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Designing technology-enabled services with model-based methods

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ABSTRACT

Services are increasingly technology-infused. Technology infusion not only brings change to existent service interfaces (e.g. self-service machines at a store), but also introduces new interfaces (e.g. website, smartphone app). This creates added complexity to service design, the field dedicated to bring innovative service ideas to life, as the number of potential touchpoints, or encounters between the customer and the service provider, also increase. Service design is a multidisciplinary and human-centric field that plans, shapes and orchestrates the different service components (people, processes, technology, physical evidence) to enable useful, usable, desirable, effective and efficient service experiences. Being a young but burgeoning field, service design borrowed tools from its constituent disciplines that, while useful, need to be bridged by a common conceptual and methodological ground. Dispersed models and methods hamper a coherent orchestration of the different designed service elements and lead to unstructured design processes. Also, the lack of a common set of concepts, models and tools hinders communication between experts in multidisciplinary service design teams.

This dissertation focuses on these challenges: the added complexity brought by increased technology infusion in services, and the use of interdisciplinary methods and models that are not integrated and, as such, fail to provide a holistic approach to all aspects of the design process. To address these challenges, the research objectives of this dissertation are threefold: (1) to evolve service design methods and models, especially regarding the understanding and incorporation of customer experience inputs into the service design process; (2) to develop new and enhanced models that leverage service design interdisciplinary perspectives, to deal with the complexity brought by technology-infusion; and (3) to systematize an end-to-end method to link different models across the service design process.

Following a design science research approach, these objectives led to three contributions, corresponding to the three research papers that are the main sections of this dissertation. First we present Customer Experience Modeling, a new model to systematize the understanding of customer experience, an underexplored area of the design process exploration phase. The second research paper introduces MINDS framework. This framework integrates different service design perspectives (management and interaction design), taking advantage of their complementary characteristics to cope with the complexity brought by technology infusion. Finally, the third research paper systematizes an end-to-end model-based service design method, from understanding the customer experience to low-fidelity prototyping. It brings together the contributions of the two previous research papers, supporting the creative transition between customer experience and the design of new services, a crucial step in any service design effort.

Applications to two different service design projects, in media and healthcare industries, are presented throughout these three research papers. In both projects the different models and the model-based method have been successfully applied, with interdisciplinary teams and stakeholder involvement. Also, successful functional prototypes were developed in each case, with its utility being vouched by companies and other project partners.

RESUMO

Os serviços estão cada vez mais infundidos de tecnologia. Esta infusão de tecnologia não só traz mudanças nos interfaces de serviço existentes (exemplo das máquinas de serviço automático), como também introduz novos interfaces (websites, aplicações para smartphones). Esta situação cria complexidade adicional para o design de serviços, a área dedicada a conceber serviços inovadores, uma vez que o número de potenciais pontos de contacto entre o cliente e o fornecedor do serviço também aumenta. O design de serviços é uma área multidisciplinar, centrada nas pessoas, que planeia, dá forma e orquestra as diferentes componentes de um serviço (pessoas, processos, tecnologia e evidência física) de forma criar experiências que sejam úteis, usáveis, desejáveis, efetivas e eficientes.

Sendo uma área jovem mas florescente, o design de serviços usa ferramentas provenientes de outras disciplinas que, embora úteis, têm que ser ligadas por uma base conceptual e metodológica comum. Métodos e modelos dispersos danificam a orquestração coerente dos diferentes elementos de serviço que são desenhados e levam a processos de design de serviços pouco estruturados. A falta de um conjunto comum de conceitos, modelos e outras ferramentas também prejudica a comunicação entre especialistas em equipas multidisciplinares de desenho de serviços.

Esta dissertação foca-se nestes desafios; na complexidade trazida pela infusão crescente de tecnologia nos serviços, e no uso de métodos e modelos interdisciplinares que não estão integrados e, como tal, não proporcionam uma abordagem holística que abranja todos os aspetos do processo de design de serviços.

Para endereçar estes desafios, os objetivos de investigação desta dissertação são os seguintes: (1) evoluir métodos e modelos de design de serviços, especialmente os relacionados com a compreensão e incorporação da experiência do cliente no processo de design; (2) desenvolver modelos novos e melhorados que alavancam as perspetivas interdisciplinares de desenho de

serviços, de forma a lidar com a complexidade trazida pela infusão de tecnologia; (3) sistematizar um método ponto-a-ponto que una diferentes modelos ao longo do processo de design de serviços.

Seguindo uma abordagem de *design science research*, estes objetivos deram origem a três contribuições, que correspondem aos três artigos científicos que constituem as secções princípais desta dissertação. Primeiro apresentamos o Customer Experience Modeling, um novo modelo para sistematizar o conhecimento sobre a experiência do cliente, uma área pouco endereçada da fase de exploração do processo de desenho de serviços. O segundo artigo científico introduz a *framework* MINDS. Esta *framework* integra diferentes perspectivas de design de serviços (de gestão e design de interação), tirando partido das suas características complementares para lidar com a complexidade trazida pela infusão de tecnologia. Finalmente, o terceiro artigo científico sistematiza um método ponto-a-ponto, baseado em modelos, que aborda desde o conhecimento da experiência do cliente, até a prototipagem de baixa definição. Este método junta as contribuições dos dois artigos anteriores, suportando a transição criativa da experiência do cliente para o design de novos serviços, um passo crucial em qualquer empreendimento de design de serviços.

Ao longo dos três artigos científicos são apresentadas aplicações a dois projetos distintos de design de serviços, no setor dos media e da saúde. Em ambos os projetos os diferentes modelos, e o método baseado em modelos, foram aplicados com sucesso e com o envolvimento de equipas de design interdisciplinares e demais partes interessadas. Protótipos funcionais também foram desenvolvidos com sucesso, para ambos os projetos, e a respetiva utilidade foi atestada pelos parceiros empresariais e outros parceiros institucionais.

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List of Abbreviations

CEM - Customer Experience Modeling

HAM – Human Activity Modeling

MINDS – Management and INteraction Design for Services

MSD – Multilevel Service Design

1. Introduction

Nowadays services represent most of the value added by the world's developed economies (OECD, 2014), and even manufacturing-oriented firms are bundling together services and products to add value to their offers, a process known as servitization (Baines et al., 2009). The understanding on services is also evolving. Services were first defined as a residual category that includes everything that is not a product (Vargo and Lusch, 2008). Later, the focus was on their distinctive features in relation to products, or the IHIP (Lovelock and Gummesson, 2004) formulation that stands for intangibility, heterogeneity, inseparability and perishability. Today, with the emergence of service-dominant logic (Vargo and Lusch, 2004), which emphasizes a paradigm change from goods provision to service, service has been defined as the "application of specialized competences (operant resources- knowledge and skills), through deeds, processes, and performances for the benefit of another entity or the entity itself" (Vargo and Lusch, 2008: p.26). This perspective implies that value is not a prepackaged or pre-produced offer, but instead is co-created by customers and service providers. Such approach can be a source of sustainable competitive advantage and can have a strong impact on service innovation, as companies move from producing products, to developing service offerings that support the co-creation of value in unique ways.

Service innovation can be defined as the creation of new and/or improved service offerings, service processes, and service business models (Ostrom et al., 2010). Indeed, the creation of new service offerings is a crucial part of service innovation. A new service is "an offering not previously available to customers that results from the addition of offerings, radical changes in the service delivery process, or incremental improvements to existing service" (Johnson et al., 2000). Service design is at the heart of service innovation since it brings new and innovative service ideas to life (Ostrom et al., 2010).

The understanding on service design is evolving. It was first considered a stage of the new service development process (NSD), one that involved the design of the service concept, service system and service process (Edvardsson et al., 2000), or that covered the whole process from idea to specification (Goldstein et al., 2002). Recently, service design is evolving and adopting a broader approach (Evenson, 2008), encompassing understanding of the customer experience and the design of new service concepts, systems and encounters (Patrício et al., 2011). Further expansion to the development and implementation stages, and considering service design a cross-cutting approach to NSD, have been suggested (Yu and Sangiorgi, 2014). This dissertation addresses this call by extending service design to both sides of the NSD spectrum; customer experience and implementation through low-fidelity prototyping.

Regarding its origins and disciplinary stance, service design is seen by some as a new field of design and, by others, as originating from other disciplines namely design, management and the social sciences (Kimbell, 2011). Patrício and Fisk (2013) have defined it as a multidisciplinary field that sits at the intersection between strategic management, marketing, operations management, interaction design and software engineering. Contributions to service design can be traced to management-oriented disciplines, such as marketing and operations management (Shostack, 1984; Johnston, 1999; Verma et al., 2002; Goldstein et al., 2002; Cook et al., 2002; Bitner et al., 2008), and design-oriented ones, including interaction design (Evenson, 2008, 2005; Mager, 2009; Pacenti and Sangiorgi, 2010; Sangiorgi, 2009; Kimbell, 2011). Mager (2009) considered service design holistic, as it involves designing for the overall experience with a service (Moritz, 2005), based in the understanding about people, context, service provider, market strategies and social practices (Evenson, 2008). It is also a hub that brings together methods and tools from various fields for the development and innovation on services (Moritz, 2005). This dissertation is aligned with this perspective that

views service design as a multidisciplinary field and aims to address the challenges posed by it, as described in the next section..

Also, service design is key for innovation, as it helps to bring service logic into innovation process (Wetter-Edman et al., 2014) and has been considered one of the research priorities for the science of service (Ostrom et al., 2010, 2015). Still, the full potential of service design to foster service innovation is yet to be achieved, as the field has important challenges to overcome.

1.1. Service design challenges

Journal of Service Research, the leading journal in service research, has published two research priorities papers summarizing a list of 10 (Ostrom et al., 2010) and 12 (Ostrom et al., 2015) priorities deemed specially relevant for research in the field. These papers considered technology and service design as two priorities for service research. Also, as Ostrom et al. (2015) emphasizes, important research questions lie at the intersection of priorities, and we consider that the cross-fertilization between technology and service design is especially relevant, as is described ahead.

First, regarding technology, both service research priorities papers (Ostrom et al., 2015, 2010) consider it a cross-cutting priority that has the potential to influence almost every aspect of service. Ostrom et al. (2015) consider technology a game changer and stress the challenge of achieving a seamlessness service across multiple touchpoints. Back in 2000, Edvardsson et al. (2000) considered technology one of the most important infrastructural elements of service firms, while Johnston (1999) warned about the challenges of technology implementation on a service setting. Technology brings increasingly important challenges to service design as it permeates every aspect of today's living and is becoming ubiquitous across service settings (Holmlid, 2009). The internet, smartphones and now the Internet of Things (Atzori et al., 2010) are effectively multiplying the ways for customers and service

providers to interact. These service channels, or service interfaces, can be a company's best competitive advantage, but can also be a liability if not integrated properly (Rayport and Jaworski, 2004; Berry et al., 2002). Hasty technology introduction on a service setting is also cautioned against (Burke, 2002; Bitner et al., 2000). As mentioned earlier, service design is a holistic field that designs for the overall experience with a service. This means that service designers need to orchestrate all these new service interfaces to enable a seamless and pleasurable customer experience. Yet, research on technology usage in a service setting has been mostly focused on understanding the drivers for adoption and satisfaction with technology-enabled services (Froehle and Roth, 2004; Burke, 2002; Wünderlich et al., 2013; Walker et al., 2002; Meuter et al., 2000) and on understanding service quality in technology-enabled services (Zeithaml et al., 2002; Sousa and Voss, 2006; Rowley, 2006; Parasuraman et al., 2005). Specifically from a service design perspective, technology-infusion is being dealt with contributions from other fields, namely interaction design (Holmlid, 2007, 2009).

This leads to the second interconnected challenge. As technology-infusion adds complexity to the design of services, service design resorts to contributions from its many constituent fields to address the complex problems it faces. However, contributions from different disciplines address specific aspects of the design process and are not integrated in structured and coherent methods, nor do they share a common language. Indeed Ostrom et al. (2010) emphasizes the multidisciplinary nature of service design and the need to integrate different disciplines to achieve an effective service design. Ostrom et al. (2015) reinforces the need to involve multidisciplinary teams in service design and to establish methods, models and languages to support the work of these teams. According to Hevner et al. (2004), models are abstractions and representations that are able to portray the problem and solution space, whereas methods define processes to provide guidance on how to solve problems. To effectively deal with technology infusion in service provision, service design needs to bridge

different contributions with new and improved methods and models. Despite models being considered crucial for service design (Holmlid and Evenson, 2008), they have receive scarce attention from academia (Segelström, 2010), and are not fully developed (Ostrom et al., 2010). While there have been contributions towards new models and method to design services (Patrício et al., 2008, 2011), the different service design perspectives need shared methods and models to effectively leverage interdisciplinary contributions and deal with increased technology infusion. This systematization of processes for creating new services is vital for service innovation and for introducing service design practices in organizations that still adopt unsophisticated and haphazard processes, based on trial and error approaches (Zomerdijk and Voss, 2011).

1.2. Objectives of this dissertation

To address the challenges posed by technology infusion and by the multidisciplinarity of service design approaches, this dissertation has three objectives. First, it aims to develop new models to support service in areas that are still underexplored, especially the understanding and systematization of customer experience information. Customer experience is a holistic concept that is defined as the internal and subjective response customers have to any direct or indirect contact with a company (Meyer and Schwager, 2007). Designing for customer experience is critical to enable value co-creation and is ingrained in service-dominant logic that advocates "collaborating with and learning from customers and being adaptive to their individual and dynamic needs" (Vargo and Lusch, 2004: p.6). Service design adopts a human-centered approach, meaning it is powered by understanding through direct observation of what people what and need in their lives, and what they like or dislike (Brown, 2008). As such, the understanding of customer experience is a key component of its exploration phase and the development of new models that enable a rich depiction of the

customer experience is crucial, so that this information can be incorporated in the service design process.

Second, this dissertation aims to link service design multidisciplinary perspectives to cope with the complexity brought by technology infusion. Service design already uses models originating from IT-related areas that are focused on the design of technology-enabled services. One of such areas, interaction design, focuses on understanding human engagement with digital technology and designing more useful and pleasing technology artifacts (Kaptelinin and Nardi, 2006). Interaction design is especially suited for this integration effort since it has a technology focus but, similarly to service design, it is a human-centric, multidisciplinary design discipline (Fallman, 2008). Also, previous research has already established a connection between these two fields, highlighting how interaction design models are used in service design (Sangiorgi, 2009; Holmlid, 2007, 2009; Miettinen et al., 2012). However, as service design makes use of these multidisciplinary contributions, the integration between them is instrumental to achieve a systematized, coherent and truly interdisciplinary design process.

Third, this dissertation aims to systematize an end-to-end model-based service design method from understanding the customer experience to low-fidelity prototyping, also supporting the creative transition between customer experience and the design of new services. Early prototyping and testing can avoid costly implementation of services that reveal unsuccessful. In this regard, models can play a key role in portraying and communicating service design concepts at early stages, without having to develop expensive functional prototypes. Models are able to deal with the complexity brought by technology and align multidisciplinary contribution. Models are abstractions, or simplifications of reality (Booch et al., 1999) that aid solving complex problems by eliminating irrelevant details (Cox, 1999) and enhance interdisciplinary communication (Simon, 1996; Larkin and Simon, 1987; Van Bruggen and

Kirschner, 2003; Brna et al., 2001). They also document decisions (Booch et al., 1999) making them capable of supporting the creative transition between the two phases of the design process; understanding the customer experience and designing new services (Patrício and Fisk, 2013). This model-based method systematizes the process of designing new services, thus contributing to leverage service design role in service innovation.

1.3. Conceptual underpinnings

The objectives of this dissertation were framed and conceptually grounded by two model-based frameworks; the Analysis-Synthesis Bridge Model (Dubberly and Evenson, 2008) adapted to service design (Patrício and Fisk, 2013) and Multilevel Service Design (Patrício et al., 2011). The Analysis-Synthesis Bridge Model explicits the role of modeling in the design process, by dividing the design process in two phases: analysis and synthesis (Dubberly and Evenson, 2008). The Analysis-Synthesis Bridge Model was already adapted to service design by Patrício and Fisk (2013). According to these authors, service designers should start by understanding the current customer experience and model it. Later, they model the service design solution and prototype and implement the envisioned solution. This framework enabled the identification of gaps in the current available models and positioned the development of new or enhanced ones (first and second objectives of this dissertation) and established the overall structure of the model-based services design method (third objective).

Multilevel Service Design (MSD) is an interdisciplinary method for designing complex service systems (Patrício et al., 2011). It structures the understanding of the customer experience and the design of new service offerings in three levels and introduces models to support the design process at each of these levels: the design of the service concept is supported by the customer value constellation; the design of the service system is supported by the service system navigation and architecture; and the design of the service encounter is supported by the service experience blueprint. MSD conceptualized the role of understanding

the customer experience and how it could be linked to the design of the new services (first objective of this dissertation). It introduced elements from interaction design, namely the focus on activities (second objective). It also conceptualized the creative leap, between understanding the customer experience and designing new services, that needed to be bridged (third objective).

In the next section with detail the methodology of this dissertation, followed by an outline of the three research papers.

2. Methodology

We have defined service design as a multidisciplinary field and emphasized contributions from fields like interaction design, However, design also plays an important role as a contributor to this dissertation, namely from a methodological point-of-view. In this section we provide an overview on the different understandings about design and research and then explain our positioning and introduce the methodology followed - design science research. Next, we explain how we applied design science research process (Peffers et al., 2007), and design science research guidelines (Hevner et al., 2004).

2.1. Design and research

The complex world of today requires integrative disciplines that put specialized knowledge in service of present and practical problems (Buchanan, 2001, 1992). Design is such a discipline. Buchanan (2001: p.9) defined design as "the human power of conceiving, planning, and making products that serve human beings in the accomplishment of their individual and collective purposes". For Simon (1996) "everyone designs who devises courses of action aimed at changing existing situations into preferred ones" (p.111), and design "is concerned with how things ought to be, with devising artifacts to attain goals" (p.114). Both Simon (1996) and Buchanan (2001) refer the historic separation between the study of natural sciences and the ones that are associated with production. Designers combine theory with practice for productive purposes (Buchanan, 1992), while natural scientists select a portion of the world aiming to explain how and why things are (March and Smith, 1995; Checkland and Holwell, 1998). Simon (1996) relates design to engineering schools and Buchanan (2001) associates them with literary and fine arts. Buchanan (1992) typified the set of areas where design takes place. The first is the symbolic and visual communications, the second is the design of material objects and the third, the design of activities and organized services. We consider that service design goes beyond this third area and encompasses the

other two, as designing service systems also must take into account symbolic and visual communications and the design of material objects. Nowadays, design literature spans several fields, namely architecture, management, engineering, product development and systems design (Kimbell, 2011).

From a research point-of-view, since design research does not follow the orthodoxy present in natural sciences, the field has been developing its methods and rules to ascertain the necessary research validity (Collins et al., 2004; Newbury, 1996; Frayling, 1993; Gregor and Hevner, 2013). Design research literature hinges between positivist and constructivist approaches (Kimbell, 2011; Dorst and Dijkhuis, 1995). Early contributions, including Simon (1996)'s, are considered an effort to position design as an orthodox and positivist research field (Cross, 2001). These were later met with dismay (Schön, 1983) and more recent design research philosophy is closer ontologically, epistemologically and methodologically to constructivist views (de Figueiredo and da Cunha, 2007). This reflects the richness of design research that encompasses multiple perspectives and branches towards different fields, from design (Buchanan, 1992, 2001; Cross, 2001; Archer, 1995, 1981) to art (Frayling, 1993), management (Pandza and Thorpe, 2010), interaction design (Fallman, 2008; Forlizzi et al., 2008), educational research (Collins et al., 2004; Edelson, 2002) and information systems (Peffers et al., 2007; Winter, 2008; March and Smith, 1995; Hevner et al., 2004; Kuechler and Vaishnavi, 2008). Specifically concerning service design, a lack of theory has been identified (Sangiorgi, 2009), although recent research is beginning to close this gap (Kimbell, 2011; Sangiorgi and Prendiville, 2014).

These different design research perspectives share a common background, with most of the authors citing Simon (1996) as a reference point (Fallman, 2008; Collins et al., 2004; Edelson, 2002; Winter, 2008; Cross, 2001; Kimbell and Seidel, 2008; Pandza and Thorpe, 2010). Still, as it is shown in Table 1, each field has developed dedicated literature on the

subject, which produced a remarkable range of related, but nevertheless distinct perspectives about design research. This is mirrored by the definitions of design research. Archer (1981: p.31) discusses different definitions: "Design research is a systematic inquiry whose goal is knowledge of, or in, the area of human experience, skill an understanding that reflects man's concern with the enhancement of order", utility, value and meaning in his habitat" was deemed too broad; "Design research is systematic inquiry whose goal is knowledge of, or in, the embodiment of configuration, composition, structure, purpose, value and meaning in man-made things and systems" was deemed too vague; and finally "Design research is systematic inquiry into the nature of design activity" was deemed to narrow. Collins et al. (2004) considers that design research addresses theoretical questions about the nature of learning in context, the study of learning phenomena in the real world rather than the laboratory, the need to go beyond narrow measures of learning and the need to derive research findings from formative evaluation. For Cole et al. (2005) design research consists of activities concerned with the construction and evaluation of technology artifacts to meet organizational needs as well as the development of their associated theories. Finally, Winter (2008) considers that design research is aimed at creating solutions to specific classes of relevant problems by using a rigorous construction and evaluation process. It is possible to see the commonalities between these definitions, but also that they are adapted to their respective fields.

Table 1 - Types of design research.

Author	Field	Types of design research
Archer (1981)	Design	- Design history - Design taxonomy - Design technology - Design praxeology - Design modeling - Design metrology - Design axiology - Design philosophy - Design epistemology - Design pedagogy
Archer (1995)	Design	- Research about practice - Research for the purpose of practice - Research through practice
Buchanan (2001)	Design	- Clinical design - Applied design - Basic design
Cross (2006)	Design	- Scientific design - Design science - Science of design - Design as a discipline
Frayling (1993)	Art (and design)	- Research into art and design - Research through art and design - Research for art and design
Kimbell (2011)	Service Design	- Designing for service
Pandza and Thorpe (2010)	Management	- Deterministic design - Path-dependent design - Path-creation design
Fallman (2008)	Interaction Design	- Design practice - Design studies - Design exploration
Forlizzi et al. (2008)	Interaction Design	- Project research - Design methods - Pattern finding - Design as research service - Critical design

Edelson (2002)	Educational Research	- Domain Theories - Design frameworks - Design methodologies
Peffers et al. (2007), Winter (2008), March and Smith (1995), Hevner et al. (2004), Kuechler and Vaishnavi (2008)	Information Systems	- Design science research

2.2. Positioning – design science research

Most of the above mentioned design research approaches (including design science research) share the process of construction of knowledge through an iterative dialogue between understanding the context; conceiving new artifacts such as new concepts, models and methods; and evaluating and reflecting upon these artifacts. However, on one hand, some design research approaches focus on the "designerly" way of knowing (Cross, 2001) that is characterized by a human-centered, creative and exploratory approach to problems, or studying and reflecting upon design practices (Fallman, 2008). On the other hand, other design research approaches concentrate on understanding the organizational phenomena in context and creating and evaluating artifacts that solve the identified organizational problems (Hevner et al., 2004). As such, from the perspectives identified, we cannot say that some are better than the others. Instead, they are adapted to different contexts and disciplines, maintaining the iterative dialogue between understanding the context, creating new artifacts, and reflecting or evaluating them.

This dissertation deals with technology and its repercussions in service, and aims at developing new methods and models to integrate the work of multidisciplinary service design teams and to cope with the complexity brought by technology-infusion in service. As such, it followed design science research. Design science research has a consistent literature that started in the IS field (Winter, 2008; Gregor and Hevner, 2013; Kuechler and Vaishnavi,

2008) and is spreading to service research (Beloglazov et al., 2014; Ostrom et al., 2015). The objectives of this dissertation regard the development of new, or enhanced, models and methods, which is in tune with design science research purpose (March and Smith, 1995; Hevner et al., 2004).

Design research and design science research are terms used interchangeably by some authors (Cole et al., 2005), others consider that they have interesting parallels (Offermann et al., 2009). For Winter (2008) design science reflects the design research process and aims at creating standards for its rigour. Hevner et al. (2004) considers it a problem solving process. Design science research is similar to Simon (1996: p.133)'s understanding of design, namely that it is concerned with devising artifacts to attain goals. For design science research, design artifacts can be constructs, or notation, models, methods, and instantiations, or implementations that are innovative, valuable and solve problems (March and Smith, 1995; Hevner et al., 2004). Axiology-wise, design research follows and utilitarian, or pragmatic (Cole et al., 2005), view with Hevner et al. (2004) claiming that built artifacts "are evaluated with respect to the utility provided in solving […] problems". Design science research prescribes intervention in the real world and is interested in achieving efficient and effective designs (Lee, 2007). As such, design science research approach is well suited to the objective of this dissertation; the development of methods and models to integrate the work of multidisciplinary service design team and to deal with the complexity brought by technology-infusion in service.

Following the same reasoning as before, we have also incorporated the interaction design perspective (Forlizzi et al., 2008) for validation of the designed artifacts. Kimbell (2011: p.41)'s perspective on design for service was reflected on these artifacts, namely the approach to designing services through a constructivist enquiry, an "exploratory process that aims to create new kinds of value relation between diverse actors within a socio-material

configuration". Indeed, while design science research can be seen has having a positivist stance due to its prescriptive process and pragmatic stance, the models and method developed are aligned with a constructivist position. Edelson (2002) has similarly developed a design process consistent with both views. We combined the rigorous and more positivist approach of design science research, with the introduction of a constructivist qualitative data collection and analysis using grounded theory tenets (Corbin & Strauss 1990; Charmaz 2006). Grounded theory was used to develop the notation for the model for understanding the customer experience and was also incorporated in the initial stages of the developed method. The use of grounded theory tenets is aligned with the rigor required for design science research methodology, but also enables a rich understanding of the context surrounding artifact use and development. Besides this combination, although we chose a design science research approach (research method adopted in the dissertation) to develop and evaluate the models and method created, these aim to foster exploration and creativity of multidisciplinary service design teams, eliminating barriers and establishing bridges that can leverage the creative and design thinking process. As such, we took advantage of the rigour brought by the well-defined processes of design science research, to develop models and methods that support multidisciplinary teams to explore their problem space and creatively and iteratively enable new ways to co-create value.

Three seminal research papers guided the application of design science research throughout this dissertation. March and Smith (1995) introduced design science research, providing a research framework where they identify research activities (build, evaluate, theorize and justify) and research outputs (constructs, models, methods, and instantiations). Peffers et al. (2007) established a design science research process, while Hevner et al. (2004) proposed a set of guidelines for design research. In the next section we describe how we followed this design science research process and guidelines.

2.3. Design science research process

For March and Smith (1995) design science consists of two basic activities, build and evaluate; building is the process of constructing an artifact for a specific purpose and evaluation is the process of determining how well the artifact performs. Peffers et al. (2007) further elaborated and proposed a design science research process with six steps that should be followed iteratively: identify problem and motivate; define objectives of a solution; design and development; demonstration by using the artifact to solve the problem; evaluation; and communication through scholarly and professional publications. These stages are not linear, and researchers can iterate between them, especially between evaluation and back to design and development. Peffers et al. (2007) also considered that any step from 1 to 4 could be a possible starting point, respectively if it has an initiation centered on the problem, on the objective, on the design and development, or on the client or context. We position this dissertation as a problem-centered approach, as its starting point was the identification of a set of challenges (technology infusion and lack of integration of multidisciplinary models). We addressed each of the phases described by Peffers et al. (2007) as follows:

1. Identify the problem and motivate: we have resorted to literature review in service design and its constituent fields to formulate the problem and its motivation. Specifically, in this activity we focused on the stages of the design process that were identified by the Analysis-Synthesis Bridge Model (Dubberly and Evenson, 2008) and Multilevel Service Design (Patrício et al., 2011), namely the understanding of the customer experience and the design of new services. As such, we covered relevant literature on customer experience, modeling, service design, technology-enabled services and interaction design. This enabled us to identify the challenges introduced earlier: service increased technology-infusion, the multidisciplinarity of service design approaches and the lack methods and models to deal with these realities.

