting the DSR methodology.

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