2. Define the objectives of a solution: according to (Peffers et al., 2007: p.55) these objectives can be "quantitative, such as terms in which a desirable solution would be better than current ones, or qualitative, such as a description of how a new artifact is expected to support solutions to problems not hitherto addressed". This dissertation objectives have a qualitative nature and comprise: (1) developing new models for service design regarding underexplored areas of the design process, namely the understanding of the customer experience; (2) linking service design perspectives, namely management and interaction design, to deal with the complexity brought by technology infusion, and (3) systematizing an end-to-end model-based service design method, from understanding the customer experience to low-fidelity service prototyping, that supports the creative transition between customer experience and the design of new services.
3. Design and development: through the research process, we created the artifacts that addressed the objectives. For the first objective (Paper I) we created Customer Experience Modeling, a new model to systematize customer experience (Teixeira, Patrício, Nunes, et al., 2012). This also meant introducing a notation adapted to customer experience and service design. A notation can be defined as the vocabulary and symbols in which problems and solutions are defined and communicated (Hevner et al., 2004). For the second objective (Paper II) we conceptualized and integrated models from two different service design perspectives; interaction design and management (Teixeira et al., 2014). Finally, for the third objective (Paper III), we integrated the previous contributions and bridged the understanding of the customer experience and the design of new service with an end-to-end model-based method. Hevner et al. (2004) and March and Smith (1995) also include as artifacts the development of applications, or instantiations, that demonstrate feasibility and the

artifact's suitability to its intended purpose. We iterated this process, improving the method and models, through two applications in distinct service industries (media and healthcare) that are described in the next phase.

4. Demonstration/Application: we evaluated the use of the method and models through two applications. The methods and models were first applied in a research project that involved a media company (cable TV, internet and mobile and landline phone provider), and a multidisciplinary design team with service designers, interaction designers, IT architects and software engineers. This research project was a suitable first iteration of this design science research process as the design team was tightly connected, with the service designers, interaction designers and software engineers being part of the same team. This enabled frequent exchange of opinions and several fast iterations of method and models before establishing their final structure. The business partner also provided a suitable context, since it operated in a heavily technology-infused industry. The models and methods were used to develop a multi-platform and multi-device functional service prototype that received positive feedback from all the stakeholders involved (multidisciplinary design team, company and customers). The second research project was chosen because it involved a different industry, healthcare, and a different design team organization, as it was distributed through three different partners. Two of these partners were research organizations in charge of, respectively, service design and software engineering. The third organization was a software company that provided the business context and would commercialize the designed service. This project organization was more loosely coupled than the previous one, enabling a better validation of the interdisciplinary communication capabilities of the method and models. Again, a functional service

prototype was developed and is being tested with health care providers and patients to be commercially implemented afterwards.

5. Evaluation: we assessed how well the artifacts support the solution to the problem with the criteria set by Forlizzi et al. (2008). These authors evaluate the contributions of new design methods based on four criteria; process, invention, relevance and extensibility. Following these criteria, each contribution made by this dissertation is thoroughly described in the research papers so that the design process can be replicated and the rationale for their selection is understood. Literature review attests the uniqueness of the proposed models and method, as they address gaps regarding the inexistence of models, the lack of interdisciplinary models and of an end-to-end service design method. The two applications also show how they bring valuable contributions to the design process that existing methods cannot offer. Both literature review and the applications in two research projects assess the relevance of the presented contributions. These applications showed that the models and method can be used in a real-world setting and support the design of services that are of use to companies and customers. Finally, the two distinct applications, with different design team structures and in different service industries, suggest that these contributions can be extended to other contexts. Process, relevance and extensibility were also evaluated through the feedback received by stakeholders and design teams. In the two applications the models were used across the service design method (described in Paper III); first the understanding of the customer experience resorted to rigorous qualitative method following grounded theory tenets; this understanding was systematized through Customer Experience Modeling (Paper I); CEM supported the design of the service concept, service system and service encounter through MINDS framework models (Paper II); MINDS enabled the low-fidelity prototyping of the

designed service. Afterwards, interaction designers and software engineers in the service design team developed functional prototypes. In the first application, three rounds of user testing, involving 4 users were done to evaluate the functional prototypes. The partner company also evaluated the results, involving a multidisciplinary team of 6 people including the regional CEO, marketing, software engineering, and new product/service development departments. This team participated in the design process and provided feedback in five different moments: after the data collection and analysis to assess the customer experience information collected and support the definition of the new service concept; after the low-fidelity prototyping and the functional prototype to provide feedback; presentation at the corporate headquarters to ensure that the developed service was aligned with the strategic objectives; and workshop with the new product/service development team to transfer the functional prototypes and the service design architecture and blueprints to support service implementation. Within the design team the strongpoints and shortcomings of the models and method were discussed, resulting in changes in their structure. For example, Customer Experience Modeling representation evolved from the first paper to the third to simplify its visual structure. Instead of dotted lines connecting the customer experience requirements and the contextual elements, like in the first paper, a colour scheme was used on the third paper. Also, the first level of MINDS framework, the customer value constellation and the affinity diagram were initially done in two separate steps and later connected (see Figure 1). However, in the second application they were done together, since it facilitated the creative effort of linking new service features to the overall constellation of providers. In the second application, the multidisciplinary service design team included members from three different partner institutions that included expertise in service design and software

engineering. This team met monthly during 18 months to accompany and discuss each step of the service design process. Adding to these meetings three workshops were done to design the service concept, the service system and finally to assess the usability of the functional prototypes. Meetings and workshops with stakeholders and within the service design team were instrumental to iterate each application and to reflect upon the use of the models. These meeting and workshops were documented either through written documents such as meeting minutes, versioning of the models, or photos. Finally, these two distinct applications, with different design team structures and in different service industries, suggest that these contributions can be extended to other contexts.

6. Communication: as suggested by Peffers et al. (2007) and Hevner et al. (2004) we communicated the problem and its importance, the models and the methods, and its utility and novelty to scholarly and practicing professionals. These communications are further detailed in the sections ahead.

Following this description of the design science research process, we detail how we have complied with Hevner et al. (2004)'s guidelines for this methodology.

2.4. Design science research guidelines

Hevner et al. (2004) proposed a set of seven guidelines for researchers to understand the requirements for effective design science research. Guideline 1 sets the outputs, or artifacts, of design science research; constructs, models, methods and instantiations. Guideline 2 concerns the need for a relevant problem, also emphasizing its importance for business. Guideline 3 stresses the need for evaluating the developed design outputs. Hevner et al. (2004) provides a list of suitable evaluation methods; observational (case study and field study), analytical (static analysis, architecture analysis, optimization and dynamic analysis), experimental (controlled experiment and simulation), testing (functional testing and structural

testing) and descriptive (informed argument and scenarios). Guideline 4 posits that design science research must provide research contributions. Guideline 5 addresses the need to apply rigorous methods in the construction and evaluation of the design artifact. Guideline 6 highlights the iterative nature of design science research. Finally, guideline 7 stipulates that design science research must be presented effectively both to scholarly and practitioner audiences.

These guidelines partially overlap Peffers et al. (2007)'s process. Still, to ensure a comprehensive understanding of how design science research was applied to this dissertation, we built Table 2 that describes each of the three dissertation research papers in light of Hevner et al. (2004)'s guidelines. In the next section we introduce each of these research papers.

Table 2 - Research contributions analyzed according to design science research process and guidelines.

Hevner et al. (2004) guidelines	Paper 1 – Customer Experience Modeling	Paper II – The MINDS framework	Paper III – Model-based Service Design Method
1. Design as an Artifact	**Construct:** Adaptation of Human Activity Modeling (Constantine, 2009) notation to a service context. **Model:** Development of Customer Experience Modeling. **Application:** Systematization of the customer experience of a media company, to support a service design project.	**Model:** Development of enhanced models that combined managerial and interaction design characteristics. **Application:** Two functional prototypes developed with the enhanced models created.	**Method**: Development and systematization of a model-based service design method, based on the previous contributions. **Application:** Two functional prototypes developed applying the model-based method developed.
2. Problem Relevance	**For research:** Research had identified customer experience as a source of sustainable competitive advantage (Shaw, 2002). Authors (Berry et al., 2002; Meyer and Schwager, 2007; Gentile et al., 2007; Verhoef et al., 2009; Zomerdijk and Voss, 2010) had studied customer experience, yet there was no way to systematize and document it to be applied and embedded in service design projects. **For business**: Service provider (media company) involved in a fiercely competitive duopoly that needed to provide outstanding customer experiences to produce sustainable competitive advantages.	**For research**: Service design takes advantage of models from many of its constituent fields. Despite research on service design models characteristics (Diana et al., 2009; Segelström and Holmlid, 2011; Alves and Nunes, 2013), there was no conceptual, or practical integration that would leverage each model strongpoints, and limit their shortcomings, especially when dealing with the complexity brought by technology-infusion. **For business**: One service provider (media	**For research**: Research identified service innovation methods as haphazard and unsophisticated (Zomerdijk and Voss, 2011), while other contributions (Patrício and Fisk, 2013; Patrício et al., 2011; Dubberly and Evenson, 2008) had set the conceptual framework for a model-based service design method and identified the need to support the creative transition between customer experience and service design. Still, there was no integrated and workable view of such method. **For business:** Fragmented and ad-hoc usage of

		company) was heavily technology-infused. In the other application, the design team needed tools to effectively communicate across different areas to develop a service that dealt with a life-threatening condition (skin cancer).	service design models damage the creation of new services. In one application (media company) there was the need to deal with greater complexity caused by technology-infusion. In the other application, there was the need to ensure that a distributed service design team systematized and documented its procedures and communicated through a common language. Also, the nature of the service developed (support for skin cancer follow-up and diagnosis) required a structured approach.
3. Design Evaluation	Adding to what was already described in step 5 of Peffers et al. (2007)'s process, we position our evaluation, according to Hevner et al. (2004)'s design research evaluation methods, as observational and descriptive. In the three research papers we study the developed outputs in case studies (observational method) and produce an informed argument (descriptive method) to build a convincing argument for the outputs' utility.		
4. Research Contributions	Addressed the first objective described in this dissertation, the development of new models in steps of the design process that are not covered by any. Specifically, this research paper proposes and describes a model (CEM) that enabled service designers to systematize unstructured qualitative experience data. It also allowed documenting customer experience and communicating it with other stakeholders.	Addressed the second objective described in this dissertation, regarding the integration of service design perspectives to deal with service technology-infusion. Specifically, this research paper conceptualized two different perspectives for service design models: management and interaction design. It also integrated these perspectives in an operable way by developing models that combined the visual and creative characteristics of the interaction perspective, with the value-creation and process-	Addressed the third objective described in this dissertation, regarding the development of an end-to-end model-based service design method. This research paper combined the previous contributions in a method that uses models to guide and systematize the design process, since initial customer experience data collection, to low-fidelity service prototyping, bridging the gap between

		orientation of the management perspective. In doing so it also supported the design of technology-enabled services.	understanding the customer experience and service design.
5. Research Rigor	Research rigor was obtained by careful adherence to design science research literature (March and Smith, 1995; Peffers et al., 2007; Hevner et al., 2004; Gregor and Hevner, 2013). Also, in each of the applications described in the research papers, data collection and analysis adhered to rigorous methods. Namely, data collection and analysis was supported in Grounded Theory (Glaser and Strauss, 1967; Charmaz, 2006; Corbin and Strauss, 1990, 2008). Grounded theory is accepted both by quantitative and qualitative researchers for combining both flexibility and legitimacy (Charmaz, 2006). Sampling proceeded on theoretical grounds, meaning that it was collected until the concepts and categories are adequately developed and consistent, i.e. when theoretical saturation was achieved (Corbin and Strauss, 1990). Data collected was qualitative, i.e. data in form of words or pictures (Neuman, 2000), and it was done resorting mostly to semi-structured interviews (Fontana and James, 2000; Myers and Newman, 2007). Relevant literature regarding interviewing was reviewed to avoid common pitfalls and obtain the desired data (Pawson, 1996; Myers and Newman, 2007; Fontana and James, 2000; Foddy and Foddy, 1994; Charmaz, 2006). Concerning data analysis, each interview was coded segment-by-segment in NVIVO 8 (QSR, 2009). Charmaz (2006) defines coding as "naming segments of data with a label that simultaneously categorizes, summarizes, and accounts for each piece of data". Also, data collection and analysis were interrelated, meaning that analysis begun after the first data is collected so that it could guide future data collection (Corbin and Strauss, 1990).		
6. Design as a Search Process.	The search process is already described in the previous sub-section still, here we add additional information regarding the specific development of the research process		
	Concerning the first objective set by this dissertation, namely the creation of new models to bridge existing gaps in service design toolset, and aligned with the business context surrounding this research project (service provider need to enable	Concerning the second objective of this dissertation, namely the development of interdisciplinary models that linked service design perspectives and aligned with the heavily technology-infused context of the research project	Concerning the third objective of this dissertation, namely the systematization of an end-to-end model-based service design method, and having developed the missing models needed to actually implement such

	superior customer experiences) we developed a new model to systematize customer experience. Having been described in the literature the prerequisites that supported a customer experience, namely the activity of the experience and its surrounding context (Zomerdijk and Voss, 2010), we searched for a suitable notation and adapted it to a service setting. Suitable representations for the model and the extent of the notation used, and adapted, were iteratively tested to provide an operable model for systematizing customer experience. Further refinement occurred when this model was used in the design phase.	business partner, we conceptualized two perspectives; interaction design and management. We then searched for suitable integrations between models of each of these perspectives, iteratively trying different pairings, until reaching the combined models that shared aspects from each perspective. Further refinements were done in the second application (skin cancer),	process (Teixeira, Patrício, Nunes, et al., 2012; Teixeira et al., 2014), the model-based method was in itself an iteration of these contributions. Still, the search and improvement cycle continued by simplifying CEM representation throughout the three levels of service design.
7. Communication of Research	**Conference papers:** (Teixeira, Patrício, Nunes, Nóbrega, et al., 2011; Teixeira, Patrício, Nunes and Nóbrega, 2011). **Journal paper:** (Teixeira, Patrício, Nunes, Nóbrega, et al., 2011; Teixeira, Patrício, Nunes and Nóbrega, 2011; Teixeira, Patrício, Nunes, et al., 2012).	**Conference abstract:** (Teixeira et al., 2013c, 2013a). **Conference papers:** (Teixeira et al., 2013b). **Journal paper:** (Teixeira et al., 2014).	**Conference abstract:** (Teixeira, Patrício, Nóbrega, et al., 2012b, 2012c). **Conference papers:** (Teixeira, Patrício, Nóbrega, et al., 2012a).
	Additionally to scholarly publication, this work has also been discussed by a practitioner-oriented audience, namely the research projects stakeholders, including the companies involved, customers and within the design team.		

3. Research papers outline

Having introduced the challenges, objectives and methodology of this dissertation the following three sections present the research papers where the challenges and objectives are addressed and the methodology is applied. The first research paper, Customer Experience Modeling (Teixeira, Patrício, Nunes, et al., 2012), introduces a new model to systematize customer experience. It addresses the first objective of this dissertation; the development of new models for underexplored aspects of the service design process. It builds upon earlier contributions that were published and presented in both service-oriented conferences (Teixeira, Patrício, Nunes, Nóbrega, et al., 2011) and interaction-design ones (Teixeira, Patrício, Nunes and Nóbrega, 2011).

The second research paper presents the MINDS framework (Teixeira et al., 2014) and concerns the second objective of this dissertation; the connection between different service design perspectives and their models. It conceptualizes two service design perspectives (management and interaction design) and introduces a set of models that combines and bridges both perspectives. Again, it builds upon previous contributions already published and presented (Teixeira et al., 2013c, 2013a, 2013b).

The third research paper integrates the two previous contributions. It relates to the third objective of this dissertation, regarding the lack of a systematized and comprehensive service design method. It presents an end-to-end model-based method that supports the creative transition between understanding the customer experience and designing new services, and guides service designers from a qualitative understanding of customer experience to low-fidelity service prototypes. This is again based on contributions published and presented in conferences (Teixeira, Patrício, Nóbrega, et al., 2012b, 2012a, 2012c).

Figure 1 illustrates how these different contributions fit together. The background structure of concrete/abstract and present/future steps is given by the Analysis-Synthesis Bridge Model

adapted to services, while the top layer (abstract) is divided according to MSD's three levels of service design. CEM covers the understanding of the customer experience (bottom left) and its systematization through models (upper left). MINDS framework deals with modeling the service design solution (upper right) and prototyping it (bottom right). Finally, the model-based service design method described on the third paper builds upon previous contributions, and structures the different models, applying an improved notation, into a coherent service design method that covers all the steps, from understanding the customer experience to low-fidelity prototyping of the service design solution.

After the three sections containing the research papers, the final sections discuss the contributions of this dissertation and conclude, also presenting limitations and opportunities for future research.

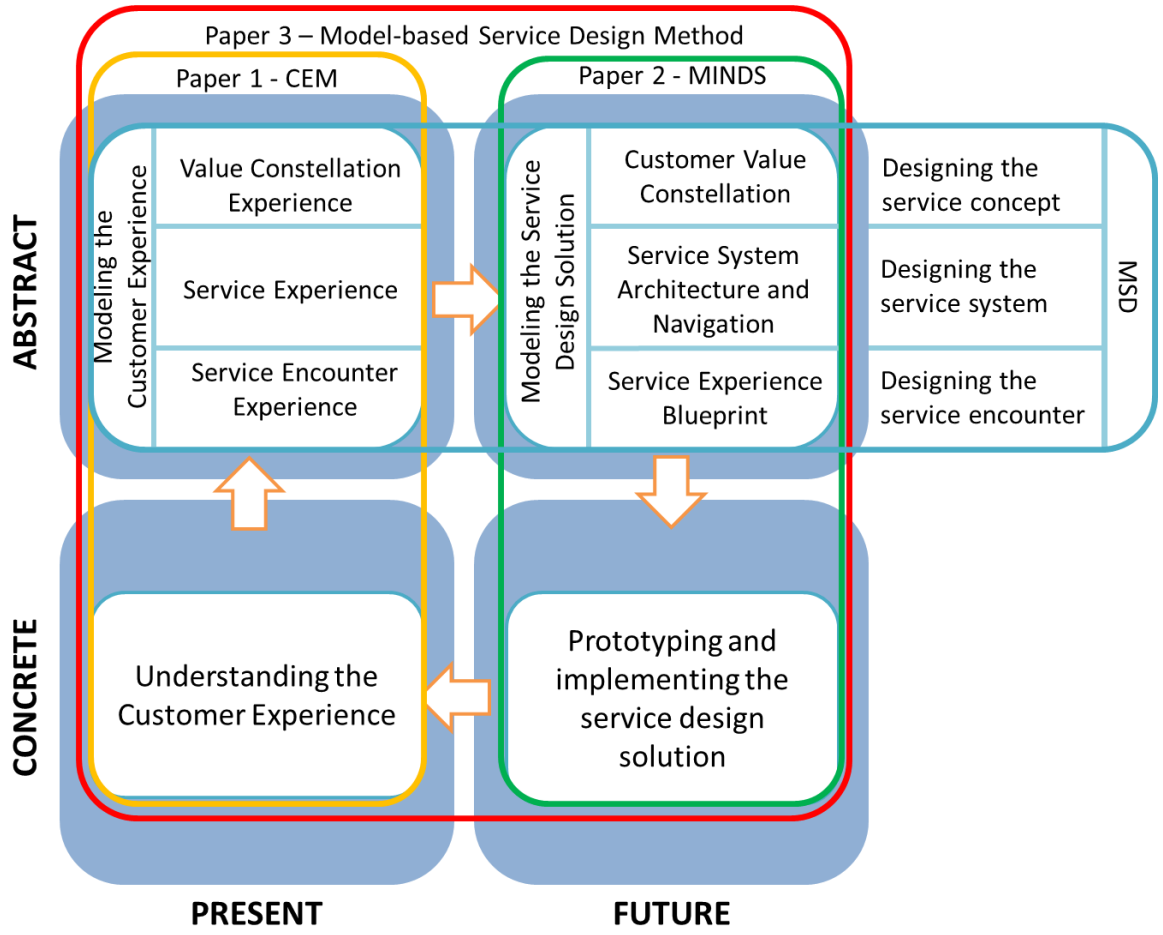

Figure 1- Conceptual overview of the model-based service design method.

4. Paper I: Customer Experience Modeling

Customer Experience Modeling: From Customer Experience to Service Design[1]

ABSTRACT

Purpose – Customer experience has become increasingly important for service organizations that see it as a source of sustainable competitive advantage, and for service designers, who consider it fundamental to any service design project. However, the complexity of customer experience is difficult to understand and model. This paper presents Customer Experience Modeling (CEM), a multidisciplinary model-based method to represent and systematize customer experience, so it can guide service design efforts.

Design/Methodology/Approach – Integrating contributions from different fields, CEM was conceptually developed to represent the different aspects of customer experience in a holistic diagrammatic representation. CEM was further developed with an application to a multimedia service. To further develop and build CEM's models, seventeen customers of a multimedia service provider were interviewed and the data analyzed using Grounded Theory methodology.

Findings – Combining multidisciplinary contributions to represent customer experience elements enables the systematization of its complex information. The application to a multimedia service highlights how CEM can facilitate the work of multidisciplinary design teams by providing more insightful inputs to service design.

[1] Paper published in the Journal of Service Management;
Teixeira, Jorge Grenha, Lia Patrício, Nuno Jardim Nunes, Leonel Nóbrega, Raymond P. Fisk, and Larry Constantine. 2012. "Customer experience modeling: from customer experience to service design." *Journal of Service Management* 23(3): 362–376.

Research Limitations/Implications – CEM's incorporation of contextual elements in a single method enables service designers to capture the holistic nature of customer experience. Further research is needed to embed CEM in existing service design methods.

Practical Implications – CEM provides service designers with a method to systematize customer experience so it can be shared between stakeholders and infused into the design process.

Originality/Value – CEM supports the holistic nature of customer experience, providing a systematic portrayal of its context and shifting the focus from single experience elements to their orchestration.

Keywords: Customer Experience, Service Design, Interaction Design

Paper type: Research Paper

1. Introduction

Companies have embraced customer experience as a way to obtain sustainable competitive advantages (Shaw and Ivens, 2005), leading some authors to claim that customer experience will be the next competitive battleground (Pine and Gilmore, 1998). Meyer and Schwager (2007) define customer experience as the internal and subjective response customers have to any contact (direct or indirect) with a company. Customer experience is a holistic concept that encompasses every aspect of a company's offering (Zomerdijk and Voss, 2009).

Service design research acknowledges the importance of experience when designing a new service (Mager, 2009, Moritz, 2005). Service design is a multidisciplinary field that involves marketing, human resources, operations, organizational structure, and technology disciplines (Ostrom et al., 2010). Following this holistic approach, service design orchestrates service elements such as the physical environment, people (customers and employees), and service delivery process to help customers co-create their desired experiences.

However, the scarcity of research about customer experiences (Verhoef et al., 2009, Stuart and Tax, 2004, Patrício et al., 2008, Roth and Menor, 2003, Hill et al., 2002) is mirrored in the methods used by service design researchers to collect and depict experience data. Service design applies interdisciplinary methods and tools from several backgrounds (Moritz, 2005), but they seem focused on single elements of customer experience, rather than on the complete landscape of experience factors. For example, consider personas which are defined as "a documented set of archetypal people who are involved with a product or service" (Saffer, 2010). Personas provide information about the customer, or a specific kind of customer, who will use the service. Another example is use cases that are focused on the intended functionality of a service (Saffer, 2010). Also, another stream of service design research has focused on the service delivery process (Smith et al., 2007), addressing aspects such as technology infusion (Froehle and Roth, 2004, Bitner et al., 2000), customer contact intensity (Chase, 1981), and internal process design to support experience (Verma et al., 1999, Voss et al., 2008). Service blueprinting (Shostack, 1984, Bitner et al., 2008) is one of the most common techniques for designing the service delivery process, while other operations management methods and techniques can also be applied to services (Johnston, 1999).

While these techniques focus on specific elements of customer experience, holistic study of customer experience through exploratory data collection methods will swiftly flood researchers with information. As Zomerdijk and Voss (2009) point out, it is unclear which service elements create the most compelling contexts. As such, while existing methods address some of the elements of customer experiences, there is no systematized representation of a more holistic view of the customer experience to support service design.

To fill this research gap and provide a robust toolset for service designers, we present Customer Experience Modeling (CEM) as a method for capturing the rich and complex

elements that shape an experience. CEM systematizes and represents customer experience to support service design efforts. The creative transition from understanding the customer experience to devising service solutions is crucial for service design, and models can play a key role in facilitating this transition process (Patrício and Fisk, Forthcoming). CEM is applied in the early stages of the service design process. CEM provides a modeling tool that enables a manageable abstraction of a complex reality and facilitates the creative transition to service design solutions. While providing a common framework for multidisciplinary team members, CEM not only portrays the problem space, but also enables envisioning the solution space.

Several multidisciplinary contributions were included in CEM. Human Activity Modeling (HAM) is an interaction design tool for capturing and representing activities and their context (Constantine, 2009). HAM provides the conceptual grounding and notation for CEM. From service design and requirements engineering, we embedded in CEM the concept of customer experience requirements (Patrício et al., 2008). Based on the Goal-Oriented Analysis concept of softgoal (Mylopoulos et al., 1999), customer experience requirements (CER) have integrated requirements engineering and service design, bringing to the latter a way to express customer desired attributes. Employing CER's enables the assessment of how each service element influences the customer experience. Finally, Multilevel Service Design (Patrício et al., 2011) provides the connection between customer experience and service design through three hierarchical levels that frame the experience study, from service concept to service system to specific service encounter.

In the next section, we detail how these contributions were integrated to develop CEM. Then we introduce CEM and present its application in a service design effort for a multimedia service provider.

2. From Customer Experience to Service Design

Following the service-dominant logic of Vargo and Lusch (2004) customer experience is not designed, rather it is co-created through customer interactions with the several service elements. To enable the desired experience, service designers must assemble a coherent set of elements, or clues, along the customer journey (Berry et al., 2002). These service elements are the context within which an experience takes place and, along with service activities, comprise the prerequisites that service designers put forward to enable desired experiences (Zomerdijk and Voss, 2009). Context encompasses the elements of each touchpoint, while activities unfold the experience.

Customers co-create unique experiences through their interactions with a service provider across different touchpoints, responding to the different designed elements, along with other elements that are not under an organization control, such as the social environment (Verhoef et al., 2009). As such, we cannot expect to design experiences that follow predicted outcomes exactly. Instead, we only design situations that better support customers in co-creating their desired experiences (Forlizzi and Ford, 2000). While many elements take part in shaping the customer experience, it is unlikely the customer recognizes any structure behind it, instead perceiving each experience as a complex but unitary feeling (Gentile et al., 2007). In this context, customer experiences cannot be designed by the organization, but services can be designed for the customer experience (Patrício et al., 2011).

Existing service design methods focus on separate elements of the customer experience but designers must embrace the holistic nature of customer experience and take any and all elements and touchpoints into account (Berry et al., 2002). This requires an approach that captures diverse customer experience components and systematizes them for service designers. Since some of these components are beyond a company's reach, we must examine the experience from the customer's eyes.

To that end, Customer Experience Modeling (CEM) supports the holistic nature of customer experience, provides a systematic portrayal of the experience context, and considers the physical artifacts, the technology-enabled systems, and the actors involved in each activity throughout a customer journey. Thus, we can characterize the customer experience and shift the focus from single elements to their orchestration. CEM does not substitute for existing methods, but provides a higher-level approach that systematizes experience information to support service design early stages. To achieve a comprehensive characterization of customer experience we followed a model-based approach, which combined several multidisciplinary contributions.

3. CEM Underpinnings

CEM is a model-based method that combines three multidisciplinary contributions to represent and systematize customer experiences for service design efforts. We use models to synthesize and communicate knowledge between members of a multidisciplinary service design team. Models are abstractions used to explain concepts and their relationships, which are too complex to be otherwise understood (Ludolph, 1998). Using models helps the design process by making visible a system's elements and its interactions, thus enabling the design team to achieve a common point of view, both of the problem and its solution (Dubberly et al., 2008).

3.1. Human Activity Modeling

CEM adapts Human Activity Modeling (Constantine, 2009) concepts and notation to represent the rich contextual environment underlying customer experience. We also employ HAM's Participation Map, which represents several contextual elements related to an activity, such as physical artifacts, actors and systems.

Human Activity Modeling (HAM) systematizes Activity Theory, a framework that puts activity and the tools that support it at the center of the design process. This enables us to

broaden our scope of analysis and achieve a holistic representation of customer experience, considering both activities and the different contextual components that frame it.

Focusing on activities, and the context in which they are performed, also helps address a key issue when designing new services; how they meet their intended customer needs. By studying how customer's get a job done (Bettencourt, 2010), instead of merely asking their opinions on a given service, we are paving a path to better address their needs (Dahlsten, 2003). In fact, short-term customer orientation, centered on solving current satisfaction problems, may privilege incremental innovation, while damaging radical innovation (Bonner and Walker Jr, 2004, Hillebrand, 2011, Dahlsten, 2003). As Ulwick points out (2002), customer satisfaction studies don't provide any clue on how to achieve it, as they are unable to reveal latent customer needs (Matthing et al., 2004). Other design related fields, such as interaction design, have also pointed to similar conclusions, suggesting designers take a closer look into user intentions, instead of merely supporting their current needs (Constantine, 2004). In service design, Multilevel Service Design (Patrício et al., 2011) has already embedded the concept of activity in its approach. Interestingly, the focus on activities to design new and innovative services has permeated different fields, all suggesting a focus on customer actions as the best way to meet their needs and develop truly innovative services (Constantine, 2004, Ulwick, 2002, Bettencourt, 2010, Norman, 2005).

HAM encompasses this activity-centered perspective, but it lacks tools to evaluate the different experience related components in a way that guides service design efforts. Furthermore, as HAM hails from interaction design, it is concerned about technology systems, thus lacking the appropriate service mindset. To address this issue, we simplify HAM's approach, focusing on the most relevant and intuitive concepts to portray customer's perspective. By limiting CEM's concepts and notation, we also make it easily understandable

and practical to all stakeholders involved in the design process, especially to those least accustomed to such model-based methods.

3.2. Customer Experience Requirements

To effectively bridge the gap between customer experience and service design we employ two additional contributions. First, to evaluate each activity and contextual element, CEM includes customer experience requirements (CER's). CER's have their origins on requirements engineering non-functional requirements, or quality attributes, more specifically on the Goal-Oriented Analysis softgoal concept (Mylopoulos et al., 1999). As non-functional attributes are the desired qualities of a software system, they needed to be adapted to a service-oriented mindset. CER's fill this gap, being defined as the perceived attributes of the interaction with a service provider that contribute to satisfaction and usage of the service (Patrício et al., 2009).

However, in CEM we apply CER's not only to a service provider but to every level of the customer experience, which may involve multiple service providers that support a certain activity. This way we are not focusing on the service provider but on the customer, thus avoiding the customer satisfaction rut mentioned before (Dahlsten, 2003). In CEM, CER's describe customer's desired qualities of an experience, thus acting as an evaluator. This way, we are able to model what customers do through the activities, how they do it through the participation map, and why they do it through CER's.

3.3. Multilevel Service Design

Finally, we employ Multilevel Service Design (Patrício et al., 2011) to structure our model from an overall customer journey, to each interaction through three levels of customer experience: value constellation experience, service experience, and service encounter experience. Multilevel Service Design (MSD) already builds upon the understanding of the customer experience to design the service offering at its different levels, and made a first

integration of HAM's concepts, namely by using the activities to represent the customer experience. However, MSD representations do not address the other elements such as actors, artifacts or CERs. CEM is positioned to overcome this limitation by offering a holistic view of the elements that form the customer experience. In Figure 1 we show how each of the concepts borrowed by CEM relate to each other. This representation is recursive for each of the three MSD levels.

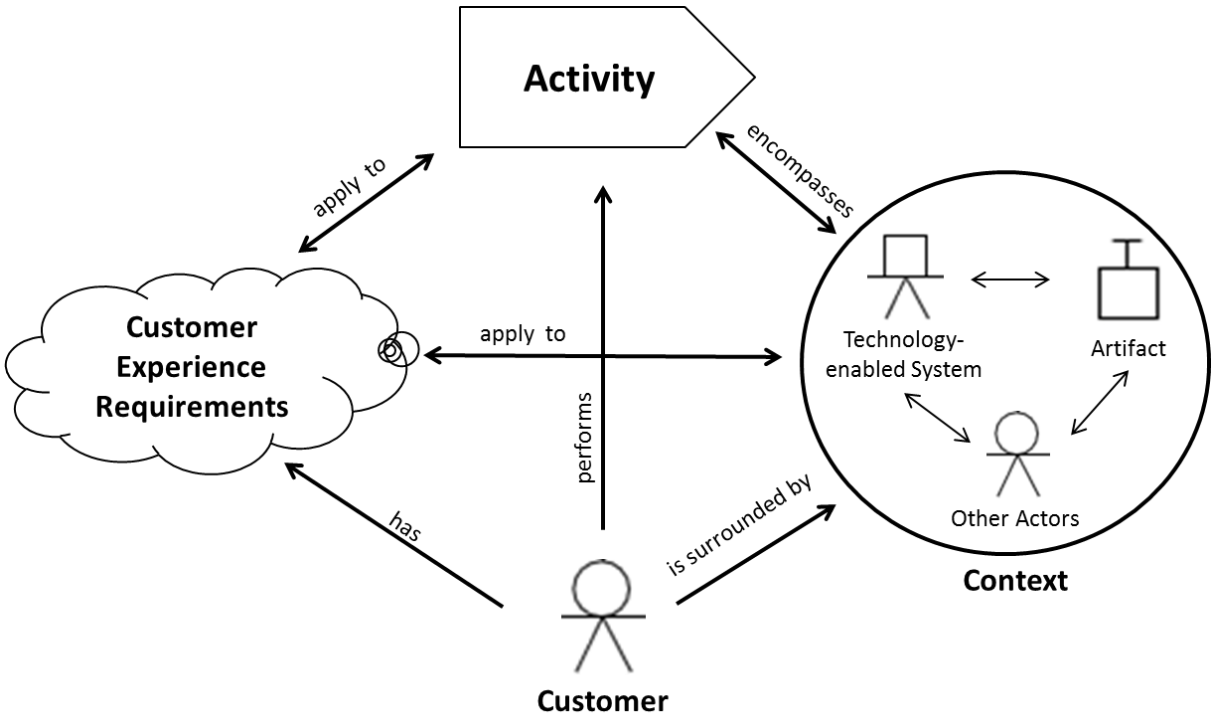

Figure 1 - CEM concepts and their relationships.

4. Customer Experience Modeling

CEM combines three multidisciplinary contributions to provide a comprehensive and systematic representation of customer experience. To apply CEM, a thorough customer study is undertaken using techniques such as interviews, observation, and contextual inquiry (Beyer and Holtzblatt, 1998).

Collected data is then systematized with three multidisciplinary contributions; HAM gives the notation and conceptual grounding for a systematic representation of the customer experience, CER's further characterize the experience by pointing out desired qualities, and the three levels of Multilevel Service Design structure the approach and establish the link to service design. HAM notation and concepts were adapted to reflect the customer and service focus because HAM was originally conceived to support the development of designed artifacts rather than designed services. Data must be analyzed to build the relevant categories for CEM, namely the activities performed, artifacts and systems employed, actors involved, and CER's. CEM's concepts and their notation are specified in Table 1. These are then structured according to the three levels of customer experience defined by MSD: value constellation experience, service experience, and service encounter experience. For each of them we elicit the relevant CER's and draw its participation map (on the right of Figure 1) with the contextual elements: artifacts, systems and actors.

Table 1: Customer Experience Modeling Notation.

Notation	Description
	Any artifact employed within an activity (Constantine, 2009).
	Non-human system (software or hardware) interacting with the customer.
	Activity participant interacting with the customer (or the customer himself).
	Perceived attributes of the interaction with a service provider that contributes to satisfaction and usage of the service (Patrício et al., 2009).
	Collection of actions or tasks undertaken for some purpose (Constantine, 2009).

4.1. Value Constellation Experience

CEM's first level, as defined by MSD, is the value constellation experience level. Value constellation experience results from interactions between the customer and all service organizations needed to perform a given customer activity. Therefore, we must first select the higher level activities, or overall activities, that apply to the specific businesses, or industries, we want to design a service for. For example, when studying the hospitality industry, we could select Accommodation as an overall activity or, for the foodservice industry, we could select Eating. Considering these broader level activities increases the possible outcomes of this kind of study. Depending on the resources available, this effort can be limited by selecting more restricted overall activities such as Travel Accommodation or Eating at home.

Based on the selected overall activities we interview customers who perform such activities. Customers are questioned about how they perform these activities, to elicit lower level activities; what they use, or interact with when performing the activities, to elicit the contextual elements; and what they value in each activity and interacting element, to elicit CER's. Ideally, one can go from overall activities, such as Eating, to smaller actions, such as Turn on the Microwave. This enables designers to trace each decision from overall goal to single interaction.

CEM depicts experiences from the customer point of view. As such, the value constellation experience level considers not only a single service organization, but all the ones which support a given overall activity. Accordingly, the participation map depicts the contextual elements from several service providers, even if a customer doesn't interact directly with them. If the performance of a contextual element can have impact upon the experience, even if indirectly, CEM should reflect it.

4.2. Service Experience Level

After we model the relevant overall customer activities at the value constellation experience level, we focus on a single service provider service system, thus crossing to the service experience level. This level systematizes customer experience data from every service encounter with a single service provider, following the same concepts and structures from the previous level. In the service experience level, the participation map reflects the contextual elements related to the specific service provider. Following the same example as before, at this level a suitable activity for the hospitality or foodservice industry would be Select a travel destination or Going to a restaurant, respectively.

4.3. Service Encounter Experience Level

The last level is the service encounter experience, where we address each specific touchpoint with the service provider. This is a very concrete level where we represent only the elements relevant to that encounter. This information could be obtained from open-ended interviews, but customers may find it difficult to recall such precise and simple activities. As such, to gather the required data for this level, it is advisable to use contextual inquiry (Beyer and Holtzblatt, 1998), through which researchers accompany customers while they carry out the activity under consideration, and thereby capture the relevant information. Finally, examples for activities at this level would be Make a reservation or Ordering.

CEM aims to fill the current lack of methods by providing a systematic representation of customer experience. Combining different multidisciplinary contributions makes possible a consistent method to support service design. From Interaction Design, HAM provides a strong conceptual framework and a clear way to represent relevant contextual elements. From requirements engineering and service design, CER's introduce customer's desired qualities providing guidelines to service designers, while MSD structures this approach. MSD also

establishes a clear-cut connection with existing design methods. Together, these contributions capture the various components of customer experience while retaining its holistic scope.

5. CEM application to a multimedia service provider

CEM was further developed and refined as part of a project to design new services and improve existing ones for a large Portuguese multimedia service provider. Its service offerings include cable TV, high-speed internet, mobile and landline phones, and several video on-demand channels. The project involved a multidisciplinary team of business specialists, designers, and software engineers, which provided a fruitful ground for CEM's application.

To begin with, we studied the service provider business model to determine the most relevant customer activities their services supported. As the huge majority of customers were final, residential consumers, and the service provider's main business goal was to maintain its market share in this segment, we excluded business customers. For residential customers, the service provider offering fit into two key overall activities; entertainment, which included cable TV and high-speed Internet, and communication, which included the mobile and landline phone services. Therefore, Entertainment and Communication were the two overall activities we started with.

Subsequently we interviewed 17 residential customers and analyzed the collected data following a Grounded Theory approach (Corbin and Strauss, 2008, Charmaz, 2006) with the help of NVivo 8 software. This analysis provided the basis to map customer activities, contextual elements, and corresponding CER's. The latter were identified as follows:

- Affordability: availability at a price deemed acceptable;
- Engagement: the feeling of being pleasantly absorbed;
- Content: availability and quantity of up-to-date multimedia materials;

- Convenience: availability and ease of access to something that is desired;
- Reliability: performing in a dependable way and with a predictable outcome;
- Reward: worth the time spent in doing it; and
- Speed: swiftness in obtaining what is desired.

For each contextual element, a factsheet was produced to better describe and communicate its characteristics, mentioning relevant design guidelines and even including actual field data, such as pictures and customer's quotations. For activities, we adapted HAM's Activity Profile (Constantine, 2009) which describes activities according to their purpose, place and time, participation, and performance characteristics. In Table 2 we illustrate such factsheets.

5.1 Value Constellation Experience

At the value constellation experience level, we selected the activity Entertainment as the most relevant for this study because, as we found out, Entertainment compared to Communication involves a much larger range of CER's, activities, and artifacts. Such complexity provided a richer example to demonstrate CEM's capabilities. The same rationale applied for the activities chosen at the service experience level and the service encounter experience level. The example shown in Figure 2 depicts the entertainment related activities, throughout the three levels of experience, for the multimedia service provider.

From the customer study, we learned that entertainment involves activities such as Playing Sports, Watching TV, and Surfing the Internet. Following the same conceptual structure shown in Figure 1, in Figure 3 we illustrate how we applied CEM throughout the three levels of customer experience, starting from the overall activity Entertainment, to the activity Recording.

Table 2 - Examples of factsheets with descriptive data.

 **Friends and Family** 	**Characteristics:** share the same space during leisure time and sometimes have conflicting interests. **Design Guidelines:** There are conflicting interests, and designed artifacts must be tough and reliable as kids might use them. **Quotation**: "My son likes cartoons, my wife likes TV series... That's why I have two set-top boxes, at least there are no fights!"
 **Set-Top Box** 	**Characteristics:** Makes the interface between the customer and the company's systems, providing added functionalities such as TV listings, recording or pay-per-view channels. **Design Guidelines:** Frequent failures seriously damage the experience as the customer wants it to be flawless and engaging. **Quotation:** "usually I zap between channels and I'll see what will be on afterwards"
Recording	**Purpose:** store TV contents for later retrieval. **Place and time:** At home and at night, or when the customer sees something interesting enough and wants to keep it, or see it later. **Participation:** Alone. **Performance:** To schedule the recording the customer has to open the TV listing and search and select the desired content. Alternatively he can start recording whenever he wants to by selecting the appropriate button on the set-top box remote.

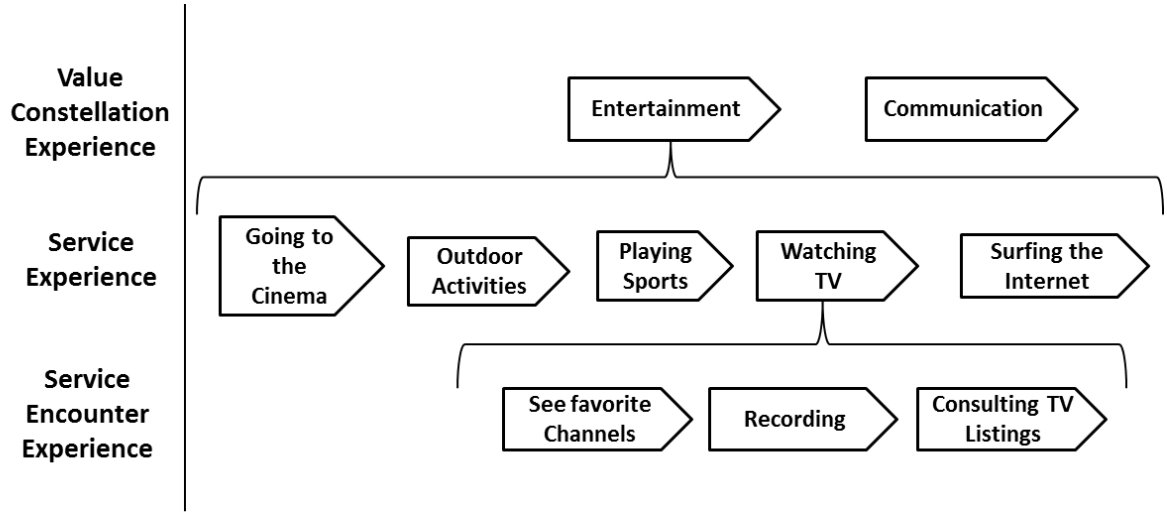

Figure 2 - Entertainment related activities.

Links between CER's and contextual elements mean that customers make an association between the two. It does not mean, however, that current elements already address those CER's, or that the CER's only apply to that element. A CER is a crosscut requirement, meaning it applies to the overall activity, and not only to a specific element. Therefore, if a CER is not linked with any contextual element it means it is a desired quality of the overall activity and, contextual elements should incorporate those qualities to better support the activity, and consequently the customer experience.

The analysis of Figure 3 reveals that entertainment is an activity rich in artifacts, such as a set-top box, HD and CRT TV's, remotes for both of these, and other less technological artifacts like books and newspapers. However, none of these artifacts are associated with the CER Engagement, which seems paradoxical considering the activity they support and suggests that they are viewed as a necessary means to an end. Also, Reliability is always present through the different levels, suggesting the importance of building systems that support foolproof Entertainment. This is even more important when friends and family are

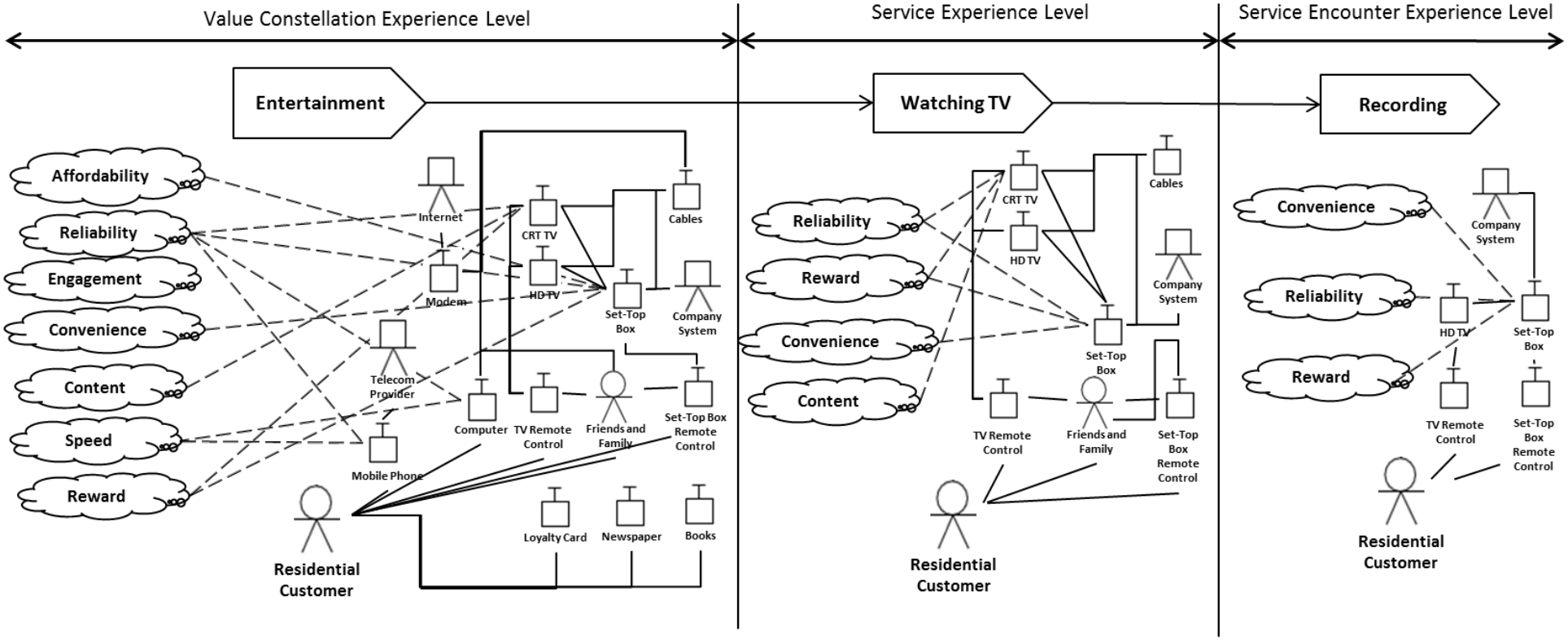

Figure 3 - CEM for a multimedia service provider.

actors included in these activities, as is typically the case, which can imply children's involvement and the ensuing strain over such technological artifacts.

5.2 Service Experience Level

Following the same example portrayed in Figure 3, we detailed Watching TV at the service experience level, thus focusing on the multimedia service provider offering. Relevant CER's for this activity are Reliability, Reward, Content, and Convenience. Contextual elements are mostly artifacts, such as Set-Top Box, TVs, and remotes for both. The most compelling design guidelines to be drawn from this example are concerned with the artifacts involved, with the customers even being aware of the cables that connect everything. For an activity where customers value convenience, the proliferation of artifacts is certainly not desirable. Also interesting is the association between the CER Contents and the CRT TV's, suggesting that customers with older TV sets still view them as the content providers, instead of the cable TV company.

5.3 Service Encounter Level

Finally, at the service encounter level we focused on the activity Recording. Reliability, Convenience, and Reward are the most relevant CER's, all of them related with the Set-Top Box artifact. In this case, only the more technological advanced high-definition (HD) TVs are present, opposed to the previous level activity Watching TV, where older CRT (cathode ray tube) TVs are also present. This indicates that customers perceive the difference between TV's and value them differently by performing different activities according to the type of TV they own. Viewed from the cable TV provider perspective, this can be troublesome, as a key artifact for this activity is not under company control. This CEM analysis enables envisioning possible solutions, such as bundling the Set-Top box and the HD TV set in a service offering.

6. Conclusion

Understanding customer experiences requires capturing rich information across all customer interactions with the service provider and even other service providers that support the overall customer activity. Customer Experience Modeling builds upon multidisciplinary contributions in a way that systematizes this rich information and structures the holistic nature of customer experience. The application of CEM to a multimedia service shows how it can facilitate understanding the customer experience and provide valuable insights to support the service design process.

6.1 Research and managerial implications

Although customer experience has been conceptualized, empirical studies about it are scarce. There is no prior holistic approach to study and portray all the elements that form customer experience. CEM provides such an approach, contributing to support service organizations to enhance customer experience as a whole, through the integrated view of activities, actors, artifacts, and technological systems.

Service design is recognized as a human-centered approach that builds upon understanding customer experience to design service offerings. However, the richness and complexity of customer experience information makes it hard for service organizations to analyze and incorporate it in their service design efforts. CEM's activity-centric and contextually rich representation gives service designers a comprehensive, yet manageable view of the problem space. CEM's multilevel structure also empowers service designers to trace the impact of their design decisions, from the overall service activity to each service encounter. By considering customer activities, their context, and expected qualities, CEM supplies more comprehensive representations of customer experiences than other methods. This structured, systematic view also facilitates the incorporation of customer experience into subsequent

stages of service design. However, CEM is not a substitute for these other methods, but a complementary and integrative approach that provides additional inputs to service design.

Service design projects require multidisciplinary teams, interdisciplinary tools and complex methods. CEM uses concise notation to offer an intuitive visual representation of the customer experience, which can be used to facilitate communication and analysis among design teams. This enables design teams to reach a common understanding of the problem space and the solution space. Finally, CEM's multilevel structure makes the method scalable and modular which, in turn, makes its application feasible for a wide range of service design projects.

6.2 Directions for Future Research

This article presents the conceptual development of CEM and its application to the design of a multimedia service. This multimedia service provided a rich foundation for understanding the complexity of the customer experience and the systematic nature of CEM. New applications to other service contexts would enable further developments and refinements of the approach.

The current work should be further integrated with service design methods, especially with Multilevel Service Design. Forging a stronger connection between CEM and MSD would ensure the continuity of the customer focus during the whole design process. An application of CEM, across the full service design cycle, would enable further insights into how CEM models connect with service offering models to better support service design. This integration could also be taken one step further, to understand how service design decisions are interconnected with business goals and models.

Depicting and orchestrating the different elements of customer experience into different diagrams of CEM can be rather time-consuming. Developing software tools that enable the easier execution, handling, and visualization of customer experience models would

significantly assist the understanding and wider application of CEM to service design projects. Such software tools would facilitate connections with models used by software engineers and interaction designers and support the work of multidisciplinary teams.

In conclusion, by combining several multidisciplinary contributions to build a model-based method, CEM captures and systematizes the holistic nature of customer experience while forging a connection with service design. The coherent models support the design process– enabling traceability from the overall service offering to each service encounter– while an established and simplified notation enhances interdisciplinary communication within and beyond the design team. Thus, service designers are able to apply CEM and infuse desired customer experiences into new or improved services.

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5. Paper II: The MINDS Framework

Integrating management and interaction perspectives for service design – the MINDS framework[2]

ABSTRACT

Services are increasingly technology-infused. Devices like smartphones and tablets are challenging service designers to orchestrate a broader range of service encounters. To cope with this technology-induced complexity, service design has borrowed methods and tools from other fields. However, multidisciplinary service design teams struggle with different approaches and models that are not integrated, lead to duplication of work and unintended consequences. To address service technology-infusion and provide a common framework for service designers, this paper presents the Management and INteraction Design for Services (MINDS) framework. MINDS is a set of interdisciplinary models that conceptualizes and integrates two service design perspectives; the managerial one that has a stronger business-orientation and deals with value propositions and service delivery processes; and the interaction design one that has a stronger technology-orientation and provides a creative and visually rich canvas to design service interfaces.

MINDS takes advantage of the complementarities between perspectives to empower service designers to orchestrate technology-enabled service interfaces, systematizing contributions from both perspectives, and providing a shared communication space for multidisciplinary

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teams. The application of MINDS in two service design projects in distinctly different industries: media and healthcare, shows how this approach can support technology-infusion and enhance the designed service interactions and experience.

1. INTRODUCTION

As technology pervades every aspect of service provision, it creates new service delivery interfaces and reimagines traditional ones through the introduction of new interactive devices. Customers now have one of such devices for every context and activity (Google, 2012) and service providers face new challenges as the Internet of Things (Atzori et al., 2010) gains traction. With this expansion of available service channels or interfaces, where a company seeks to manage a relationship with a customer (Rayport and Jaworski, 2004), customer journeys are becoming more complex and the number of potential service encounters is increasing. Technology not only brings more service interfaces, but they must be carefully orchestrated to support desired customer experiences (Berry et al., 2002). Haphazard deployment of new technologies in a service setting can do more harm than good (Bitner et al., 2000; Burke, 2002; Rayport and Jaworski, 2004). To address this challenge, literature on technology in service settings (Bitner et al., 2000; Burke, 2002; Walker et al., 2002; Wünderlich et al., 2013), and multi-interface services (Patrício et al., 2008; Sousa and Voss, 2006) has been expanding, but still the topic is not yet well understood (Wünderlich et al., 2013). Ostrom et al. (2010) identified "leveraging technology to advance service" as a service research priority.

To meet this accelerated rate of technology-infusion, service design has added interdisciplinary capabilities in technology-oriented fields, primarily by building bridges with interaction design (Forlizzi, 2010; Holmlid, 2007, 2009; Miettinen et al., 2012; Sangiorgi, 2009). Interaction design focuses on understanding human engagement with digital technology and designing more useful and pleasing technology artifacts (Kaptelinin and

Nardi, 2006). This led to the emergence of an interaction perspective in service design (Sangiorgi, 2009), which focused on the contributions from interaction design to create the visual appearance and navigation of technology-enabled service interfaces. However, service design is a multidisciplinary field that brings together expertise from different fields (Moritz, 2005) including services marketing, operations management and information systems (Patrício and Fisk, 2013). These fields each have their own way of approaching service design. The management perspective builds on service marketing, service operations, and strategic management. It also has a stronger focus on the business concerns of the service provider. The management perspective deals with the service value proposition and service delivery process, including the backstage and frontstage orchestration. Since management and interaction design approaches emerged from different disciplines, they do not share the same language and tools, which may lead to communication problems within design teams. These problems result in design process misalignments, lack of synergies, and undesired outcomes, because decisions taken by management and interaction design are interdependent (Gorb and Dumas, 1987; Tether, 2008).

To address the challenges posed by technology-enabled service interfaces and to integrate service design management and interaction perspectives, this paper presents the Management and INteraction Design for Services (MINDS) framework. MINDS is an interdisciplinary framework comprising a set of combined models that provide a shared language and process to integrate and bridge the work of service designers from both management and interaction design perspectives. Bridging these perspectives with operable models enables service designers to address the complexity of orchestrating a growing number of technology-enabled service interfaces. It also support synergies and improves knowledge sharing. The MINDS framework builds on multi-interface service research (Patrício et al., 2008, 2011; Teixeira et al., 2013) and existing design tools (Bitner et al., 2008; Carroll, 2000; Curtis and

Vertelney, 1990; Patrício et al., 2008; Segelström, 2009) to establish a set of models along with a design process encompassing the three design levels of Multilevel Service Design (Patrício et al., 2011): the service concept, the service system and the service encounter.

In the next section, we review relevant literature regarding service design models and examine each perspective. In the third section, we present the conceptual models and processes of the MINDS framework in detail, highlighting the integrations done and the synergies obtained. In the fourth section, we describe the application of MINDS in two distinct industries: media and healthcare. In these service design projects, a multidisciplinary research team, encompassing service design, service marketing, interaction design and software engineering, collaborated for a total of four years, during which the MINDS framework was developed and tested. Finally, we discuss our contribution and consider future opportunities for research.

2. DIFFERENT PERSPECTIVES OF A COMMON TRADE

Service designers have a wealth of tools or models available from many contributing disciplines. Like other literature with an interaction design or software engineering influence, we are using the concept of models (Holmlid and Evenson, 2008; Huang et al., 2013; Patrício et al., 2011; Teixeira et al., 2012). Models are abstractions, or simplifications of reality (Booch et al., 1999) that use constructs (notation) to represent both the design problem and its solution space (Hevner et al., 2004). Models help visualize and guide the development of complex systems and document decisions (Booch et al., 1999). In the service design field, some authors employ the concept of tools (Alves and Nunes, 2013; Diana et al., 2009; Stickdorn et al., 2011) and others further elaborate by calling them visualizations, or visual tools (Diana et al., 2009; Segelström and Holmlid, 2009; Segelström, 2009). We employ the concept of models since it has a multidisciplinary scope, bridging service design, interaction design and software engineering. Still, despite naming differences, models, tools or

visualizations share a design background, meaning they support humans in conceiving, planning and making products, services or systems that serve individual and collective purposes (Buchanan, 1992, 2001).

Several authors have compiled, compared and evaluated service design models separately. Moritz (2005) offers a comprehensive listing and description of models used by service designers and Miettinen (2009) and Stickdorn et al. (2011) provide a collection of service design models and explain how they work. Other authors have compared and classified service design models: Alves and Nunes (2013) provide a taxonomy of service design models and Diana et al. (2009) classifies service design models according to their degree of iconicity and relation with time. Also, Segelström (2009) researches the practitioner's purposes, influences and patterns for using service design models. Further work positioned service design models in the different stages of the Analysis-Synthesis Bridge Model (Segelström and Holmlid, 2009) and according to service theory traits (Segelström and Holmlid, 2011). Interaction design research also addresses many of the models reviewed by these authors (Cooper et al., 2012; Goodwin, 2011; Holtzblatt et al., 2004; Saffer, 2010). However, while this research identified and categorized a panoply of service design models, service designers still need to fit these models into a coherent process for each design project. This requires managing interdependent and interdisciplinary contributions and leveraging their strong points, while overcoming their pitfalls.

Based on prior research and on two service design research projects involving a multidisciplinary team of service designers, interaction designers, service marketers and software engineers, we systematized management and interaction design perspectives as described in Table 1. The management perspective models have a background in service marketing, service operations, and strategic management and focus on conceiving value propositions to co-create value with customers. An illustrative case is Lovelock (1994)

Flower of Service, which depicts the core and supplementary services that comprise the service concept. The management perspective is also focused on the service delivery process, with the service blueprint (Bitner et al., 2008; Shostack, 1984) being the most prominent example. Service blueprints pinpoint waiting and failure points, while orchestrating frontstage and backstage service operations. These management perspective models have clear and well defined structures, providing a robust backbone for organizing and systematizing service design projects. Still, they are focused on the service concept and the process of service delivery and lack an aesthetic dimension that showcases the qualitative aspects of the experience, such as the attractiveness and atmosphere (Diana et al., 2009).

Table 1 - Characteristics of service design perspectives.

	Management Perspective	**Interaction Perspective**
Background	Business-oriented: Service marketing, strategic management and service operations background	Oriented towards the interaction with technology devices: Interaction Design
Focus	Value proposition and service concept, customer experience and service delivery process	User experience with technology-enabled interactive devices and their surrounding context
Models emphasis	Structure and systematization	Visual aspect and creative thinking

Service design models with an interaction focus have their background in interaction design. These models are focused on the users of the service and their surrounding context, foregoing the business perspective. They are less structured and as such are suited for more creative

exploration. They use illustrative visual tools that are more empathic and give all members of the design team a broader communication space. Storyboards and wireframes (Bowles and Box, 2010; Truong et al., 2006) are good examples of this design perspective. Management and interaction perspectives are interdependent and their models have complementary characteristics. However, they have yet to be integrated conceptually and practically as part of a broader systematized design process. Service designers can choose between wide assortments of models, but there is no clear guidance on what models to choose, in which phase of the design process to apply them, and how to bridge managerial and interaction concerns.

With the MINDS framework we synthesize a set of well-established service design models, from each perspective, and follow the three-levels of Multilevel Service Design which links the strategic and operational levels, encompassing the design of the service concept, the service system and each service encounter (Patrício et al., 2011). This establishes a tight connection between levels, enabling the systematization of the design process and traceability of design decisions. It also ensures consistency from the strategic to the service encounter level, which is considered a major challenge for service organizations (Goldstein et al., 2002). Finally, the MINDS framework provides a shared language for service design projects and achieves synergies by clearly mapping each interdependent contribution, thus avoiding repetition of efforts, or unintended consequences from one perspective to the other. With the integration of both management and interaction perspectives in shared models and process, MINDS models tightly link technology deployment and usage with the development of value propositions and operational concerns. In the next section, MINDS conceptual underpinnings are detailed.

3. THE MANAGEMENT AND INTERACTION DESIGN FOR SERVICES (MINDS) FRAMEWORK

The MINDS framework comprises a set of interdisciplinary models that combine management and interaction approaches to service design in three levels. With the combined MINDS models we integrate the value creation, delivery process components and structure of the management perspective, with the visualization acumen of the interaction perspective.

The development of the MINDS framework followed a design research methodology (Buchanan, 2001; Hevner et al., 2004; March and Smith, 1995; Peffers et al., 2007). Design research can be seen as a problem solving process (Hevner et al., 2004), and design scientists strive to create artifacts, i.e. constructs, models, methods, and implementations that are innovative and valuable (March and Smith, 1995). Following design research guidelines (Hevner et al., 2004; Peffers et al., 2007) the MINDS framework provides new artifacts, namely models and implementations (guideline 1) that address and solve a relevant problem with important research contributions (guidelines 2 and 4). In the pursuit of research rigor (guideline 5), MINDS followed appropriate literature regarding qualitative data collection and analysis (Charmaz, 2006; Corbin and Strauss, 1990; Myers and Newman, 2007; Pawson, 1996). MINDS development was iterative (guideline 6) and validated through two case applications (guidelines 3 and 7), involving extensive feedback from customers and other stakeholders and regular meetings with the service design team.

In Figure 1, we portray the foundational models for the MINDS framework, as well as related models positioned according to their level and perspective. This figure is not intended to be an exhaustive listing of service design tools. Instead, it portrays the underpinnings of our conceptual framework, taking into account models that cover the three levels of service design; the service concept, the service system and the service encounter. From this set of models, MINDS integrates three of them with a stronger management perspective (customer

value constellation, service system navigation, and service blueprinting) with other three with a stronger interaction design perspective (affinity diagrams, storyboards and interaction sketches).

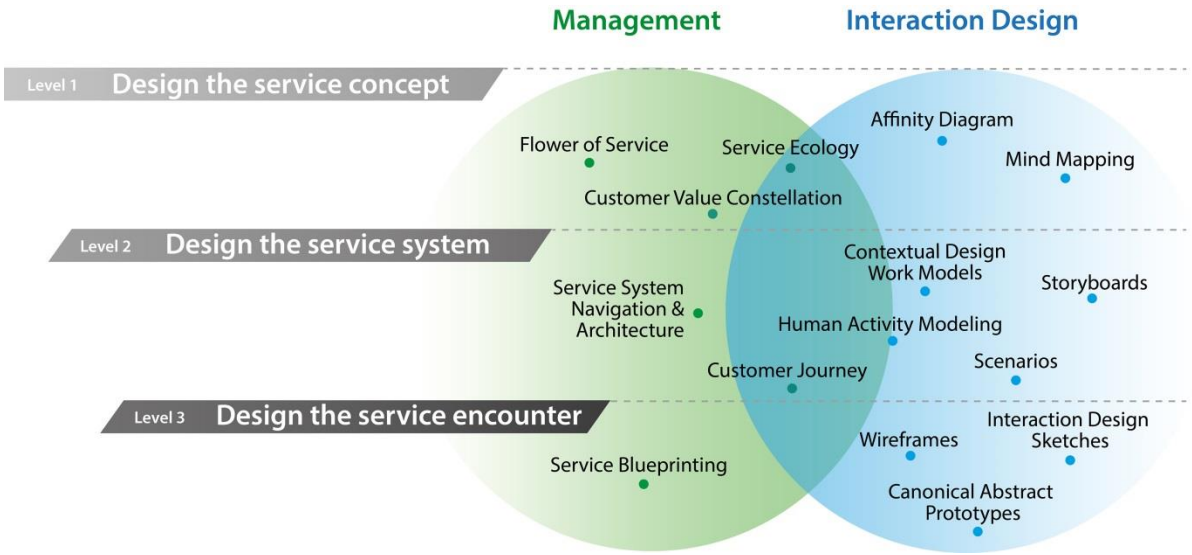

Figure 1- Positioning MINDS model underpinnings according to their perspective.

Figure 2 illustrates the MINDS conceptual framework through the three levels of service design. The top level, designing the service concept, is on the left and combines customer value constellation, to depict existing and new service offerings and concepts, and affinity diagrams to explore and prioritize service features for each new service concept. Service concepts created at this level are detailed at the service system level, depicted on the middle of Figure 2. At this level, MINDS combines service system navigation to structure the design of technology-enabled multi-interface services, with storyboards to describe and visually depict the desired customer journeys. Finally, each set of service interface (lines of the service system navigation) and activities performed by the customer (columns of the service system navigation) is detailed at the service encounter level. For the design of the service encounter, MINDS combines service experience blueprints, to depict the service deliver process in a multi-interface context, with interaction sketches, to depict the technology-enabled service interfaces. The models for each perspective at each level and the rationale behind their integration are detailed ahead.

3.1. Designing the service concept

Goldstein et al. (2002) consider the service concept to be the key driver for service design decisions at all planning levels. Edvardsson and Olsson (1996) define service concept as the utility and benefits provided to the customer. Patrício et al. (2011) broadens this definition beyond the services internally offered by the firm, including other service providers in the customer constellation of available offerings.

3.1.1. Management Perspective

From a management perspective, models at the service concept level are focused on portraying the firm's value proposition, either as a set of core and supplementary offers (Lovelock and Wirtz, 2011), or as a constellation of offerings and relationships (Normann and Ramirez, 1993). These provide mostly a business point-of-view of the service concept. The customer value constellation (Patrício et al., 2011) portrayed service offerings and their relationships from a customer point-of-view, focusing on the services that support a customer overall activity, independently of the service provider. As such, in Figure 1 we have positioned the customer value constellation close to the intersection between management and interaction perspectives, but still in the management area. Whereas a service ecology (Miettinen, 2009; Moritz, 2005) is a holistic representation of a service system and its surrounding context. It represents and structures all the factors that surround a service, including actors, relationships and physical evidence into common categories. Service ecology is focused on the service provider, but is also quite unstructured and can support a more visual representation of the service system. Thus, we positioned it in the intersection between management and interaction perspectives. At the service concept level, management perspective models are very structured and strongly focused on the development of value propositions. As such, they are not so supportive of creative efforts for generating new service ideas.

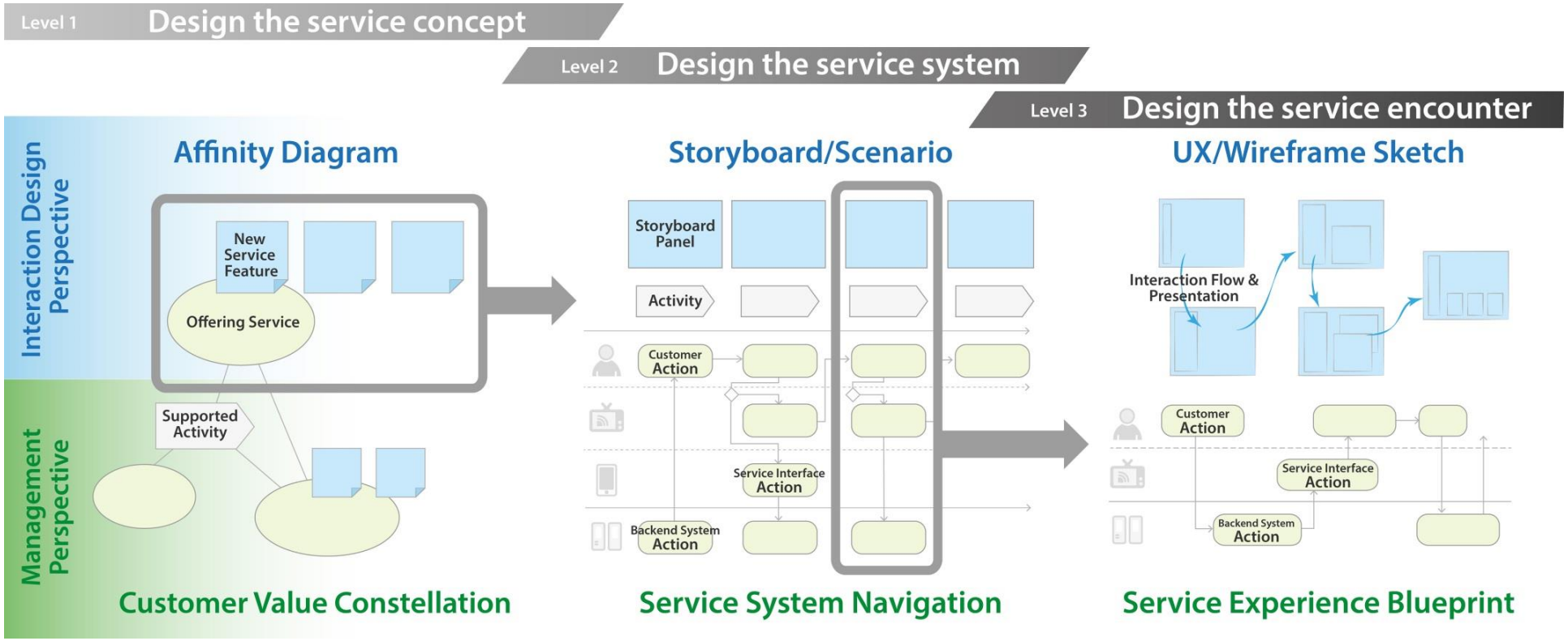

Figure 2 - MINDS framework conceptual structure.

3.1.2. Interaction Perspective

From an interaction perspective, models at the service concept level have more creative and exploratory features that can explicate these concepts. For example, affinity diagrams, also known as KJ method, structure collected data and brainstorming outputs in homogenous categories (Alves and Nunes, 2013; Beyer and Holtzblatt, 1997; Moritz, 2005). Building affinity diagrams is an interactive effort that enables service design teams to creatively explore new concepts and reach a common understanding about complex problems. Other models such as mind maps (Buzan and Buzan, 1993; Moritz, 2005) are less structured and more sketch-based. They use words, images, and symbols to explore a problem. These models are more open and geared towards supporting the creative generation of new ideas and concepts. Still, they don't consider the business environment surrounding these new concepts.

3.1.3. Integrating perspectives with the MINDS framework

For the design of the service concept, the MINDS framework integrates the customer value constellation to explore new forms of value co-creation, with the customer and affinity diagrams to brainstorm and detail new service ideas. As seen in Figure 2, developing these models starts by having the design team focus on the overall customer activity that the new service will support, and depict the current set of service offerings related with that activity through the customer value constellation. For example, to design a mortgage loan service, the design team should start by focusing on the overall activity (buying a house) and the different services that customers use to co-create their value constellation experience (real estate, decoration, legal services…). Then, based on the collected data, the design team brainstorms new service concepts and features, and iterates toward a desired customer value constellation, while representing its features through the affinity diagram. Structuring the concepts and features in a clear way also

helps to compare and prioritize them. With this enhanced MINDS model the design team can position the value offering of the new service in relation to existing offerings in the customer value constellation, while retaining a customer point-of-view. The design team can also detail the value offering in a creative and structured way, comparing potential design concepts and prioritizing design efforts. Since this enhanced model is built with the complete design team brainstorming and prioritizing, it establishes a shared understanding among its members and fosters communication and creative synergies among designers with different expertise. Finally, it also brings interaction-oriented experts to this strategic decision-making level, a role traditionally assumed by their management-oriented counterparts.

3.2. Designing the service system

Spohrer et al. (2008: 104) define service systems as configurations of "people, technologies, and other resources that interact with other service systems to create mutual value". Edvardsson and Olsson (1996) regard the service system as the company's staff, customers, physical/technical environment and organization and control. As such, designing the service system requires the definition of a mix of service offerings, interfaces, tangible evidence, processes, people´s roles and technology (Patrício and Fisk, 2013).

3.2.1. Management Perspective

From a management perspective, models at the service system level emphasize the service delivery process across the entire customer journey. A systematic model to structure the service system, and the alternative paths customers may take across service encounters, is the Service System Navigation and the Service System Architecture (Patrício et al., 2011). These models are especially suited for technology-enabled services since their structure supports designing for multi-interface services. Customer

journeys portray the overall service provision process through ordered sets of touchpoints, or service encounters, i.e. moments of interaction between the customer and the firm (Bitner et al., 2000). They illustrate a customer's path through these potential service encounters, but can also encompass stages before and after interacting with the service (Segelström and Holmlid, 2011). Customer journeys share characteristics from management and interaction. They are process oriented but their relatively loose structure supports creative thinking and aesthetic depictions. As such, in Figure 1 we have positioned the customer journey at the intersection of management and interaction perspectives. Management perspective models for designing the service system are structured and process-oriented. They also allow for understanding the implications of design decisions at the frontstage on backstage operations. However, they do not represent the intended look and feel of new services and as such provide an incomplete view of the service experience.

3.2.2. Interaction perspective

From an interaction perspective, models at the service system level are more focused on depicting customer activities and their surrounding context. For example, Contextual Design's Work Models (Beyer and Holtzblatt, 1997; Holtzblatt et al., 2004) describe customers and their surrounding context and relationships. Also, Human Activity Modeling provides models to represent the context surrounding customer activities (Constantine, 2009). While these two sets of models are customer and context focused, they are more schematic and not very illustrative. On the other hand, storyboards, with their origins on comic books and movie making (Hart, 2007; Segelström, 2010), are a very visual tool. They are short graphical depictions of a narrative (Truong et al., 2006), with this narrative assuming the form of a customer journey in a service design setting. Scenarios are can also portray customer journeys as they are story narratives about

people and their activities (Carroll, 2000; Preece et al., 2002). They represent the world as users see it and omit the behind the scenes use of software, or other technological support, to achieve a task (Carroll, 2000; Goodwin, 2011; Preece et al., 2002). From an interaction perspective, models to design the service system are context focused, visual and appealing, providing a qualitative and rich representation of the service experience. However, they lack a defined structure that can deal with complex service systems, and they do not address the implications of design decisions at the frontstage on backstage operations and multi-interface management.

3.2.3. Integrating perspectives with the MINDS framework

To design the service system, the MINDS framework combines models that structure a technology-enabled service delivery process across service encounters, while visually depicting that same process. This way we are able to systematize the design process, support multiple technology-enabled interfaces and provide an engaging and aesthetically captivating depiction of the new service delivery process. To this end, we use Service System Navigation and Service System Architecture (Patrício et al., 2011) to provide the necessary structure and combine them with customer journeys (Segelström and Holmlid, 2011), scenarios (Carroll, 2000) and storyboards (Curtis and Vertelney, 1990) to add the visual elements.

As shown in Figure 2, we begin designing the service system building upon the service concept and service features defined on the earlier level. First, with the service system architecture (SSA) we design the new service delivery process taking into account the customer activities to be supported, and the set of service interfaces that will provide the respective services. The SSA is not shown in Figure 2 as it is implied on the next model, the Service System Navigation (SSN). Through the SSN we orchestrate and illustrate potential customer journeys based on defined scenarios. This provides a dynamic view

of the service system, depicting alternative customer journeys according to each pair of activities and service interface chosen by the customer. With the SSA and SSN service designers decide, for example, what activities should be supported on smartphone, or in a website, or both. Take for example an electronic check-in for a flight. You can do it through the airliner website, or through the smartphone app. Yet, if you need to show your frequent flyer card, you can have different activities depending on the service interface. On the smartphone the airliner app would just show the card with a code bar for reading, while the website would support the printing of a frequent flyer card. Finally, we illustrate the customer journey and embed the desired contextual elements on the SSN through a storyboard.

MINDS' improved representation can handle as many technology-enabled service interfaces as necessary, while providing an early visualization of the service by illustrating the main characteristics and contextual elements of customer journeys. This also improves communication within the design team and with other stakeholders that are able to visually see the service concept coming to life. MINDS' systematized structure also provides an architectural plan to guide further detailed design in the next level, the design of the service encounter.

3.3. Designing the service encounter

The service encounter is a moment of interaction between the customer and the firm (Bitner et al., 1990) and has been considered "the crux of service delivery" (Johnston, 1999). It is also called a touchpoint, or moment of truth and can take place face-to-face or through various communications technologies.

3.3.1. Management perspective

Models from a service design management perspective detail the service delivery process for each service encounter. The first management service design tool concerns

the design of the service encounter and is known as service blueprinting. With a service operations background, service blueprinting was introduced by Shostack (1984) to provide managers and service developers with a comprehensive and workable framework for addressing service development issues. Its structure puts customer actions on center stage, and includes onstage/visible employee actions, backstage/invisible employee actions, support processes, and physical evidence (Bitner et al., 2008). A connection between service blueprinting and interaction design was developed by Spraragen and Chan (2008). This work emphasized the visualization aspect of the service blueprint by employing interaction designers, albeit its focus was on customer's emotional states. Service experience blueprinting (Patrício et al., 2008) also employed interaction design concepts from Human Activity Modeling (Constantine, 2009) and adapted the original service blueprints to multi-interface services. Similarly to the design of the service system, management models for the design of the service encounter are structured and process-oriented and lack a visual and appealing element that can reflect the desired look of each service encounter and interface.

3.3.2. Interaction perspective

From the interaction perspective service design tools are focused on depicting the aesthetics and interactions of service interfaces, especially those that are technology-enabled. They support service designers' creative efforts by offering a canvas for low-fidelity prototyping of interfaces. Their structure is flexible and can be suited to each service design project. Sketches (Buxton, 2007) are the least structured models. They can depict almost anything, are quick, timely, inexpensive and disposable. Wireframes (Bowles and Box, 2010) on the other end are prefilled screen layouts with low detail representations of an interface, thus being quite structured. Canonical Abstract

Prototypes (Constantine, 2003) are at the middle ground because they only provide a layout schematic without dwelling on the aesthetics. These interaction perspective models are suitable for visually representing the desired look of each service interface, but their loose structure does not address operational service provision concerns.

3.3.3. Integrating perspectives with the MINDS framework

For the MINDS framework, we combine models to strengthen the design of technology-enabled service encounters. From the management perspective, we employed the service experience blueprint because it was already adapted to multi-interface services (Patrício et al., 2008). Service blueprinting already encompasses a physical evidence layer, so we augmented it with interaction sketches, a combination of interaction wireframes and sketches to depict the interaction flow. With the interaction sketches, we illustrate the service delivery process of a technology-enabled service encounter and document the disposition of interface elements for software engineering development.

As illustrated in Figure 2, each customer activity in each service interface, at the design of the service system level, is detailed with a service experience blueprint and an interaction sketch. Through this process, each service encounter can be clearly traced back to the service system. This tight connection overcomes a too narrow focus on individual service elements and avoids overlooking the dynamic and ongoing process of contact between customers and the service organization (Zomerdijk and Voss, 2010). To build this model, service designers define the set of customer and service interface actions with service experience blueprints, while roughly depicting the visual aspect assumed by the service interface with interaction sketches. This provides a clear view of how human interaction should be, thus making it easier to design technology-enabled services (Voss, 2003). It also forces service designers to consider the interdependence between frontstage service provision, backstage support and best practice interactions

for the specific service interface. This ensures early alignment between perspectives and avoids undesirable or unforeseen impacts. For example, it avoids the design of a login process that only later is discovered not to conform with specific interface interaction design guidelines.

With the synthesis of service experience blueprints and interaction sketches, service designers can define the service provision process and illustrate the visual appearance of its technology-enabled service interfaces, ensuring it follows the appropriate interaction design guidelines. This model strengthens communication between the design team and other stakeholders, and helps making the transition for the development of the technological system that enables the service experience. Software engineers are given a view of the technology-enabled service interface in the context of the overall service system, thus being able to better grasp its desired behavior and visual aspects. In the next section, we apply the MINDS framework to service design projects in two different industries.

4. APPLICATION OF THE MINDS FRAMEWORK TO TWO SERVICE DESIGN PROJECTS

The MINDS framework was conceptualized, developed and improved as part of two service design research projects, undertaken in collaboration with service providers from healthcare and media industries. These projects provided rich settings for MINDS development and validation, as they involved multidisciplinary teams engaged in a full-fledged service design effort, since initial customer analysis to functional prototyping, or deployment, of new services. The scope of both projects required experts in service marketing, service design, interaction design, software architecture and software engineering to collaborate and share knowledge. Both projects took place in service industries with intensive technology-infusion and aimed at create innovative multi-

interface services. MINDS framework enabled the design team to deal with the multidisciplinary and technology-enabled nature of these projects. Also, these applications of MINDS in two different service industries, media and healthcare, bode well for the framework applicability in other service settings.

4.1. Designing a new service for watching football

MINDS was first applied in a three-year project involving the design of new and improved services for a multimedia group that provides cable TV, internet, mobile phone, landline phone and other associated services. The heavy technology-infusion of such industry, associated with a broad multidisciplinary research team with competences in service marketing, service design, interaction design and software engineering, provided a fertile ground for the initial development of the MINDS framework. Faced with the need to deal with multiple service interfaces, systematize the design process and facilitate communication within the design team and with other stakeholders, this team started to integrate different field-specific knowledge in a common framework that became MINDS.

Following a service design approach, the project started with an exploration phase involving a qualitative study with 17 in-depth interviews with residential customers. This initial study enabled an in-depth understanding of the customer experience and enabled the identification of opportunities for developing new services. Through the application of Customer Experience Modeling (Teixeira et al., 2012) customer experience data was systematized along the three levels of service design so that it could support each design decision through the design process. Building upon this outcome several service concepts were discussed and prioritized with the service design team and the company. At this point, the design team and the media company decided to pursue a service concept dedicated to improve the experience of watching football (soccer). This

prompted a return to the field for further data collection. A second qualitative study with contextual inquiry (Beyer and Holtzblatt, 1997) and observation (Adler and Adler, 1994) collected data on customer experience related with watching football.

Based on the outputs of the customer experience study the team was able to apply MINDS. First, they integrated customer value constellation and affinity diagrams and brainstormed the new service concept: a multi-interface service with social, informative and interactive features for watching football. Then, the resulting concept was reflected in the design of the service system through a storyboard combined with the service system navigation. Since these models not only structured the service process, but also showcased the look and feel of the service experience, they were shown to the company for initial validation. Incorporating feedback from the company, namely concerning technology infrastructure capabilities and broadcast rights, the team adjusted the models and designed each service encounter with service experience blueprints and interaction sketches. Again, these low-fidelity prototypes were discussed and validated with the company. Finally, the team delivered a fully functional, cross-platform and multi-device prototype that was subjected to two rounds of user testing for further improvement. The MINDS framework was instrumental in this process, helping service designers to deal with the heavy technology infusion, systematizing and documenting the design process, and acting as a shared communication tool for the several experts involved.

4.1.1. Football watching service concept

Figure 3 shows the augmented model for the design of the service concept. The customer value constellation (Patrício et al., 2011) depicts the services that support the activity "Viewing soccer", and was based on the results of the qualitative study with customers and football fans. It encompasses different media providers, such as pay-per-view and regular cable TV channels, other information sources like newspapers and

social platforms, like social networks or email. The customer experience study showed that football fans were very social and shared the various match occurrences through their chosen social networks. They also tried to watch matches accompanied whenever possible. They searched information both previous to the match, and during the match, from various sources and about team, league and player statistics. Finally, busy work and family schedules sometimes interfered with watching the match, as such fans would lose important match moments, or the entire match.

This portrait set the groundwork for a brainstorming where an affinity diagram was built and superimposed over the relevant football related services. Thus, the new service concept emerged with three main components: (1) information related with teams and tournaments, (2) social networking capabilities including videoconferencing, and (3) interactive in-match features, with multiple device support, dynamic timeline and commenting features. This improved representation supported service designers in exploring and organizing the new service features, while working in close connection with the different value propositions. This way they were able to prioritize between concepts and features, selecting those aspects of the constellation that added more value to both the service provider and its customers.

4.1.2. Football watching service system

With the service concept defined, the design team was capable of developing the service system that would operationalize it. This level initially employed a service system architecture (Patrício et al., 2011) where it was decided which activity would be supported in each device. Later, a scenario (Carroll, 2000) was drawn to illustrate the most representative use cases (Booch et al., 1999; Constantine and Lockwood, 2001) in a coherent customer journey, and represented through a service system navigation (Patrício et al., 2011) and a storyboard (Greenberg et al., 2012; Segelström and Holmlid,

2011; Truong et al., 2006). In Figure 4, we illustrate a customer journey where the customer is alternating between two service interfaces, the set-top box and the smartphone (each line at the frontstage represents a service interface) to access social features and watch the football match with enhanced features (the customer activities are represented in the columns). The tasks colored in lighter gray are performed by the customer at the selected service interface, as part of his customer journey. Tasks colored in darker gray are alternatives in other service interfaces that are not actually performed in the portrayed customer journey. The storyboard on the top provides a richer visual description of the customer journey, adding the relevant contextual elements and background information. At this level, a new interaction situation was uncovered through the application of MINDS framework. When used in close physical proximity (sharing the same network), both a tablet and a smartphone could interact with the set-top box and between themselves, leveraging each other's strengths to enable a better customer experience. These service interfaces were initially prepared to function separately, supporting the activities that the design team thought were the most convenient for each device capability (and illustrated in the service system architecture and storyboard). However, when combined and used concurrently the interaction with these interfaces could change, adapting to their context (close physical proximity) and merging into a seamless interaction experience. For example, the smartphone or tablet could act as a keyboard when connected to the set-top box, thus substituting the very cumbersome remote control. Using the MINDS framework representation with a combined service system navigation and storyboard, the design team uncovered this new opportunity to enhance the customer experience through innovative context-specific service interfaces (Teixeira et al., 2013), also devising a suitable customer journey that coherently took advantage of it.

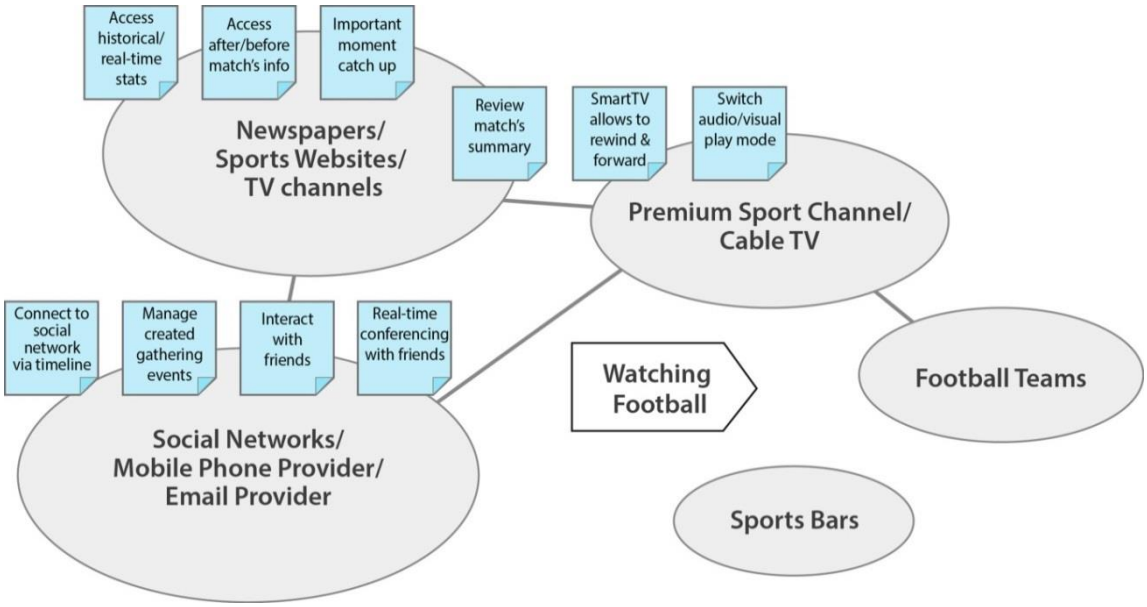

Figure 3 - Football watching service concept with Customer Value Constellation and Affinity Diagram.

Overall, this MINDS enhanced model gave a birds-eye view over the designed service, illustrating the available interfaces and how they fit together in a coherent customer journey. By drawing a storyboard the design team illustrated the intended service provision, strengthening the common understanding of the service concept among the team, and with other stakeholders. By emphasizing the visual aspect, service designers are able to better immerse themselves in the desired customer journey, thus spotting potential problems or opportunities based on the richer context information, and improving the detection of inconsistencies between service encounters and devices.

4.1.3. Football watching service encounter

In the final step of this design process, each potential service encounter for each device was detailed with an extended service experience blueprint (Patrício et al., 2008). In this project, this phase proceeded in three week cycles. On the first week the service designer would present an initial service blueprint for team discussion and validation. Then, in the next week, the interaction designer would present the initial sketches for

the interfaces that corresponded to the blueprint, and the team would also validate it. Finally, in the third week, the software engineering team would present an initial implementation of the interface and functionality behind it.

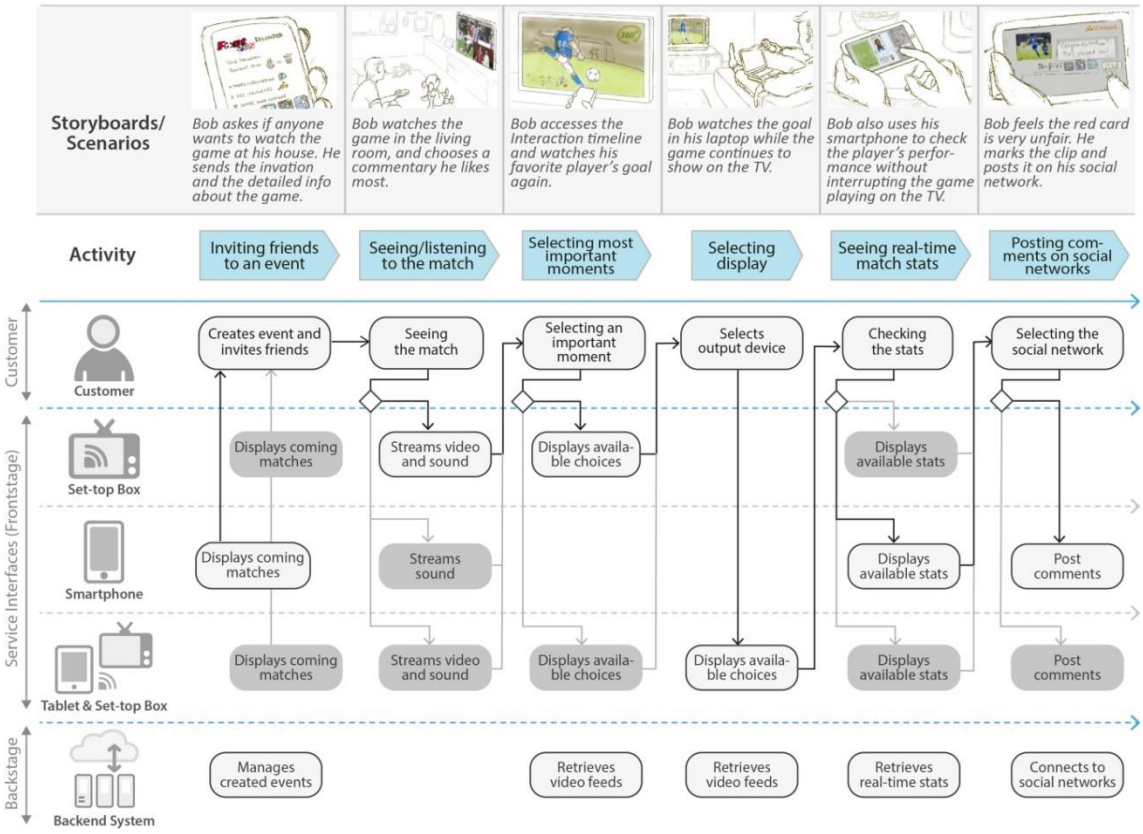

Figure 4 – Football watching service system with Service System Navigation and Storyboarding.

Contributions from the service and interaction designer were merged in an extended service experience blueprint, with interaction sketches that not only detailed the service delivery process, but also the visual aspect of the service interface. Figure 5 shows one of such service experience blueprints depicting the activity "Seeing and selecting match most important moments". While the interaction process is schematically described through the service experience blueprint (bottom half of the model), the interaction sketch details the layouts and possibilities of interaction with the service interface. With these representations not only the service delivery process is portrayed, but the intended technological interfaces are also sketched and synchronized with each step of the

blueprint, providing an early-on preview of the envisioned service encounter. The integration of service delivery process information with the unfolding interfaces also provides a significant advantage for the software engineering team, as they can begin development with a significant rendition of the system look and functionality. Thus, this MINDS model enabled a coherent vision of the new service system and the service experience within the team and effectively improved communication and accelerated the development, enabling the three week cycle described earlier.

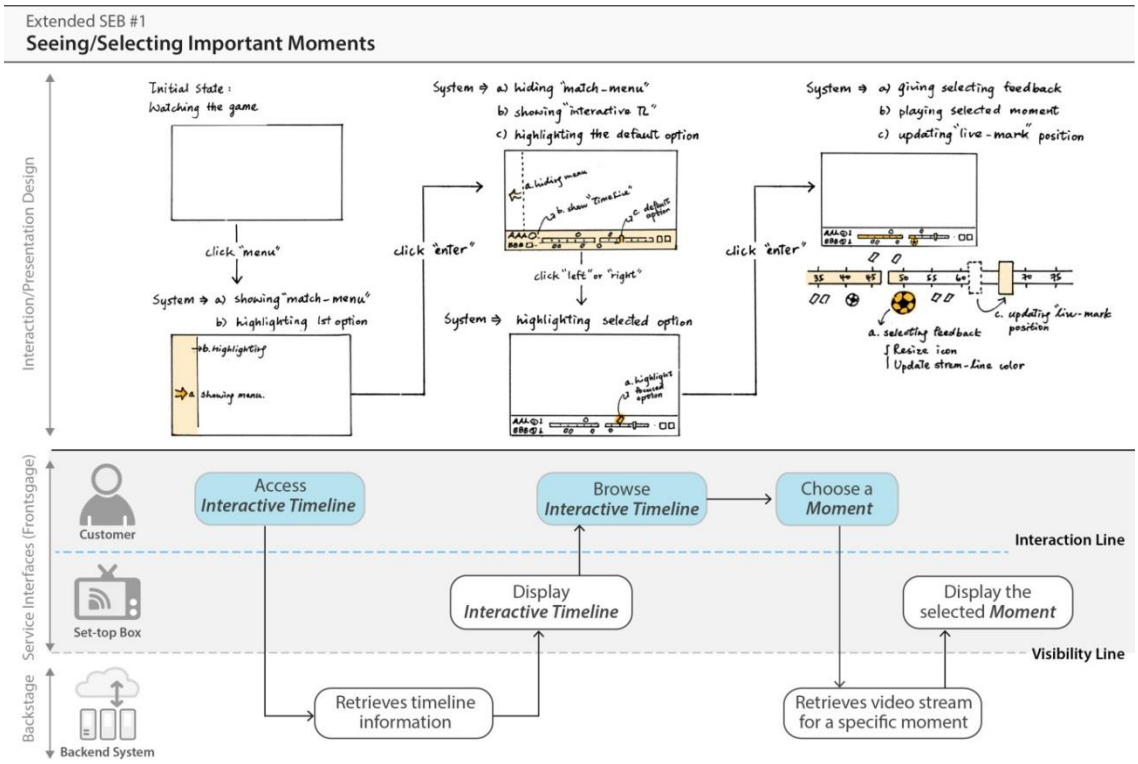

Figure 5 - Service experience blueprinting and interaction sketches for the activity "Seeing/selecting important moments".

The end-result of this effort was a fully functional prototype available in three different devices (set-top box, smartphone and tabled) and two different platforms (Google TV and IOS). The prototype received very positive feedback from the client company and was successfully tested in their infrastructure. Figure 6 shows screen captures of this prototype, namely the menu for selecting matches (left), and the interactive timeline

function in the match view (right). Further developments on the deployment of this prototype were not shared with the research team due to confidentiality issues.

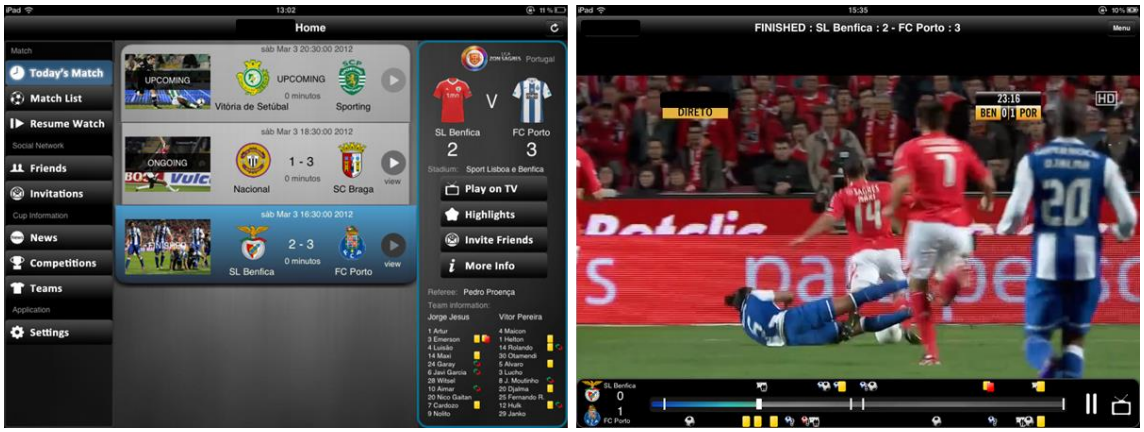

Figure 6- Screen captures of the working prototype of the new football watching service.

4.2. Designing a service to support skin cancer patients

The second research project focused on supporting skin cancer patients in their follow-up routines, while facilitating the process of sharing medical information with dermatologists. This research project had three partners: a research institution in charge of the initial customer experience analysis and the service design project, another research institution in charge of setting up the technological infrastructures and developing the systems, and a software house that developed the service and integrated it in its portfolio. In this project the service design team had a broader set of stakeholders (partner company, partner research institution, patients, dermatologists and primary care physicians) with whom communication was essential. MINDS models were used to involve stakeholders, share findings and validate concepts along the design process.

This project started with a preliminary identification of key stakeholders, followed by 8 in-depth interviews with dermatologists in a private practice, a general hospital and a cancer hospital. These interviews were complemented with 12 in-depth interviews with

skin cancer patients, and patients at a screening facility, prior to any diagnosis. Results showed that there was significant information missing for initial triage, and that patients diagnosed with skin cancer needed to constantly survey their moles for any suspicious changes. Changes in dangerous moles can indicate cancer development and cause death in a few months. These patients need to have regular check-ups with dermatologists and follow-up on their moles in the meantime, to ensure that any mutation is rapidly spotted. Our service design effort was focused on improving this routine and also ensuring that the dermatologists remained constantly updated on their patient's status. With the support of MINDS a smartphone application for patients was developed, enabling them to take more accurate pictures and manage historical records of their moles, while making them available for their dermatologists through a web portal. These pictures could also be shared with other physicians through the country's national electronic health record. Reminders and notifications were also implemented. To improve initial triage, a smartphone application was also developed for general practitioners. With this application general practitioners were able to improve their reports with images and send them to dermatologists for further diagnosing.

4.2.1. Supporting skin cancer patients service concept

To design the service concept we began by building the customer value constellation based on the customer study with skin cancer patients and dermatologists. As seen in Figure 7, the customer value constellation encompasses both primary and specialized care, and public and private care, as well as support services like non-governmental organizations (NGO's) that provide free cancer screening, or hardware and software manufacturers. Customer experience study showed that fast and accurate diagnosis was the main requirement for both patients and dermatologists, followed by a convenient and timely access to specialized care. As such, brainstormed ideas shown in the affinity

diagram were focused on: facilitating information exchange to speed-up triage from primary care to specialized care treatment; improving patient self-made check-ups to detect any early signs of cancer; and facilitating relevant information exchange within the national health service through the electronic health record.

With the combined use of the customer value constellation and affinity diagram the design team was able to position the new service concept not only for public health services, but also for private health services, as they share similar characteristics and many patients use them complementarily. The study showed that there were no procedures in place to safely share clinical data with NGO's and, as such, the design team decided not to extend the service to these organizations.

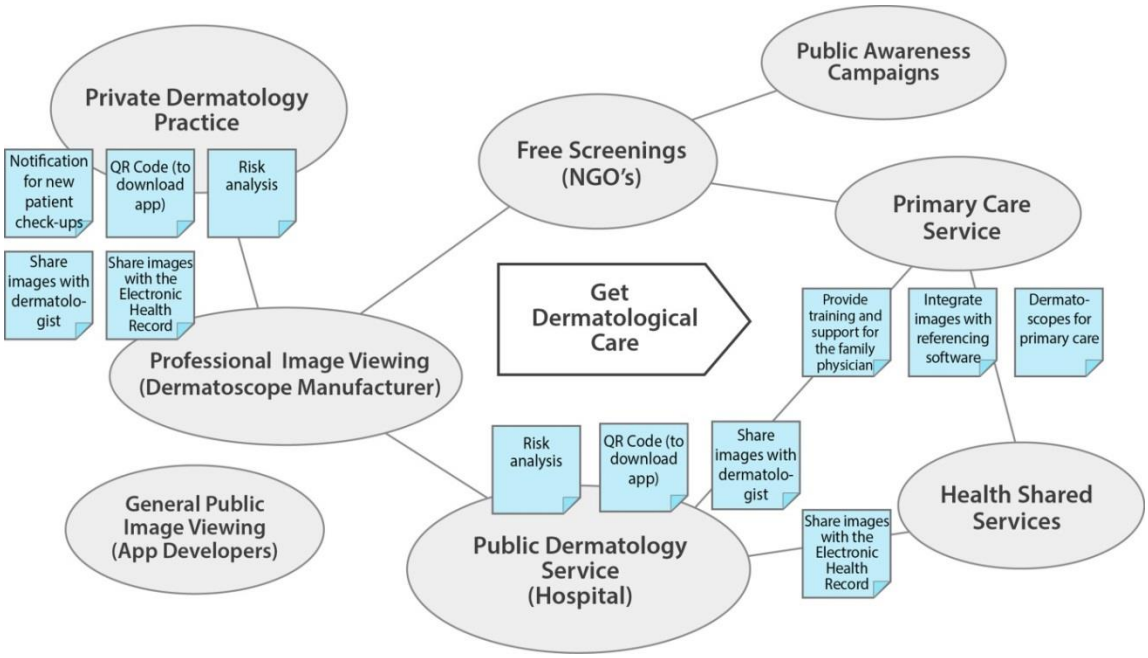

Figure 7 - Skin cancer service concept with customer value constellation and affinity diagram.

4.2.2. Supporting skin cancer patients service system

Having defined the service concept in the previous level, the service system was designed with MINDS integration of the service system navigation and storyboards. In Figure 8, we present one example where we depict a customer journey for a patient that

needs to follow-up his moles evolution. This is the case when a patient has suspicious moles that do not require immediate intervention, but need to be monitored for any abnormal development. According to the customer experience study, it is of vital importance that such developments are quickly reported to a dermatologist to reassess the diagnosis. As such, in Figure 8, our customer journey follows patients since first spotting the mole and consulting a dermatologist, until they start monitoring their moles regularly and sharing their pictures with this specialist, through the electronic health record. This model, integrating a service system navigation and a storyboard, helped the design team reason about the multiple service interfaces, including the interchange and complementarity between the smartphone app and the web portal. MINDS models also enabled the application of graceful degradation (Florins and Vanderdonckt, 2004) of the interface, i.e. ensuring the continuity and consistency of the design throughout multiple platforms with different capabilities. Taking advantage of the visual richness of the storyboard, this model was used as a communication tool, not only among the design team, but with a broader set of stakeholders, including dermatologists and patients. Used in this project workshops, the storyboard depicted the main idea behind the service concept and sparked the discussion between stakeholders. The design team would then adapt the service system navigation according to the inputs from the stakeholders.

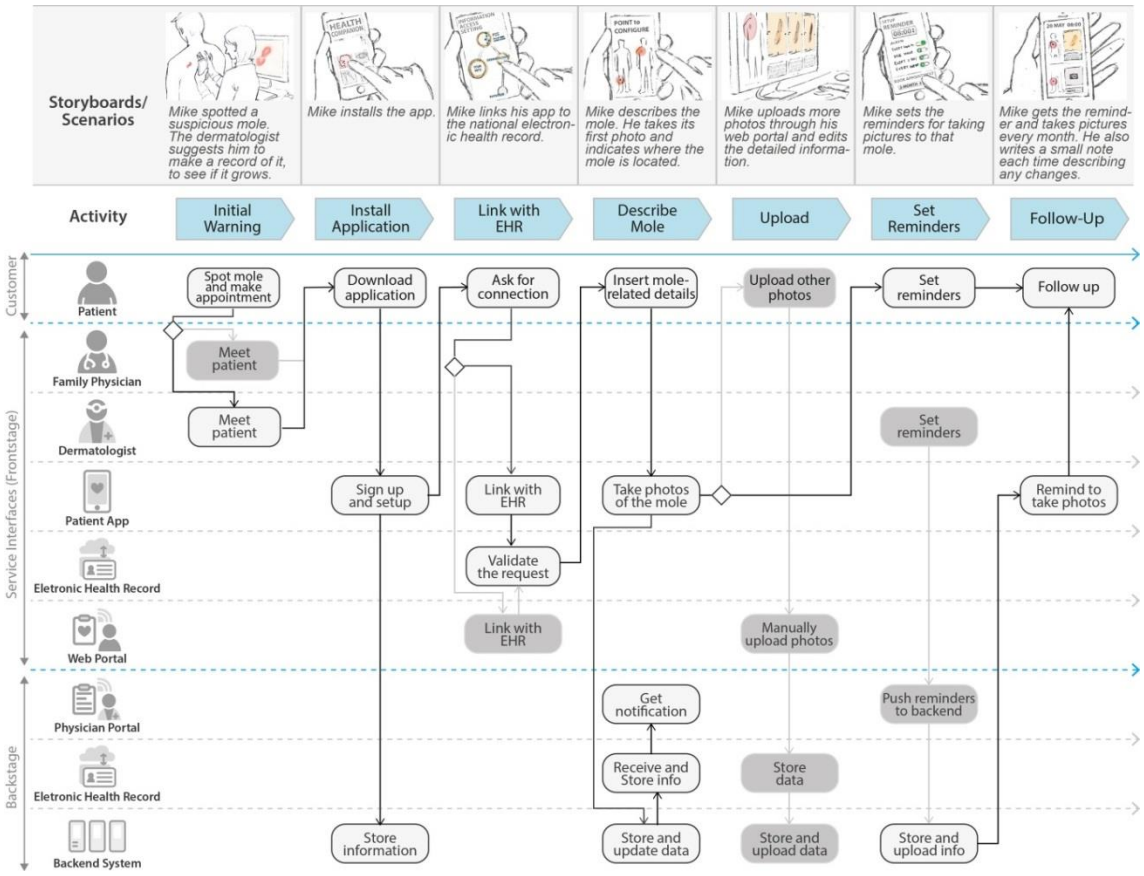

Figure 8 - Skin cancer service system with service system navigation and storyboarding.

4.2.3. Supporting skin cancer patients service encounter

Having defined and discussed the service system, the design team was able to detail each service encounter. Figure 9 portrays the service experience blueprint and interaction sketch for a specific service encounter, the description of a new mole in the smartphone application. This model not only specifies the service delivery process for the specific encounter, but also details the interaction flow and the visual aspect of the technology-enabled service interface. This includes not only wireframes of the interface, but observations regarding possible ways to interact with it. In the specific case shown in Figure 9, we defined a process that is easy to accomplish for any smartphone user, with images describing the intended actions and helpful hints. It includes some basic metadata that was found to be useful during customer experience studies. This MINDS model acted as an initial low-fidelity prototype and was used to discuss process and

interaction issues, to communicate with software engineers and do some initial user testing.

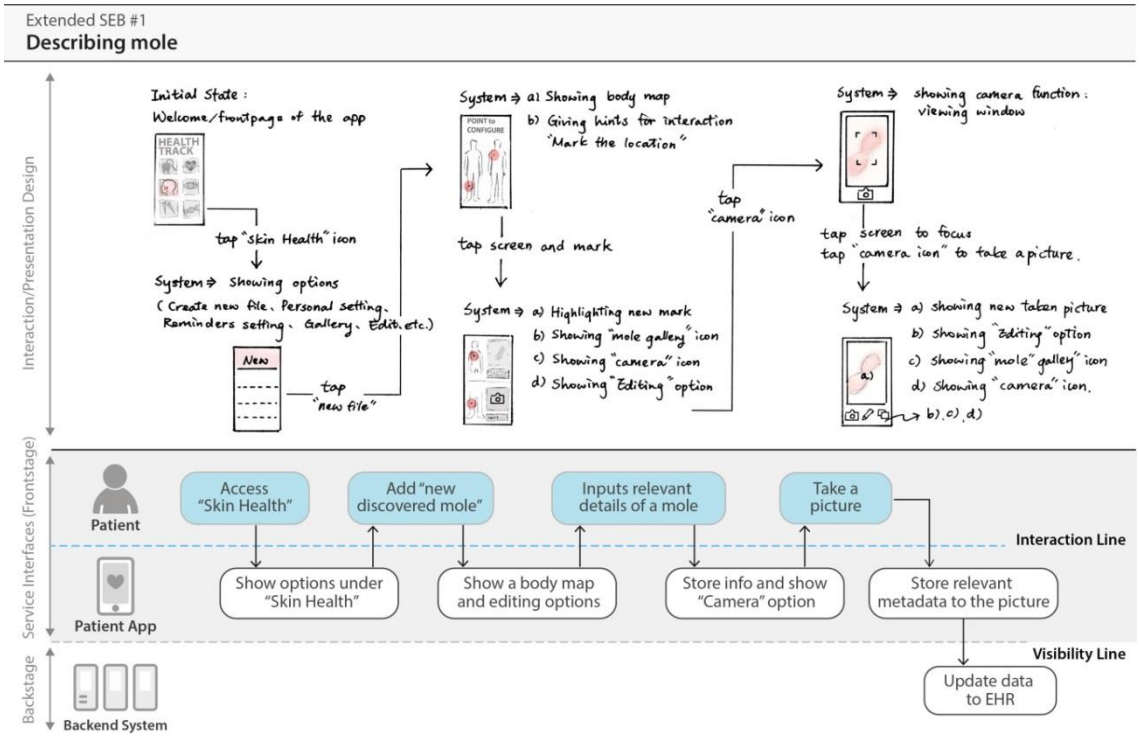

Figure 9 -- Service experience blueprint and interaction sketch for the activity "Describing a mole".

In this project, several technological components of the service were developed by the teams of the two other organizations also involved in the research project. In this context, the application of the MINDS framework was especially relevant as a communication tool. The MINDS framework supported a total of six workshops hosted at each phase of the design process, involving service designers, interaction designers, software engineers, patients and dermatologists. MINDS framework acted as a multidisciplinary and cross-organization communication tool, energizing idea sharing and ensuring that all the stakeholders had a common vision about the service.

Following the MINDs supported service design process, a functional prototype of this service was developed by one of the project's partner organizations. Screen captures of this prototype are shown in Figure 10.

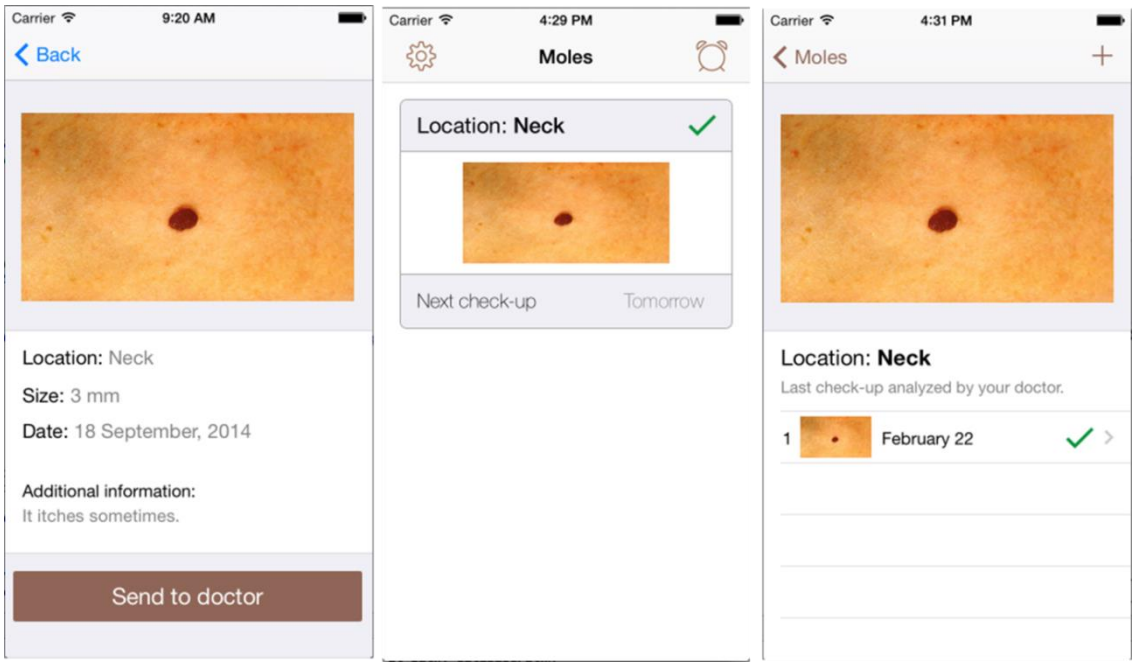

Figure 10 - Screen captures of the working prototype of the service to support skin cancer patients.

5. MINDS CONTRIBUTIONS FOR SERVICE DESIGN

MINDS addresses two challenges faced by service designers. First, it helps designing technology-enabled services that are increasingly complex and frequently lead to poor integration between service interfaces and broken customer experiences. Second, it integrates service design models that deal with technology (interaction perspective) with models that deal with value creation and service delivery process (management perspective), therefore overcoming communication problems within design teams, design process misalignments, lack of synergies and undesired outcomes.

MINDS adds to current research on service design models (Alves and Nunes, 2013; Diana et al., 2009; Miettinen, 2009; Segelström and Holmlid, 2009, 2011; Stickdorn et al., 2011) and answers to research priorities (Ostrom et al., 2010) by conceptualizing and integrating two perspectives: (1) the interaction perspective, grounded in interaction design; and (2) the management perspective grounded in service marketing, operations management and strategic management. This conceptualization helps service designers

with different backgrounds to position their perspectives and models, thus taking advantage of their complementarities. Through the MINDS framework, elements of the service design team with management and interaction design backgrounds can work on their reference models, taking advantage of their specific strengths, but can also better understand how the different models and design decisions are interconnected (e.g. service system navigation and storyboards). MINDS also empowers service designers in dealing with service technology-infusion. It provides the models needed to orchestrate multiple service interfaces along complex customer journeys, and actually design these interfaces in close connection with the service delivery process and business value proposition.

MINDS acknowledges and embraces the interdependence of interaction and management perspectives, providing a practical integration with a set of models that leverage their complementarities: management models provide the business orientation, structure and systematization, while interaction models enable a technology orientation and an aesthetic and creative view of the service being created. To link strategic decisions to operational ones MINDS follows MSD's three levels of service design: service concept, service system and service encounter. In each level it combines models from both perspectives. At the service concept level, it employs customer value constellation to explore new forms of value co-creation and affinity diagrams to brainstorm and detail new service ideas. With this integrated model the design team can detail the value offering in a creative and structured way. Also, service designers coming from an interaction design background are called to participate in this strategic decision making level, a role usually assumed by management-oriented experts.

At the service system level, this framework integrates contributions from service system navigation, customer journeys, scenarios and storyboards. This way MINDS' model not

only handles the complexity of designing for multiple technology-enabled service interfaces, but also provides a visual depiction of the new service delivery process. It also enables a tighter connection between frontstage design and backstage operations, giving both management and interaction oriented designers a clearer view over the interdependence of their decisions.

Finally, at the service encounter level, MINDS brings together service experience blueprints and interaction sketches, thus providing early low-fidelity prototypes that are linked with the service provision process. This model ensures that technology-enabled interfaces follow appropriate interaction design guidelines and fit backstage operations and system architecture. Due to its stronger visual elements it is also able to support and improve communication with stakeholders.

Overall, MINDS interdisciplinary models provide a shared service design process, support synergies in service design teams and reduce misalignments between perspectives. With such efforts service design can evolve from its multidisciplinary background, where each expert contributes with his own perspective, to an interdisciplinary discipline, where different approaches are integrated in a single effort (Jessup, 2007).

6. CONCLUSION

As services become increasingly technology-enabled, service designers are reaching out to other fields to address the additional complexity and challenges brought by technology. In this effort, service design has developed an interaction perspective, strongly influenced by interaction design, a field devoted to the design of interactive devices. Another service design perspective is more managerial, dealing with the intricacies of strategic management, service operations and marketing. Despite the strong interdependence between these perspectives, they are frequently pursued

separately, with their own experts and models. This lack of communication leads to undesired impacts between design decisions, duplication of efforts, and missed synergies along the design process.

Leveraging the strong collaboration within a multidisciplinary research team with competences in service marketing, service design, interaction design and software engineering, we built the Management and INteraction Design for Services (MINDS) framework. MINDS is a set of interdisciplinary service design models that combines management and interaction perspectives to support the design of technology-enabled services. These combined models merge management-oriented models (customer value constellation, service system architecture, service system navigation, and service experience blueprinting) with interaction-oriented models (affinity diagrams, scenarios, storyboards and interaction sketches).

The application of the MINDS framework to two service design research projects showed that our approach: guides service designers through the rich maze of models and techniques, from distinct perspectives, and through the different service design levels; supports the design of multiple technology-infused service interfaces, portraying their interactions and contributing for a coherent customer experience; establishes a common ground for communication and a shared view between service design team elements; and supports stakeholder involvement through rapid and low-fidelity prototyping.

The MINDS framework represents an effort towards the evolution of service design as an interdisciplinary field, through integration of management and interaction design perspectives. However, further research in other service industries and contexts can strengthen the framework identifying potential improvements such as the conceptualization of additional perspectives (e.g. IT architecture, software engineering)

and the integration of other models either by substituting, adapting or extending the current proposal. For example, while MINDS focus was to integrate management and interaction design perspectives, it provides contact points with software development through the service encounter level. An expansion of these models towards software engineering could facilitate the deployment of designed services, namely by using use cases or other well established models, such as UML's (Booch et al., 1999). Also, new challenges posed by technology, such as the emergence and dissemination of the Internet of Things and context-aware systems, can stimulate further improvements and adaptations. Context-aware systems are able to read, interpret and adapt their operation without human intervention, in order to provide the most appropriate service and the best experience for each situation (Baldauf et al., 2007; Hong et al., 2009; Schilit and Theimer, 1994; Vanderdonckt et al., 2008). Context-aware service interfaces, or dynamic service interfaces (Teixeira et al., 2013), will require appropriate models that can manage their self-adapting abilities.

While future work can improve the applicability of the MINDS framework, its current structure bridges management and interaction perspectives, providing models that are structured, systematized, visually rich, and able to deal with technology-infusion in services.

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6. Paper III: A model-based service design method

DESIGNING SERVICES WITH MODEL-BASED METHODS

Abstract

Services have risen to a prominent position within the world's developed economies. Still, service innovation processes have been deemed unsophisticated and haphazard and the design of new services is less understood than product design. This can be explained by the fact that service design is a multidisciplinary and holistic field that deals with complex, ill-structured and ill-defined problems. Service design models come from different fields, cover specific problems and are not integrated. Service design methods do not cover the full-length of the design process, instead specializing in distinct aspects, or steps of this process. This lack of a systematized connection between models and methods can make the service design process ad-hoc, as designers are left with little guidance.

To bridge the gaps between distinct methods and tools we developed an end-to-end model-based method that links several contributions and goes from qualitative customer experience data collection to low-fidelity service prototyping. This model-based method also supports the creative leap between understanding the customer experience and designing new service solutions. Concretely, it establishes the connection between Customer Experience Modeling (CEM) that systematizes customer experience information and MINDS framework that provides the set of models for service design.

To assess the feasibility and usefulness of this method, we present two applications in different service industries; media and healthcare. We applied the model-based method in these projects to link, step-by-step, customer experience information and the design of the

new services, across the three levels of service design: service concept, service system and service encounter. While the models from CEM and MINDS broke down the complexity of designing services and enhanced the communication among the design teams and other stakeholders, the integration between the two ensured that the designed service supported the desired customer experience.

1. Introduction

The importance of services in the economy is undisputable. Even traditional manufacturing companies became "service infused", as they learned to differentiate from their competition by providing services along with their products (Edvardsson et al. 2000). However, despite the economic significance of services and the constant strive for innovation no matter the activity sector, the design of services is still "not a well-established practice and the processes, tools, and inputs needed for effective service design are not fully developed" (Ostrom et al. 2010). In fact, service design is much less understood than product design (Norman 2011). Service innovation processes are frequently unsophisticated or haphazard (Zomerdijk and Voss 2011) and service providers are much less likely to employ designers than manufacturing firms (Tether 2008).

The fact that designing services is such a complex task (Norman 2011) can explain why it is not well understood. Service design, the field dedicated to bring innovative service ideas to life (Ostrom et al. 2010) involves a deep understanding of people, context, service provider, market strategies, and social practices (Evenson 2008). It deals with what Rittel and Webber (1973) named wicked problems; ill-structured and ill-defined problems that have no optimal solution, but a satisficing one (Simon 1996).

Dealing with such complexity requires multidisciplinary teams whose members expertise can tackle the different and changing problem dimensions (Van Bruggen and Kirschner 2003).

For that matter, service design acts as a hub that brings together expertise from different fields such as strategic management, marketing, operations management, interaction design and software engineering, to design service offerings that enable customers to co-create valuable experience (Moritz 2005; Patrício and Fisk 2013). However, while there is a wealth of methods and tools that come from these different fields, they cover limited aspects, or specific steps of the design process, and are not integrated in an end-to-end, well-defined service design process. Specifically, there is the need to document and visualize the creative transition from understanding the customer experience to defining the service solution (Patrício and Fisk 2013). The lack of comprehensive methods that organize and coordinate the usage of tools at the right steps of the design process can explain why service innovation processes have been considered unsophisticated or haphazard.

To address the challenges posed by service design complexity and multidisciplinarity and offer an end-to-end method that bridges the gap between customer experience and the design of new services, we propose a model-based method that systematizes the design process, since data collection to low-fidelity prototyping. To do this we use models as buildings blocks. Models are abstractions, or simplifications of reality (Booch et al. 1999) that use. They can deal with complex and wicked problems in a setting with multidisciplinary stakeholders (Van Bruggen and Kirschner 2003). Models help to visualize and guide the development of complex systems and document decisions (Booch et al. 1999). Thus, they enable the traceability of design decisions across the multiple service design levels (Patrício et al. 2011) and bridge the creative transition between customer experience and service design.

To do this the proposed model-based method builds upon several contributions: Analysis-Synthesis Bridge Model (Dubberly et al. 2008) adapted to service design (Patrício and Fisk 2013) and Multilevel Service Design (Patrício et al. 2011) provide the method overall

structure; and Customer Experience Modeling (Teixeira, Patrício, Nunes, et al. 2012) and MINDS framework (Teixeira et al. 2014) provide the models that were integrated in the method. We present two applications, in distinct service industries, media and healthcare, to demonstrate the feasibility and effectiveness of the models and methods (March and Smith 1995).

In the next section we detail how models are useful to deal with complex and wicked problems, such as those faced by service designers. Afterwards, we present the conceptual underpinnings of this model-based service design method, followed by a step by step description of the method and its application in the two service design projects. Finally, we explore our contributions and conclude, addressing future research opportunities.

2. Why Models?

Simon (1996, 132) in his paramount book "The Science of the Artificial", considered that a "deeper understanding of how representations are created and how they contribute to the solution of problems will become an essential component in the future theory of design". As most of the times it is not possible, or too expensive, for designers to work directly on the real world, design has resorted to models as representations of this world (Goel and Pirolli 1992). Models aid problem and solution understanding (Hevner et al. 2004). Models deal with complexity by eliminating irrelevant details, thus synthesizing the relevant knowledge, and making missing information explicit, and representing implicit information explicitly (Cox 1999). They clarify design issues and highlight tradeoffs, speeding decisions and development (Constantine 1998).

Also, models have been found capable to enhance interdisciplinary communication (Brna et al. 2001; Van Bruggen and Kirschner 2003; Hevner et al. 2004; Larkin and Simon 1987; Ludolph 1998; Simon 1996), guaranteeing that the understandability and specificity of the constructs, or notation, and the level of abstractions is adapted to the audience expertise (Van

Bruggen and Kirschner 2003; Cox 1999; Scaife and Rogers 1996). This is especially relevant for a multidisciplinary field such as service design, where experts from different fields have their own vocabulary and way of approaching problems, thus making it difficult to share their knowledge and achieve a common ground of understanding.

Finally, models document decisions (Booch et al. 1999), and documentation and visualization is vital to support the creative transition between understanding the customer experience and designing new services (Patrício and Fisk 2013). Due to their characteristics, models have been considered crucial to successful service design (Holmlid and Evenson 2008), and a priority to enhance service innovation (Ostrom et al. 2010).

As such, a method based on models is suited to deal with service design complexity and multidisciplinarity. It also enables the systematization and documentation of design decisions, supporting their traceability across the service design process, from multiple service design levels and between research results and the design of new services. In the next section we present the relevant literature on customer experience and service design models, and introduce the conceptual underpinnings of our model-based service design method.

3. Conceptual underpinnings

As detailed in the previous section, models can deal with service design complexity and multidisciplinarity. Still, current models have not been integrated in methods that cover the entire design process. Instead, they are focused on understanding the current situation, or the problem space, or in the devising of new solutions, or on the solution space. In service design, we address the problem space with models and methods to understand the customer experience and we address the solution space with models and methods to design new services. In this section we detail the relevant literature regarding these two phases and, in the next section, we show how we integrated them into an end-to-end model-based method.

3.1. Understanding the Customer Experience

Customer experience has been defined as "the internal and subjective response customers have to any direct or indirect contact with a company" (Meyer and Schwager 2007). Research has emphasized the need to broaden the concept of customer experience and adopt a holistic perspective that extends through all interactions between customers and service providers (Berry et al. 2002; Meyer and Schwager 2007), encompassing different customer internal responses (Gentile et al. 2007; Verhoef et al. 2009), and also including "the small details that make a big difference" (Bolton et al. 2014). Further developments also advocate looking to the network of service providers that contribute to a customer experience (Tax et al. 2013). However, this research on customer experience is focused on conceptualizing and describing it. To actually model it we need first to look to other fields that dedicated significant efforts to systematize the relation.

UML hails from software engineering and provided the use cases (Booch et al. 1999), a model that captures the goals and sets of action of someone who is using an information system. Use cases started to model people and their context (through the goals), but their focus is on information systems, not on services, thus failing to recognize the holistic perspective of customer experience. Contextual Design's work models (Beyer and Holtzblatt 1997; Holtzblatt et al. 2004) are customer focused and greatly expand the depth of information captured. Still, they are dedicated to the development of IT systems making them constrained by their usage and not take into account the full range of potential contacts, or the customer journey, between a customer and a service provider. Human Activity Modeling (Constantine 2009) partially solves this issue by being focused on the activities that the customer performs. Human Activity Modeling (HAM) is an activity-centric and systematic approach for capturing and representing activities and their context (Constantine, 2009). An activity-centric design does not focus on goals and preferences of individuals, but on behavior surrounding tasks (Saffer 2010). Research from both IT related fields (Constantine

2004, 2009; Kaptelinin and Nardi 2006; Kuutti 1996; Norman 2005) and management and marketing (Bettencourt 2010; Ulwick 2002) points out that a focus on the customer's activities is preferable to a focus on the customer per se. From a services viewpoint, activity theory has been suggested as a suitable approach for service design as it takes into account the wider context of action in service encounters (Sangiorgi 2009). HAM notation was already applied in service design methods such as Multilevel Service Design (Patrício et al. 2011) and Customer Experience Modeling (Teixeira et al. 2012). Still, HAM per se, still focuses on designing IT systems, lacking the adequate service mindset.

Customer Experience Modeling (CEM), on the other hand, was purposedly developed for a service setting. CEM is a modeling tool for capturing and systematizing the rich and complex elements that shape customer experience, enabling a manageable abstraction of this holistic concept and facilitating the creative transition to service design solutions (Teixeira, Patrício, Nunes, et al. 2012). CEM overcomes previous models shortcomings in relation with capturing customer experience in a service setting. It is activity-centric, meaning that the understanding of customer experience is guided by customer activities elicited through qualitative data-collection. It then considers contextual elements such as the physical artifacts, the technology-enabled systems, and the actors (persons) involved in each activity throughout the potential customer journeys. It also uses customer experience requirements (Patrício et al. 2004) to evaluate each activity and contextual element and is structured according to the three levels of service design (Patrício et al. 2011). Thus, CEM is the most adequate modeling tool to understand the customer experience in a service setting. However, being focused on customer experience, it does not include models to actually design new services. It needs to be integrated with appropriate models from the service design side to build an end-to-end model-based method.

3.2. Designing new services

Due to the multidisciplinary nature of service design, there are a significant number of models dedicated to the design of new services. In fact, Alves and Nunes (2013) extracted from the literature a list of 164 tools and methods used in service design. Segelström and Holmlid (2009) interviewed 14 service designers and identified 57 various techniques. Other authors provide listings of service design models with different lengths (Miettinen 2009; Moritz 2005). Still, this emphasizes the richness and diversity of service design, but also explains the ad-hoc and haphazard nature that design process usually suffers from in this field. In fact, these models often tackle, or portray, specific aspects of the service design process in isolation and are not integrated on a broader method.

However, some research has already provided an integration effort. Multilevel Service Design (MSD) is an interdisciplinary method for designing complex service systems Patrício et al. (2011). It structures the design of service offerings in three hierarchical levels: the service concept, the service system and the service encounter. MSD divided these levels for both customer experience and service design, considering that understanding customer experience precedes service design. While MSD already established the levels both from the customer experience and the service design process, it only developed the methods for the latter part of the process; the customer value constellation, the service system navigation and architecture and the service experience blueprint.

These were later augmented by MINDS (Management and INteraction Design for Services) framework (Teixeira et al. 2014). MINDS is an interdisciplinary framework comprising a set of combined models that provide a shared language, process and models for service designers from both management and interaction design perspectives (Teixeira et al. 2014). The MINDS framework builds upon MSD and existing design tools (Bitner et al. 2008; Carroll 2000; Curtis and Vertelney 1990; Patrício et al. 2008; Segelström 2009) to address services increasing technology infusion and bridge service design's management and interaction

design perspectives. MINDS adds a visual aspect and reinforces the creative component of management-oriented models. In doing this it establishes itself as a low-fidelity prototyping tool that materializes the service design concepts that were modeled. Its interaction design component is also a suitable connection to software engineering, thus establishing the necessary bridges with the development and implementation of the service in a real-world setting.

However, while enhancing MSD models, MINDS' models are still focused on the solution space and they lack the necessary development from the customer perspective. To build an end-to-end model-based method we need to integrate the appropriate models from the customer experience side and from the service design side, and align them to support the creative transition between these two phases. In this respect, both Customer Experience Modeling and MINDS framework are structured according to the three levels of service design set by MSD. Also, they both cover the relevant aspects to model, respectively, the customer experience and the service design phases. As such, integrating these two contributions we are able to build a model-based service design method from customer experience data collection to service prototyping. In the next section we explain how all of these contributions fit togethers and in the following section we introduce two applications of this model-based method.

4. The model-based service design method

A method defines a process (Hevner et al. 2004), or a set of steps used to perform a task (March and Smith 1995). Methods provide guidance to solve problems (Hevner et al. 2004). As we have seen, service design problems are wicked ones. They are complex, ill-defined and ill-structured and, at the same time, the methods to address them have been deemed unsophisticated and haphazard. In fact, service design models are numerous and come from different fields and they are not easily integrated in coherent methods. This makes the service

design process ad-hoc and unpredictable. To address these challenges we have integrated two contributions that were purposely developed for service design and share the same conceptual structure: Customer Experience Modeling (CEM) and the Management and INteraction Design for Services (MINDS) framework. CEM is able to systematize customer experience information, while MINDS structures and supports the design and visualization of the new service. Both follow the multilevel structure defined by Multilevel Service Design (Patrício et al. 2011), making them closely aligned and well positioned to make the creative transition between understanding the customer experience and the design of new services. In this section we detail the methodology behind the construction of this method, followed by a detailed explanation on how to apply it. In the next section we present the applications of the method in two service industries; media and healthcare.

4.1. Design Science Research

Design science strives to create models, methods, and implementations that are innovative, valuable and solve problems (Hevner et al. 2004; March and Smith 1995) and are efficient and effective designs (Lee 2007). It consists of activities concerned with the construction and evaluation of these models, methods and implementations to meet organizational needs, as well as the development of their associated theories (Cole et al. 2005). The development of the service design model-based method followed Hevner et al. (2004) and Peffers et al. (2007) guidelines to provide meaningful and rigorous design science research. Concretely we designed two different types of artifacts: a method and two applications (guideline 1). The problem is relevant both for academia and practitioners (guideline 2) as service innovation methods have been deemed haphazard and unsophisticated (Zomerdijk and Voss 2011) and there was a need to support the creative transition between understanding the customer experience and service design (Patrício and Fisk 2013). Contributions were communicated and evaluated by scholarly and practitioner audiences (guidelines 3 and 7), with workshops

and communications in research conferences (Teixeira, Patrício, Nóbrega, et al. 2012a, 2012b, 2012c). It contributed with a method that uses models to guide and systematize the design process, since initial customer experience data collection, to low-fidelity service prototyping, bridging the gap between understanding the customer experience and service design (guideline 4). Artifact construction followed rigorous data collection and analysis methods (guideline 5), through recorded semi-structured interviews that were analyzed using grounded theory canons (Charmaz 2006; Corbin and Strauss 1990) and evaluation was done by scholarly and practitioner audiences. Building upon other contributions, this model-based method is part of a continuous search and improvement cycle to provide suitable tools for service designers (guideline 6). Also related with guideline 6, small incremental improvements were made to CEM to facilitate the visualization across the three different levels. As such, now CEM is represented by a single model with the relevant contextual elements highlighted according to each level, whereas previously a different model was built for each level, containing only the information related that level and losing the rest.

4.2. Conceptual structure

The overall conceptual structure of the presented method is adapted from Dubberly et al. (2008) Analysis-Synthesis Bridge Model and its adaptation to service design (Patrício and Fisk 2013). We use the Analysis-Synthesis Bridge Model because it explicits the role of modeling in the design process (Dubberly et al. 2008). The Bridge Model is divided in two phases: analysis and synthesis. Each phase encompasses a present state, and an envisioned one, thus structuring the design process in four major steps; the present concrete situation, the abstraction of the present situation through models, followed by the abstraction of the envisioned situation also through models and finally, back to the concrete, with the prototyping and implementation of the envisioned solution. The Analysis-Synthesis Bridge Model was already adapted to service design by Patrício and Fisk (2013). These authors

named each of the steps as represented in Figure 1; understanding the customer experience, modeling the customer experience, modeling the service design solution and prototyping and implementing the service design solution. The present situation analysis and synthesis is covered by Customer Experience Modeling (Teixeira, Patrício, Nunes, et al. 2012), while MINDS framework (Teixeira et al. 2014) covers the envisioned solution analysis and synthesis. Multilevel Service Design (Patrício et al. 2011) provides the leveled structure for the synthesis or modeling steps. Figure 1 illustrates how all these contributions fit together, supporting the creative transition between customer experience and service design and obtaining a comprehensive method to design services.

In the next sub-section we detail each of these steps; the understanding of the customer experience, the creative transition towards the design of the new service and the actual design of the new service.

4.3. Understanding and modeling the customer experience

Following the Analysis- Synthesis Bridge Model adapted to service design (Patrício and Fisk 2013) we start by understanding the customer experience through qualitative data collection methods (bottom left of Figure 1) such as interviews (Foddy and Foddy 1994; Myers and Newman 2007; Pawson 1996), contextual inquiry (Beyer and Holtzblatt 1997) or non-participant observation (Adler and Adler 1994). This exploratory qualitative data collection produces rich, but unstructured data. To actually make this data actionable and shared between interdisciplinary service design team members we resort to CEM models. CEM identifies the customer activities and their surrounding context, namely the physical artifacts, persons and information systems involved. It also evaluates both customer activities and contextual elements through customer experience requirements. Grounded theory principles should be followed to allow further emergence of relevant categories or concepts (Charmaz 2006; Corbin and Strauss 1990, 2008; Glaser and Strauss 1967) as well as procedures to

ensure the validity of the collected qualitative data (Maxwell 1992; Tracy 2010). To aid in the data analysis and develop CEM's categories we use a computer-assisted qualitative data analysis software (Bringer et al. 2004; QSR 2009).

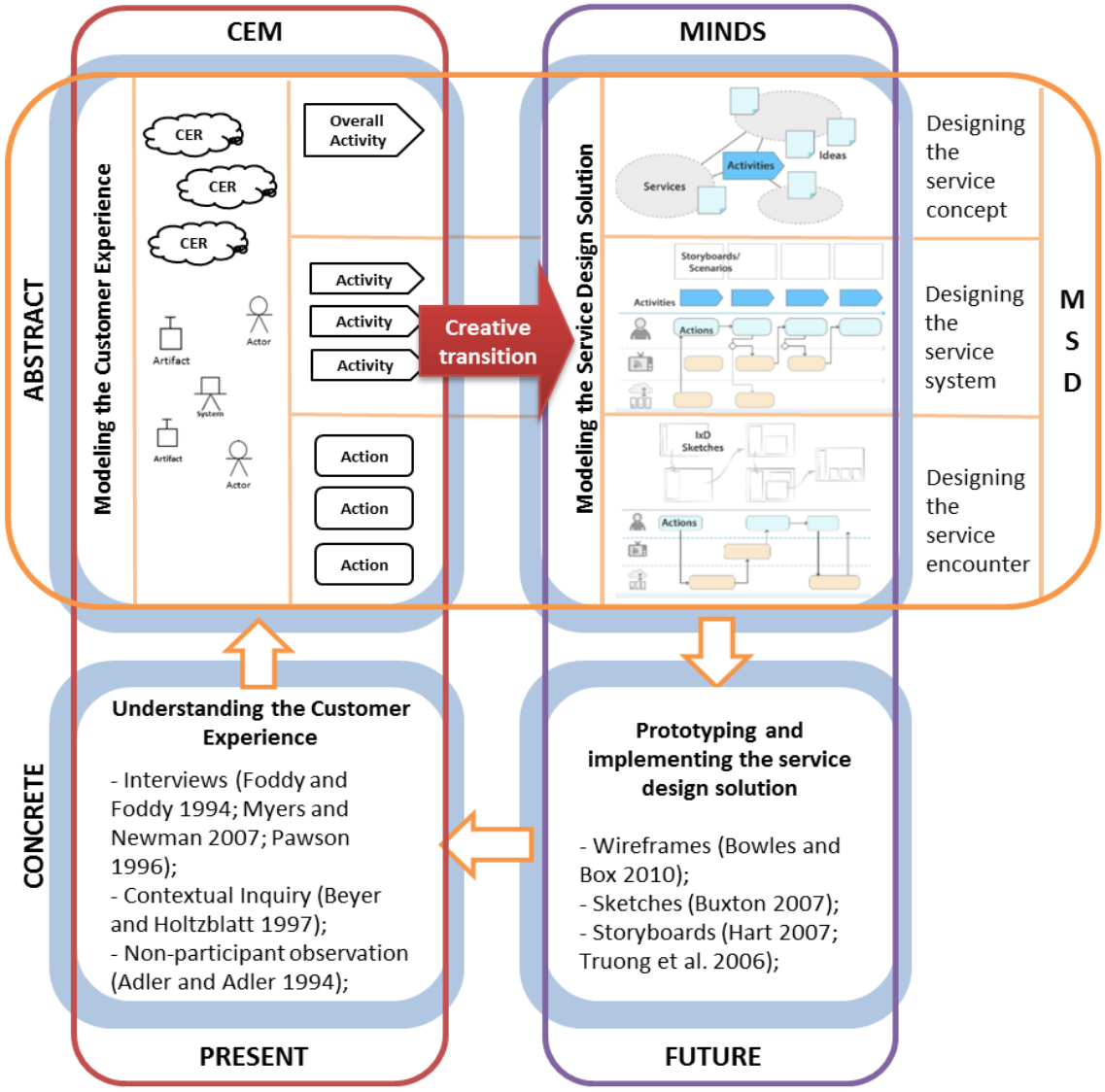

Figure 1 – Model-based service design method conceptual underpinnings.

We are then able to build CEM's models across the hierarchical levels defined by MSD (top left of Figure 1); value constellation experience, service experience and service encounter experience. The value constellation experience level is focused on the overall customer experience while performing a broad customer activity, such as buying a house, or having fun. These are activities with a wide scope, involving many smaller actions or tasks,

supported by several service providers. This overall activity is selected according to the service design project objectives and portrays all the related activities, independently of the service provider that supports them. The service experience level focuses on all the interactions between a customer and a service provider service system. This level portrays the customer experience enabled by the defined service concept. Finally, the service encounter experience level systematizes the customer experience on each single service encounter, or moment of interaction between the customer and the service provider (Bitner et al. 1990). As such, this hierarchical approach starts by analyzing the context of an activity performed by a customer regardless of the service provider, then focuses on the experience with a single service provider, and again in the experience in each of the possible service encounters with this provider.

CEM models abstract, systematize and make customer experience data manageable and shareable between interdisciplinary team members. CEM models support the creative transition towards the design of the new service throughout the design process, from designing the service concept, to the service system and each service encounter. We detail next this transition and then we present the models used for the design of the new service.

4.4. Supporting the creative transition

With CEM portraying activities and their surrounding context, as well as evaluating them with customer experience requirements, designers are able to do an informed creative transition from understanding the customer experience to defining the service solution. As such, CEM provides a set of concrete inputs for MINDS' models.

In the first level we make the transition from the value constellation experience to the design of the service concept. At this stage, through its contextual elements, CEM enables the identification of the service providers that will be represented in MINDS model. For example, if CEM shows systems like social networks, or artifacts like a specific equipment or

hardware, then we can represent the service provider responsible for those contextual elements in the MINDS model. Customer experience requirements then fuel the brainstorming activity that develops new service concepts and their features, which are also represented in MINDS.

In the second level, the transition made is between the service experience and the design of the service system. At this level CEM supports the identification of current and potential service interfaces, defined as "any place at which a company seeks to manage a relationship with a customer, whether through people, technology, or some combination of both" (Rayport and Jaworski 2004, 4). For example, if CEM shows that customers use tablets, smartphones, or laptops it indicates that the service interfaces of the new service can be apps or websites. CEM's customer experience requirements also inform the design of new customer activities that change the current customer journey to an improved one.

Finally, in the third and last level, the transition between service encounter experience to the design of the service encounter, CEM's customer experience requirements and contextual elements guide the design of the encounter process and visual aspect that is depicted by MINDS' model. For example, if CEM shows that a customer action is supported by a smartphone, then the process of service delivery and the visual aspect of the interface must condone with the relevant guidelines for that system.

Still, while the most relevant flow of information is from CEM towards MINDS, CEM model can also be updated after the design of the new service to depict the new, desired, customer experience. Further details and more concrete examples are provided in the next section when the applications of this model-based method are introduced. Meanwhile, we conclude this section by detailing models for designing new services.

4.5. Designing the new service

The next step is designing the new service offering to improve the customer experience by applying the models from MINDS framework across the three service design levels (top right of Figure 1). As such, we begin by designing the service concept with MINDS augmented model that is comprised by a Customer Value Constellation (Patrício et al. 2011) and an affinity diagram (Beyer and Holtzblatt 1997; Moritz 2005). The service concept comprises the utility and benefits provided to the customer by a firm (Edvardsson and Olsson 1996), or other service providers in the customer constellation of available offers (Patrício et al. 2011). Affinity diagram structures brainstorming outputs in homogenous categories and supports the prioritization of efforts. Customer value constellation positions the new service concept in relation to other competing or complementary service offerings that support our customer overall activity.

Having defined the new service concept in the next level we design its service system. Designing the service system is MSD's second level and involves detailing the service concept by defining a mix of service offerings, interfaces, tangible evidence, processes, people´s roles and technology (Patrício and Fisk 2013). For this level MINDS framework combines storyboards (Truong et al. 2006) to illustrate the customer journey, with service system navigation (Patrício et al. 2011) to define the frontstage and backstage process and the service interfaces that will support each activity of the customer journey. Each pairing between activity and service interface is then detailed on the third and final level, the design of the service encounter. At this level, MINDS combines interaction sketches with service experience blueprints (Patrício et al. 2008). The service experience blueprint augments the original service blueprint (Bitner et al. 2008; Shostack 1984) with the support for multi-interface services, thus depicting the process of service delivery with the flow of customer, frontstage and backstage staff actions in a specific interface. The interaction sketches provide a first low-fidelity prototyping of the visual aspect and flow of interaction with the service

interface. These interaction sketches can be refined to encompass actual wireframes (Bowles and Box 2010) thus also documenting the disposition of interface elements for software engineering development (bottom right of Figure 1). As described, each of these models is directly supported by the relevant CEM model, thus linking each design decision to the relevant customer experience information.

As described this model-based method deconstructs service design complexity by employing a set of techniques and models since data collection to low-fidelity prototyping. In this process it integrates scattered contributions and bridges the gap between understanding customer experience and designing new services. To validate the applicability and usefulness of this method we present in the next section two applications in distinct service industries.

5. Designing two services with the model-based method

Applications, or instantiations in design-science literature, demonstrate the feasibility and effectiveness of models and methods (March and Smith 1995). The development of applications cross-cuts Hevner et al. (2004) guidelines and ascertains design-science research validity. As such, we present applications developed as part of two service design projects in two different service industries: media and healthcare. Both these projects provided a rich setting for the application of this method, as they addressed complex problems brought by broad, ill-defined problems, orchestration of multiple technology-enabled service interfaces and multidisciplinary teams of service managers, interaction designers, IT architects and software engineers.

In the first project, the service design team was faced with a company trying to get a competitive edge in a very competitive market of cable TV and internet providers. We applied the model-based method to support the development of an innovative, multi-platform and multi-device service to improve the experience of watching football (soccer), the number one sport in the company's country of origin. The second project intended to support the

diagnosis and follow-up of skin cancer patients. The model-based method enabled the development of two distinct services that sped up the screening process and follow-up of suspect cases. Each of these projects is detailed next.

5.1. Improving the football watching experience

The objective of this service design project was to develop and innovative service that would provide a sustainable competitive advantage to an industry partner. This company, a leading provider of technological services such as cable TV, internet, mobile phone, landline phone and other associated services, was involved in a fiercely competitive environment and wanted to avoid the commoditization of its offering. This created a complex setting, with ill-defined requirements and multiple potential technology-enabled service interfaces. Also, the multidisciplinarity of the design team assembled compounded the complexity involved, as each expert brought valuable knowledge, but did not share any common framework to work and communicate. As such, we had several challenges. First, the customer experience was very rich and complex, involving multiple systems, technology-enabled devices, people and diverse activities. Second, the design of the new service needed to leverage this technology in a creative and coherent way, to allow an innovative and consistent customer experience. Third, and as a consequence of the latter two, the creative transition between the two steps of service design needed to be tightly aligned and connected. As is detailed ahead, the model-based method addressed successfully these challenges.

Data collection began by collecting with 17 semi-structured interviews (Myers 1997) done to residential customers with the aim of building a portrait of their overall experience concerning entertainment activities. These interviews were analyzed segment-by-segment, following grounded theory canons (Charmaz 2006; Corbin and Strauss 1990) with the computer-aided qualitative data analysis software (CAQDAS) NVIVO 8 (QSR 2009; Seale 2008). Customer experience information was systematized with CEM and presented to the

company. Using a CAQDAS along with CEM's set of constructs and model enabled the design team to support their findings, tracing each customer experience element (activity or contextual component) back to the relevant interviews, and to the audio segment if needed. Based on this initial customer experience study, the company and the design team decided for the development of a new service that would improve football (soccer) watching experience. Football is the number one sport in this company's country and was closely aligned with its marketing positioning.

With this decision taken, the service design team collected additional data through more focused structured interviews (Myers and Newman 2007) with football fans, observations (Adler and Adler 1994) of football matches and contextual inquiry (Beyer and Holtzblatt 1997) also with football fans. Contextual inquiries are interviews and observations done in the environment that we want to analyze, providing an accurate picture of the problem space. With this second data collection we achieved a better understanding of the customer experience regarding the activity of watching football. This understanding established the basis for the actual service design effort that ensued.

5.1.1. Designing the service concept for the football watching service

In this first level, we should have the broadest possible view, i.e. we should look to the customer overall activity and its related context. In this case, we have studied the customer experience with the overall activity "Watching football". As portrayed on Figure 2 (on the left), we found a complex context, filled with technology-enabled artifacts and supporting systems, such as TV, set-top box, remote controls, laptop and mobile phones. The customer experience requirements for this overall activity were the following: enthusiasm, comfort, sharing, information and viewing quality. This closely relates to the context at hand; the laptop and mobile phones are used to search for information and share opinions before, during and after the match; the match itself is a source of enthusiasm, or lack of thereof in

more boring games; the TV apparatus (including set-top box) is requested to provide viewing quality; and comfort is related to being able to watch the match at home.

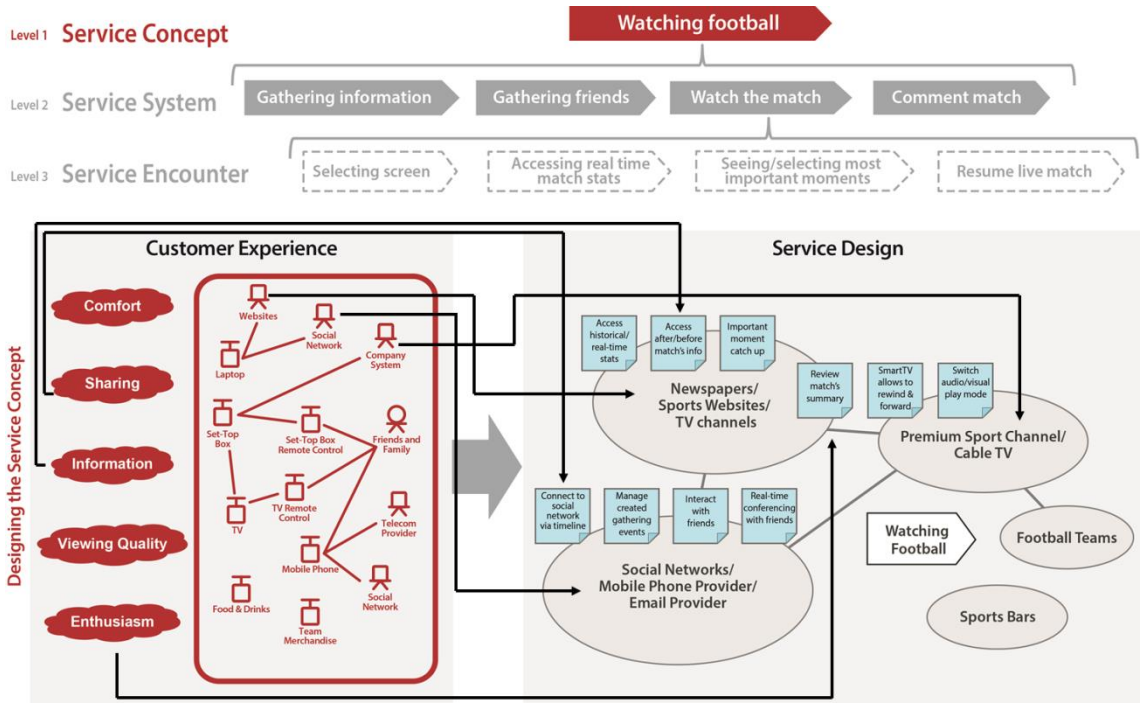

Figure 2- Designing the service concept for the "Watching football" activity.

This understanding of the customer experience supported the transition towards the design of the new service concept depicted by MINDS' model. In Figure 2 we have highlighted some of the ways in which these models are integrated. For the sake of clarity we have not drawn every connection between the models, but only the most relevant ones. For example, the systems depicted in CEM, like social networks, websites or the company system, enabled the identification of the network of existing service offerings depicted by MINDS (on the right of Figure 2). Also, customer experience requirements such as information, sharing, or enthusiasm were the basis of to brainstorm new concepts and their features. As shown, we supported sharing, information and enthusiasm by developing a service concept that integrated social networks, sports websites, and an augmented experience through the cable TV service, powered by the capabilities of the latest set-top boxes. We detail this new service in the next level, the design of the service system.

5.1.2. Designing the service system for the football watching service

At this level we detail the customer overall activity into its constituent, more detailed activities. According to our customer experience study and as shown in Figure 3, the overall activity "Watching football" includes activities such as "Gathering information", "Gathering friends", "Watch the match" and "Comment match". Each of these activities has customer experience requirements and contextual elements that are highlighted on the CEM model as seen in Figure 3, on the left. In Figure 3 we have selected "Watch the match" and we can see that "Viewing quality" and "Enthusiasm" are important requirements and that the set-top box, its remote and associated system, and the TV, are the most relevant contextual elements. Still, evolving from previous research (Teixeira, Patrício, Nunes, et al. 2012), and as part of design-science research continuous search and improvement process (Hevner et al. 2004), we highlight the most relevant parts of CEM model, in accordance with the information obtained from the customer experience study, but we kept the full representation of CEM always available, since its holistic view can provide further insights for the design team.

The design of the service system is supported by MINDS' model for this level (Figure 3, on the right) that depicts the newly designed service provision process, with the new activities on the columns and the service interfaces on the lines, and a visual representation that illustrates the intended look and feel of the service. This visual representation can act as a low-fidelity service prototype, thus reaching towards the last step of the Analysis-Synthesis Bridge model adapted to service design, and closing the design cycle.

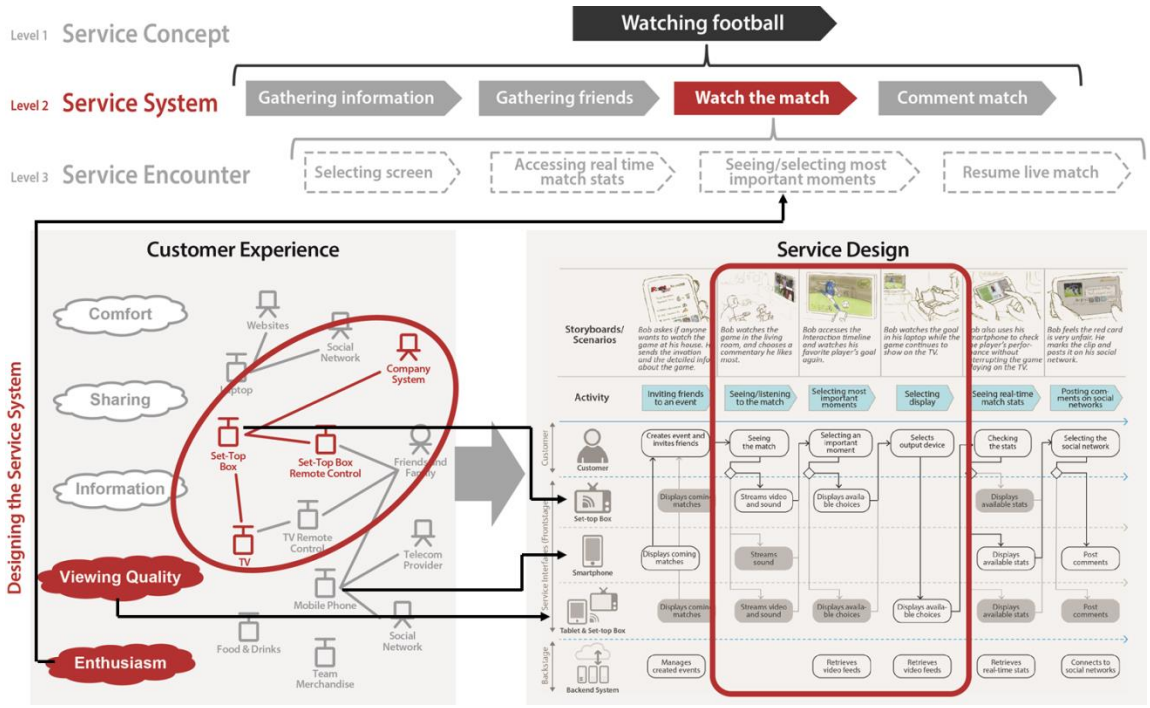

Figure 3- Designing the service system for the activity "Watch the match".

At this level, CEM informs the development of MINDS' model in several ways. First, the physical artifacts depicted on CEM, such as the set-top box, the laptop or the smartphone can be service interfaces. In the case portrayed, the original service was only provided through the set-top box. However, the newly designed service had multiple interfaces, with smartphones and tablets working along and dynamically with the set-top box (Teixeira et al. 2013). Second, activities collected through the customer experience study are a starting point to the design of the service system, but by no means should the new service be limited by them. As we can see in Figure 3, the original activity "Watch the match" was actually turned into potentially three new activities. While in the original service the customer would simply watch the match in his TV, connected to the set-top box, in the newly designed service, and to boost the required enthusiasm, the customer was offered the possibility to stream the match to mobile platforms, such as tablets and smartphones. He had a timeline populated with the most important match moments (goals, red cards, yellow cards) so he could watch them easily again, or for the first time if he wasn't following the match. Also, he could watch these moments in a separate device, so that he could continue to view the match without

interruptions in the primary screen. These new activities and interactions are detailed in the third and final level – the service encounter.

5.1.3. Designing the service encounter for the football watching service

The service encounter is a moment of interaction between the customer and the firm (Bitner et al. 1990). At this level we detail each possible interaction with the newly design service, i.e. each pairing between activities and service interfaces. In the case shown in Figure 3, the activity "Seeing/selecting most important moments" is supported by the set-top box and the tablet. As such, this gives rise to two different service encounters that are detailed separately. In Figure 4 we show the models for the service encounter supported by the set-top box. We depicted the activities at this level with dashed lines, since they were not a direct result from the customer experience study, but are newly design activities. The CEM model has only a couple of elements highlighted since we are designing very specific aspects of the service. Again the transition between customer experience and designing the new service offering is facilitated by the models integration. Both the customer experience requirements and the contextual artifacts (set-up box and set-up box remote) guide the design of the service encounter. Namely, they provide the interaction guidelines for the visual aspect of the service and the process of service delivery. In the models shown the customer experience requirements, "Information" and "Enthusiasm", are supported by an interactive timeline feature that shows the most important moments of the match, and enables viewers to select those moments and swiftly see them again. The interaction with this timeline is done through the set-top box remote control and must take into account its capabilities, namely its buttons and their disposition.

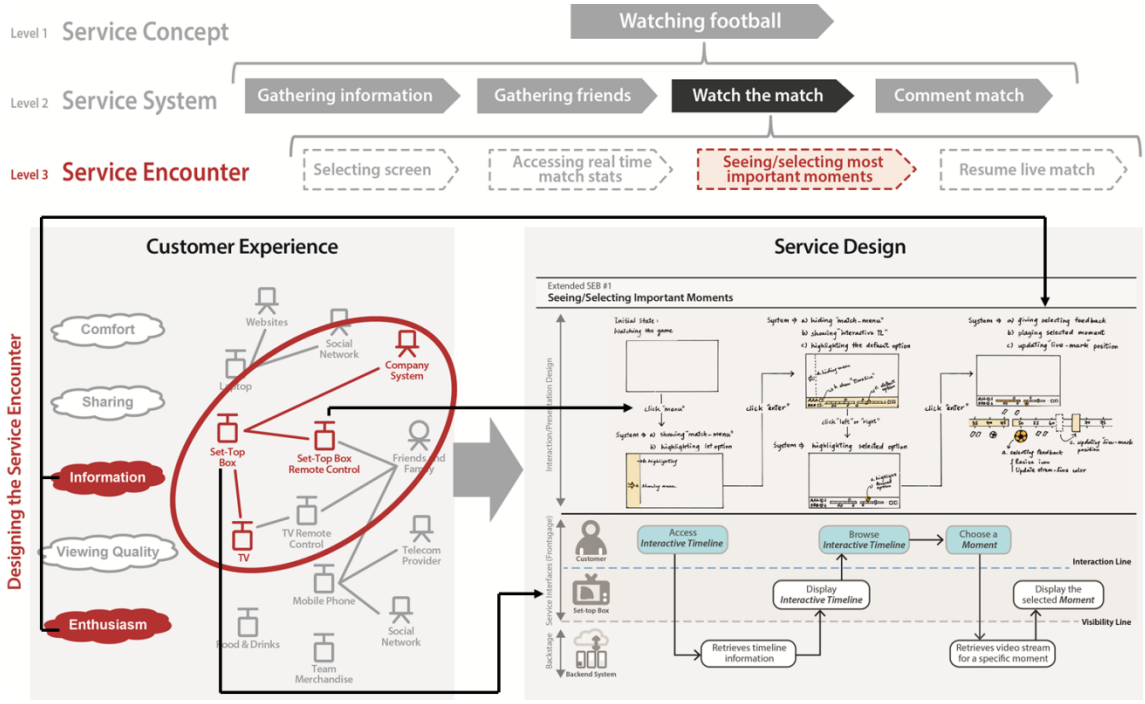

Figure 4 - Designing the service encounter for the activity "Seeing/selecting most important moments".

This model-based service design method supported the multidisciplinary team in the design of a complex, technology-enabled service. CEM model systematized a rich customer experience, with an abundance of technological artifacts and diverse requirements. The alignment and common structure between models supported the creative transition between customer experience and the design of the new service. MINDS models enabled the orchestration and prototyping of a complex service with three different service interfaces (set-top box, tablet and smartphone), and their possible combinations. These models were also used to provide regular updates and support discussions with the company. The end-result was praised by the company and initial steps were taken towards the implementation of the service. Further developments were not shared with the research team due to confidentiality issues.

5.2. Supporting skin cancer patients

The objective of this service design project was to design a new service to support skin cancer patients. The design team involved three different partners; two research institutions,

one with expertise in service design and the other in healthcare information systems, and a software house. With this dispersed design team it was paramount to establish a common and systematized set of models and method to support communication, leverage each partner contribution and avoid misguided efforts. As such, we applied the model-based service design method to guide the design process. Data collection involved a total of 20 semi-structured interviews to potential skin cancer patients that were waiting to be screened, to already diagnosed patients that were under follow-up procedures, and to dermatologists. Similarly to the former project, data was analyzed following grounded theory canons and with the support of NVIVO 8.

5.2.1. Designing the service concept for the skin cancer patients service

The starting point to the design of the service concept was the overall activity "Get dermatological care". This overall activity is broad enough to encompass all other activities, since an initial warning about a mole, until follow-up situations after a skin cancer treatment. From the customer experience study we were able to build CEM model and understand the most important requirements for patients, and the context that surrounds them in relation with skin cancer. As is shown on the left of Figure 5, the customer experience requirements reflect the importance of getting a speedy access to specialized counseling, and obtaining an accurate diagnosis. As we found out, skin cancer is a deadly disease that can kill very rapidly if not swiftly diagnosed and treated. The problem is that access to dermatologists is quite difficult for the most part of the patients involved. The analysis of the contextual experience elements helps to understand this. We see that the patient contacts primary care physicians, or other specialists and they are the ones that make the referral to the dermatologist. To have a good initial diagnostic this referral should be accompanied by images of the lesions or moles. However, in most cases, in the public healthcare service, referrals are not accompanied by images and, as such, dermatologists are not able to make an accurate initial triage to schedule

appointments. With a lack of dermatologists and appointments being scheduled months in advance, a serious, misdiagnosed skin cancer case can mean a death sentence. Also, images are important for patients who already had an appointment with the dermatologist, as they might be asked to follow-up on their moles, or for patients who were already treated for skin cancer, as they need to monitor their moles regularly.

Taking in consideration this context, the service design team actually developed two different concepts, as can be seen through MINDS' models in Figure 5 (on the right). As we can see the creative transition between the customer experience and the design of the new service is again facilitated by the alignment between the models. Through the contextual elements we identified most of the service providers. Customer experience requirements (especially "Speed" and "Diagnostic accuracy) supported the brainstorming of the service concepts and their features. One concept was centered on primary care centers and integrated the referral system with a portable dermatoscope to enable the easy attachment of quality pictures of the moles. It also provided guidance on the diagnosis of early skin cancer signs by detailing a step by step procedure to be followed by primary care physicians. This enabled these first-line caretakers to provide adequate information to dermatologists and ensure a swift and accurate screening process. The other concept was focused on supporting follow-up cases, both for public and private dermatology services, and involved a mobile application that took advantage of smartphone cameras to facilitate constant monitoring of moles, ensuring that a constant level of care is given and that any warning sign will be swiftly detected. In the next level we detail this latter concept.

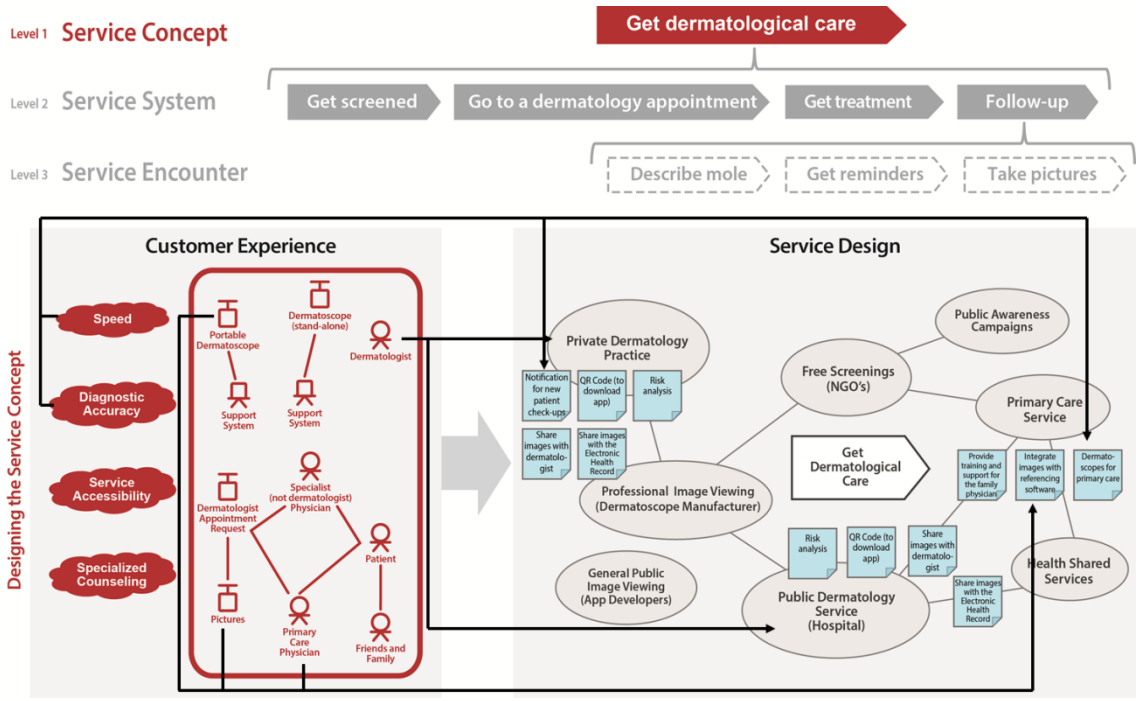

Figure 5 - Designing the service concept for the skin cancer patients service.

5.2.2. Designing the service system for the skin cancer patients service

The second service concept supported the "Follow-up" activity. Again, as shown in Figure 6, speed, diagnostic accuracy and accessibility were the requirements to support. We also added in the CEM model the new service that strengthened the connection between dermatologist and patient. Following the same reasoning than before, as it is something that was designed anew, we have depicted it with dashed lines. Again, contextual elements such as systems and artifacts enabled the constructions of MINDS' model, where it is possible to see that we added a significant number of new service interfaces. In fact, the team designed a service with a smartphone application that enabled patients to take pictures and send them immediately to their dermatologists for assessment. The dermatologist then accessed each picture through a web portal and was able to communicate with the patient and schedule an appointment if needed. This greatly improved all three customer experience requirements; diagnosis speed and accuracy and service accessibility. Patients also had the opportunity to synchronize their pictures with the national electronic health record, a nation-wide data

sharing platform. Finally, as also can be seen in Figure 6, new activities in the service encounter level were added to support the customer experience requirements "Speed", "Diagnostic Accuracy" and "Service Accessibility". We detail one of those activities next.

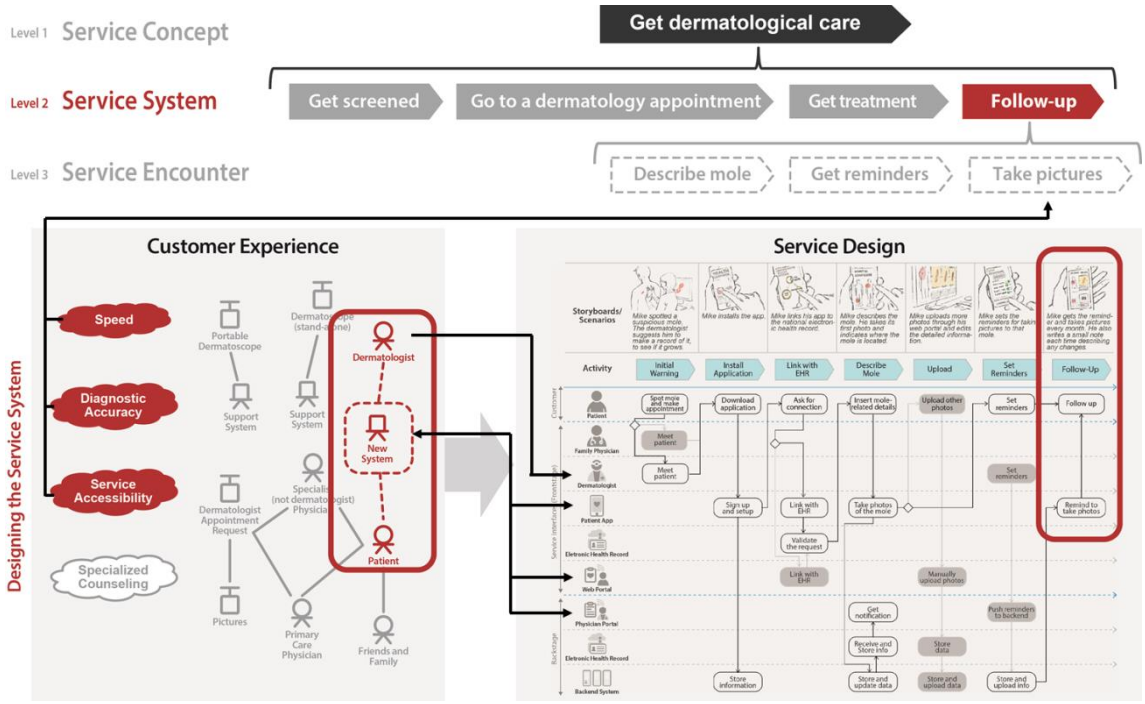

Figure 6 - Designing the service system for the activity "Follow-up".

5.2.3. Designing the service encounter for the skin cancer patients service

At this level we have divided the follow-up activity into three new activities; "Describe mole", "Get reminders" and "Take pictures". Figure 7 depicts CEM and MINDS' models for the activity "Describe mole" and we can see on the left that the latter deta ils the interaction between the patient and the newly created system, the smartphone app. Again, the connection between the models is highlighted. The service delivery process follows the interaction guidelines established for the new system, according to the technological platform chosen. The customer experience requirements "Speed", "Diagnostic Accuracy" and "Service accessibility" guided the design of the service encounter. The process for this service encounter includes the inclusion of metadata to each picture taken: the patient details the

place of the body where the mole is located to facilitate recollection afterwards; he also provides details about his skin type, as they are important to assess the potential danger of the mole. These increase the diagnostic accuracy as any picture of a mole needs to be contextualized according to place of the body and skin type. The smartphone app was also designed with a simple and visual attractive interface to improve the service accessibility. It also includes the connection with the dermatologist and the electronic health record to improve the screening speed.

With the distinct partners participating in this project, the design team was dispersed through three institutions. Thus, the model-based service design process was especially relevant as a way to document and trace design decisions. Given the important nature of the problem (skin cancer) it was vital that customer experience was correctly captured and reflected in the design of the new service. The model-based service design method ensured a tight fit since data collection to low fidelity prototyping. The service was further developed to a fully functional prototype and its deployment by the commercial partner is being studied.

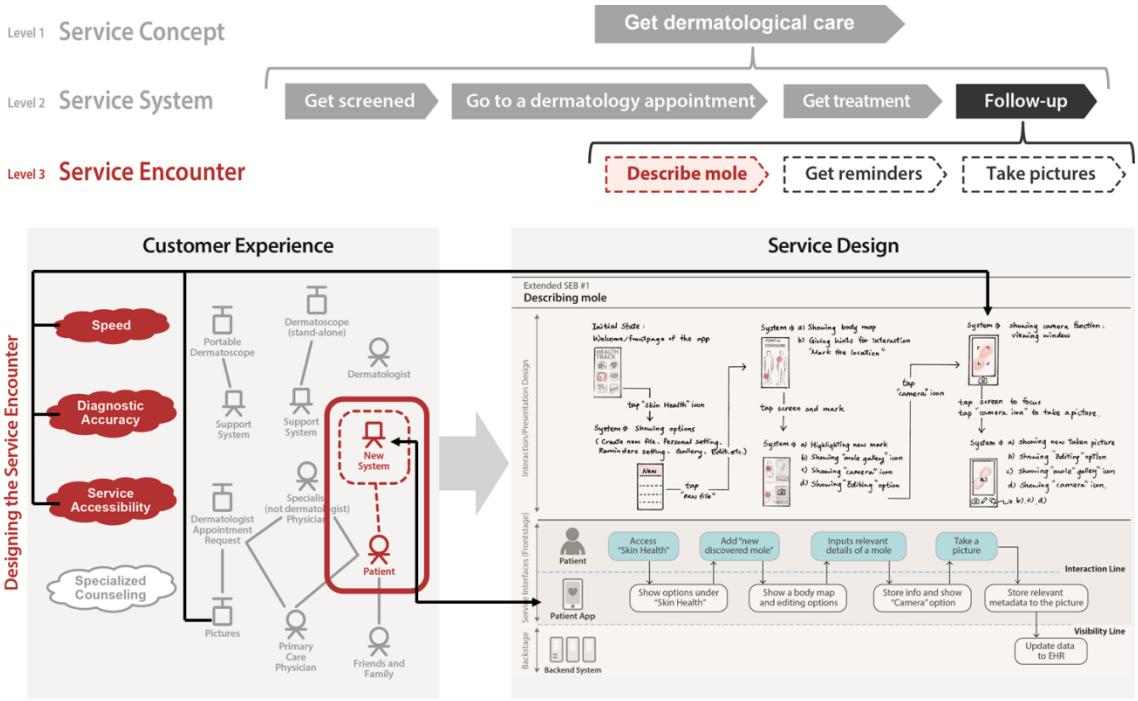

Figure 7 - Designing the service encounter for the activity "Describe the mole".

6. Contributions

The presented model-based service design method addresses three interrelated challenges: first, problems faced by service design are complex, or wicked, since they are ill-structured and ill-defined, and involve methods and tools from many of its constituent disciplines; second, these methods and tools cover specific steps of the design process and are not integrated in a coherent end-to-end method that can guide service designers; third, the creative transition between the understanding of the customer experience and the design of the new service requires appropriate tools for documentation and visualization.

To address these challenges we integrated previously scattered research and introduced a model-based method that spans from qualitative data collection to low-fidelity service prototyping. Being based on models this method is able to deal with the first presented challenge; service design complexity and multidisciplinarity. In fact, researchers found that models aid problem and solution understanding (Hevner et al. 2004) by eliminating irrelevant details (Cox 1999). They also have been found capable to enhance interdisciplinary communication (Brna et al. 2001; Van Bruggen and Kirschner 2003; Hevner et al. 2004; Larkin and Simon 1987; Ludolph 1998; Simon 1996) by setting a common language between team members.

Leveraging separate contributions this model-based method is also able to address the second challenge; the lack of an end-to-end service design method. This method integrated conceptually and operationally two contributions; CEM that deals with the systematization of customer experience information and MINDS that deals with the design of new service. These provide to service designers an end-to-end method, since qualitative data collection to low-fidelity prototyping

Finally, as models are able to document decisions (Booch et al. 1999), they also tackle the third challenge; the need to support the creative transition between understanding the

customer experience and designing new services. Models enable the traceability of design decisions and have been found capable of supporting this transition (Patrício and Fisk 2013). Concretely, at the service concept level, the integration between CEM and MINDS enables the identification of the current relevant service providers and support the brainstorming of new service concepts and their features. At the service system level, these models support the identification of current and potential service interfaces and inform the design of new customer activities that change the current customer journey to an improved one. Finally, at the service encounter level, these models guide the design of the encounter process and its visual aspect as they both need to comply with guidelines for system development and aesthetics.

This method was tested with two applications that showed its feasibility and usefulness in different contexts and industries, being able to lead to fully functional service prototypes and potentially deployable services in both cases.

With this model-based method, both researchers and practitioners can surpass the haphazard and ad-hoc nature of today's service design processes. By providing an integrated set of models, this method deconstructs service design complexity, achieves a common language for multidisciplinary teams, systematizes an end-to-end design process and documents and traces the design decisions so that the gap between customer experience and service design is successfully bridged.

7. Conclusions and future work

Service design methods have not kept up with service's economic importance. There is a recognized lack of dedicated methods and tools (Bitner et al. 2008; Ostrom et al. 2010), leading to unsophisticated service innovation processes (Zomerdijk and Voss 2011). This can be seen as a consequence of the complexity and the broad range of expertise needed to design services.

To address these challenges we developed a method that guides service design teams since qualitative data collection to low-fidelity service prototyping. It uses the abstraction characteristics of models to focus on the most important aspects of the customer experience and the service design, while systematizing and documenting the design process. To achieve this, the model-based method builds upon earlier contributions that were not integrated: Analysis-Synthesis Bridge Model (Dubberly et al. 2008) adapted to service design (Patrício and Fisk 2013) and Multilevel Service Design (Patrício et al. 2011) provide the conceptual grounding; Customer Experience Modeling (Teixeira, Patrício, Nunes, et al. 2012) systematizes and models qualitative customer experience data; and MINDS framework (Teixeira et al. 2014) models the new service value proposition, delivery process and visual depictions that act as early service prototypes. We have shown, through two applications in different service industries, how the method can be applied and its usefulness in making the design process more systematic, documented and easily shared among stakeholders.

Still, further applications in other industries can open opportunities to add additional perspectives and models to the method. While MINDS framework has an important interaction design perspective, additional integration with software engineering models, such as UML's (Booch et al. 1999) can extend the method and better support functional prototyping and implementation of new technology-enabled services. Also, so far we have emphasized the qualitative gains that can be obtained through the application of such a model-based method, such as systematization, traceability, documentation, predictability and better and easier knowledge sharing. However, the presented models have a formal structure, with defined constructs that can be adapted and improved to support a more quantitative-oriented analysis of the design process. Finally, adequate software support for the models would greatly reduce the time and effort spent in producing them, improve their adoption and aid the suggested quantitative-oriented analysis.

Despite this future work, the current model-based method already provides an end-to-end design process that is able to deal with complex and multidisciplinary problems and bridge the gap between customer experience and the design of new services, thus addressing important and recognized challenges faced by service design.

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7. Contributions

With services gaining increased prominence, service design is under added pressure to bring to life innovative service ideas. In fact, Ostrom et al. (2010) identified "enhancing service design" as a research priority for the science of services. However, service design faces important challenges that need to be overcome: the increased complexity brought by the ever increasing technology-infusion, and the multisdisciplinarity of models and methods used to tackle it. To address these challenges we have employed a design science research methodology (March and Smith, 1995; Hevner et al., 2004; Peffers et al., 2007) to develop new and enhanced models and methods. These outputs contribute to improve service design range of dedicated tools while embedding contributions from technology-oriented fields, namely interaction design, to support service designers in dealing with the complexity brought by technology-infusion in services. Specifically, this dissertation offers three main contributions: (1) a new model to systematize customer experience that enables a rich portrayal of experiences supported by technology and facilitate the incorporation of customer experience inputs in the service design process; (2) an integrated set of enhanced models that bridges two service design perspectives (interaction design and management) to support the design of technology-enabled services; and (3) an end-to-end model-based method that leveraged the previous contributions and bridged the gap between understanding the customer experience and designing new services. The following sub-sections discuss these contributions in more detail.

7.1. Contribution to create new service design methods and models

The identification and development of models that addressed underexplored areas of the service design process was the first objective set out for this dissertation. Taking into account the lack of models that could portray a holistic view of the different aspects of the customer

experience, Customer Experience Modeling (CEM) was developed (Teixeira, Patrício, Nunes, et al., 2012). Considering that customer experience is a holistic concept (Berry et al., 2002; Zomerdijk and Voss, 2010) and that studying it through exploratory data collection methods can produce vast amounts of unstructured data, CEM provided a model to systematize customer experience information. It also offered a language to enable that portrayal in a way that can be easily understood and communicated by members of multidisciplinary teams. Research in customer experience had already identified the understanding of customer activities and their context as the ground for service designers to enable and enhance service experiences (Zomerdijk and Voss, 2010). Similarly, from a technology-oriented point-of-view, Human Activity Modeling (Constantine, 2009) also puts activity and the tools that support it at the center of the design process. Taking advantage of this cross-cutting emphasis on the activity and context, the proposed constructs evolve Human Activity Modeling (HAM) by adapting it to service settings. Moreover, to ensure that CEM can be applied to interdisciplinary service design projects and does not require significant training, the concepts and notation from HAM were simplified, focusing on the most relevant concepts and intuitive representations, so service designers can easily understand and apply them. CEM also evolves HAM by integrating customer experience requirements (Patrício et al., 2009) to evaluate both activities and their contextual elements, as these requirements are crucial for enhancing the customer experience and were not previously addressed by HAM.

Overall, CEM captures the rich and complex elements that shape a customer experience, and systematizes and represents this experience to support service design efforts. Due to its interdisciplinary support, it contributes to deal with the complexity brought by technology and to improve the customer experience incorporation in the service design process. As service design projects are, by nature, multidisciplinary, CEM also contributes to a wider use

of service design by organizations, as its models offer a common language that can facilitate communication and analysis among design teams and document their progress and findings. It ensures that all experts engaged in these efforts, regardless of their background, reach a common understanding of the customer experience. This is especially important as understanding the customer experience is the basis of the design process.

7.2. Contribution to integrate service design perspectives and enhance existing models

The integration of different service design perspectives, to deal with the complexity brought by technology-infusion, was the second objective of this dissertation. Following CEM development on the customer experience side, MINDS framework enhanced the service design side to support technology-infusion and integrate multidisciplinary contributions. Based on the assortment of scattered service design models, MINDS identified and conceptualized two perspectives for service design; management and interaction design. These perspectives have different backgrounds and focus. Management perspective models originate in service marketing, service operations, and strategic management and focus on conceiving value propositions to co-create value with customers and on the service delivery process. On the other hand, interaction design models are focused on the users of the service and their surrounding context, foregoing the business perspective. MINDS took advantage of the complementarities between these perspectives to develop three enhanced models that support the design of technology-enabled services.

At the service concept level, MINDS combines customer value constellation with affinity diagrams, enabling the design team to address the strategic decisions regarding the definition of the value proposition in the customer value constellation (management perspective), while fostering creativity and generation of new design ideas through the use of affinity diagrams (interaction design perspective).

At the service system level several contributions were combined; service system navigation, customer journeys, scenarios and storyboards. With service system navigation and storyboards, the service design team is able to link a rich visual representation of the provided service (through the storyboard) with a more structured representation of the service system that needs to be developed (through the service system navigation). MINDS therefore evolves management and interaction approaches by integrating their process and visual characteristics.

Finally, at the service encounter level, MINDS brings together service experience blueprints and interaction sketches. This enhanced model details the interaction design along with the service provision process, ensuring that technology-enabled interfaces follow appropriate interaction design guidelines and fit backstage operations and system architecture.

Overall, MINDS contributes over other management-oriented models, like Multilevel Service Design, by adding a creative and visually rich layer to these models. By providing visual representations of the service being developed, these models, especially the latter two, act as early low-fidelity prototypes that make the designed service more discernible and facilitate the communication between the design team and other stakeholders. MINDS framework contributes over other interaction design models by linking them to the strategic decision making and service provision process, enabling the incorporation of their inputs in earlier stages of the design process. By leveraging the contributions of a management-oriented perspective and a more technology-oriented one, MINDS is uniquely equipped to deal with the complexity brought by technology-enabled services.

7.3. Contribution to develop an end-to-end model-based service design method

Having created new models and enhanced existing ones, the systematization of a comprehensive and coherent end-to-end model-based method was the third, and final, objective of this dissertation. Existing literature highlights that service design is much less

understood than product design (Norman, 2011) and that service innovation processes are unsophisticated or haphazard (Zomerdijk and Voss, 2011). As service design models are adapted from other disciplines they do not share the same language, nor are they integrated in a systematic design process. In fact, a systematic service development process was considered one key success factor for new service development (Zomerdijk and Voss, 2011). As such, service designers and companies struggle with unstructured approaches that have unpredictable outcomes.

Building upon the structure set by Analysis-Synthesis Bridge Model adapted to service design (Dubberly and Evenson, 2008; Patrício and Fisk, 2013) and Multilevel Service Design (Patrício et al., 2011), the model-based service design method presented in this dissertation knits previous contributions in a coherent and systematized service design process, since the understanding the customer experience to low-fidelity service prototyping. This approach therefore contributes to bridge the gap between customer experience and service design. By aligning the model-based contributions (CEM and MINDS), and taking advantage of models ability to document the problem and solution space (Booch et al., 1999) this method also supports the creative transition from understanding the customer experience to designing the new service. This is an important contribution of the method as this transition has been considered to be at the heart of service design (Patrício and Fisk, 2013).

Overall, with this method CEM feeds, level-by-level, MINDS models. At the service concept level it enables the identification of the current relevant service providers, as well as supports the brainstorming of new service features, by evaluating current activities and context resorting to customer experience requirements. At the service system level it enables the identification of service interfaces and supports the design of new customer journeys. Finally, at the service encounter level, it provides guidance to design interactions by taking into consideration the context surrounding the use of a specific service interface and its customer

experience requirements. For example, when designing for a set-up box, the design team should take into consideration not only the interface *per se*, but also the input device used (e.g. remote control, smartphone) and the activity being performed (portrayed in CEM). Changing channels can be equally easy in a remote control or in a smartphone, input a password can be much more complicated and in need of adaption to the context. Also, MINDS models can also feed back to CEM to have it represent the desired customer experience, instead of the current.

Throughout the three levels of service design, this method provides a thorough, integrated and coherent process, with an interdisciplinary scope, thus empowering service designers to deal with the field's complexity, namely the one brought by technology-infusion.

7.4. Managerial implications

The interest, involvement and positive feedback received by companies that partnered in the two service design projects presented (in media and healthcare) emphasizes that the contributions from this dissertation have real managerial implications. The method and models help practitioner design teams to achieve a common view of the problem and solutions space, aligning early-on the different expert views and avoiding costly misunderstandings, like having a service designed that does not fit an organization structure, or cannot be supported by its IT infrastructure. The same reasoning applies to the early prototyping and testing capabilities of these models that can avoid costly developments of services that are not implementable or successful. This can also have implications in the internal organization of the company. By defining a process and a common notation, the method and models help companies to overcome too strict and opaque development processes that stifle creativity and innovation. A systematic process is considered key to successful design of new services (Zomerdijk and Voss, 2011). Also, instead of having specialized teams that execute a task, with expert models, and then hand over to another team

that executes another task, without an overall view of the concept, this method and models support cross-organizational task-forces that ensure that all areas are aligned. Models also help making service designers work tangible, hopefully helping to ease the seemingly lack of recognition of these professionals in service companies (Tether, 2008).

The two applications showed that the notation used in the models is easily understandable without previous training and they do not require any specific skill or software to be used, allowing a swift introduction in companies. This allows that members of the design team and customers use these shared models to discuss service concepts and features, thus truly engaging in co-creation of new services. Specifically, the visual characteristics of MINDS' model are useful to involve stakeholders as they can easily relate with the low-fidelity prototypes that are drawn.

Finally, the end-to-end model-based method enables companies to systematize their design process, making it less ad-hoc and haphazard and more manageable and foreseeable. With this model-based method companies can better estimate resources allocation and, consequently, costs. Still, further work can be done to leverage research and managerial implications of these contributions, as is discussed in the next section.

8. Conclusions and Future Work

This dissertation aims to address two relevant challenges faced by service design. First, the complexity of designing services is increasing as technology permeates service provision. Additional service interfaces need to be integrated with existing ones and with frontstage and backstage processes. Failure to do so damages customer experience. As service designers try to address this problem, the multitude of tools and their backgrounds raises another challenge. Service design multidisciplinary nature leads to a multiplicity of tools and techniques that come from different backgrounds and have a specific scope. Such tools are not adapted to a service mindset and have different languages, making it difficult to integrate them in coherent methods. This hinders coherent orchestration of multiple designed service elements and leads to unstructured and ad-hoc design processes that damage service innovation. We have set three objectives to deal with these challenges: (1) to develop new models regarding underexplored areas of the design process, specifically its exploration phase; (2) to integrate service design perspectives (management and interaction design) in enhanced models that are interdisciplinary and capable of dealing with technology-infusion; (3) to systematize an end-to-end model based method, from understanding the customer experience to the design of new services.

Following a design science research methodology (Peffers et al., 2007; Buchanan, 2001; March and Smith, 1995; Hevner et al., 2004), a problem-solving paradigm, this dissertation has answered to these objectives by developing three main contributions. First, CEM (Teixeira, Patrício, Nunes, et al., 2012) addresses the lack of models to depict and systematize customer experience and introduces a notation with simple vocabulary, adapted to service design and technological settings. Second, MINDS (Teixeira et al., 2014) introduces a set of enhanced interdisciplinary models that integrates a managerial and a technological perspective in the design of new services. Third, these models were combined

along an end-to-end method that guides service designers since the understanding customer experience to the design of new services. Finally, two applications involving distinct service design projects in media and healthcare industries, demonstrate that these contributions can be used in real-world settings and are useful to solve the problems they mean to address.

However, the contributions presented in this dissertation are not without limitations. First, the interdisciplinary work done throughout this dissertation is mainly related with interaction design. While service design and interaction design share characteristics and focus that supports a smoother integration, service design has a broader range of contributor fields that can provide additional insights regarding technology-infusion (e.g. IT architecture and software engineering, operations management). IT architecture and software engineering have well established methods and models that can enhance current contributions. Also, these fields have a strong expertise in model formalization that can facilitate software support in model generation, handling and transformation. Operations management can also provide further integration opportunities. The contributions presented in this dissertation are mostly focused on the frontstage of service provision, and operations management can bring needed insights and stronger connection with the backstage service delivery processes. Future research should therefore evolve service design methods for better integration and connection with other approaches.

Second, two applications can be considered too few to consider the method and models applicable to services in general. The two applications involved distinct and representative service industries (media and healthcare), and provided a first validation, showing that the methods and models were usable and useful. However, other important industries (e.g. banking, retailing or transportation) and contexts could be covered to further validate and improve these contributions. For example, applying the methods and models in a business-to-business context, or in a service that has less technology-infusion, could provide further

validation, and interesting improvement opportunities. Also, the applications presented in media and healthcare are not representative *per se* of these industries, as they are diverse and complex (especially healthcare). As future research, the presented method and models can be improved by expanding the application to other service industries, with different characteristics, and by applying it further in media and healthcare. Finally, an evaluation and quantification of the impacts of the model-based method would provide added validation and improvement opportunities.

This dissertation contributes to research priorities for the science of service (Ostrom et al., 2010), namely the ones regarding enhancing service design and leveraging technology to advance service. It brings to service design a new method and models that are firmly aligned with the field core characteristics; its holistic and rich understanding of service experience and value co-creation with customers, and its multidisciplinarity with an unique combination of management, strategy, marketing, design, operations and technology knowledge. The contributions presented both advance research and have managerial implications, as the method and models developed can be used by companies and practitioners to support their work and make service design efforts more manageable.

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