RESEARCH

Christian Zagel

Service Fascination

Gaining Competitive Advantage through Experiential Self-Service Systems

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Abstract

With the success of online shopping, stationary retail has continuously been loosing attractiveness during the last couple of years. This especially applies to the textile industry whose retail stores, independent of a certain brand, almost do not differ from each other in regard to their structure. In addition, products and brands of the modern consumer goods industry increasingly become exchangeable. Exclusively offering products at a cheap price and at high quality standards is not sufficient anymore for differentiating from competitors. Consequently, an increasingly important task of today's retail business can be found in the attractive presentation of the products next to the consistent update of the product assortment. In this context practitioners and researchers ascribe exceptional importance to the creation of positive shopping experiences. Especially in regard to young focus groups, innovative technologies become an important element for effectively reaching the goal of customer excitement and hence facilitate an outstanding positioning of a brand. It is particularly the traditional retail stores that offer companies the possibility to present their brand and to differentiate themselves from competitors by offering exceptional, value-added services.

Concepts for the systematic creation of positive customer experiences, applying modern information technology, have so far hardly been investigated. Hence, this thesis deals with the question of how the stationary textile retail business is able to provide its customers with an exciting and fascinating shopping experience by using innovative technologies. These experiences should not only set themselves apart from traditional e-commerce offers, but combine the online strengths with the ones of the stationary point of sale in the form of a holistic omni-channel approach. The concept is oriented on the needs of the young customers, the so called "digital natives", that challenge retailers with their technology readiness and therefore have to be addressed in an appropriate way. For that reason, the presented research approach focuses on research gaps amongst the fields Customer Experience Management, Services Science, and Human-Computer Interaction. These include a lack of knowledge about the distinctive drivers of positive experiences, about the psychological effects of technology application, as well as suitable engineering and evaluation methods.

As a solution to close these research gaps the “Service Fascination Research Model“ is presented. Next to a user-centered engineering approach it also includes an evaluation method used to assess the effects of technology application. As part of the Customer Experience Management strategy, the components focus on the implementation of holistic digital services that provide their users both an emotional as well as a functional value. Applying a design-science approach, five exemplary, fully functional prototypes of interactive self-service systems along the customer journey of a textile retail store are developed: An interactive shopping window, a low-cost body scanner based on the Microsoft Kinect, a context-adaptive outfit recommendation system, an interactive fitting room, as well as a mirror linked to social media networks. The implementation of these futuristic interaction concepts is done using the presented engineering approach and by involving the focus group into the development process. Each of the self-service systems is assessed using the presented evaluation model. The findings provide important insight into promising combinations of virtual and real shopping elements. Especially the delivery of functional and emotional values sets the basis for creating customer satisfaction and for strengthening customer loyalty. The revelation of cause-effect relationships leads to implications for additional research potentials and to the composition of recommendations for action in a business context. The results provide starting points for the implementation and evaluation of new digital self-service technologies.

Kurzfassung

In den vergangenen Jahren verlor der stationäre Einzelhandel, insbesondere durch den Erfolg des Online-Handels, kontinuierlich an Attraktivität. Dies trifft in besonderem Maße auf die Bekleidungsbranche zu, deren Ladengeschäfte sich hinsichtlich ihrer Struktur kaum voneinander unterscheiden. Auch werden Produkte und Marken in der Welt der Konsumgüterindustrie zunehmend austauschbar. Das Angebot kostengünstiger oder qualitativ hochwertiger Produkte ist als Alleinstellungsmerkmal nicht mehr ausreichend. So ist neben der kontinuierlichen Erneuerung der Produktpalette auch deren attraktive Präsentation ein wichtiger Bestandteil der Handelstätigkeit. In diesem Zusammenhang wird insbesonderere der Gestaltung von Einkaufserlebnissen eine außerordentliche Bedeutung zugemessen. Gerade in Hinblick auf junge Fokusgruppen gewinnen innovative Technologien an Relevanz, um das Ziel der Begeisterung und Markenpositionierung effizient zu erreichen. Vor allem traditionelle Ladengeschäfte bieten Unternehmen die Möglichkeit, ihre Marke zu präsentieren und sich durch außergewöhnliche Alleinstellungsmerkmale von der Konkurrenz zu differenzieren.

Konzepte zur systematischen Erzeugung positiver Kundenerfahrungen mithilfe moderner Informationstechnologie sind bislang kaum erforscht. Diese Arbeit beschäftigt sich daher mit der Frage, wie der stationäre Textil-Einzelhandel durch den Einsatz innovativer Technologien ein spannendes und fesselndes Einkaufserlebnis bieten kann. Dieses soll sich nicht nur von reinen E-Commerce-Angeboten abheben, sondern deren Stärken mit denen des stationären Point of Sale im Rahmen eines umfassenden Omni-Channel-Ansatzes kombinieren. Der Fokus liegt dabei auf den Anforderungen der jungen Kundschaft, den „Digital Natives", die durch ihre hohe Technologieaffinität eine besondere Herausforderung für den Einzelhandel darstellen und daher auf besondere Weise angesprochen werden müssen. Der vorgestellte Forschungsansatz zielt auf Forschungslücken zwischen den Feldern Customer Experience Management, Services Science und Human-Computer Interaction. Diese erstrecken sich von fehlendem Wissen bezüglich der Treiber positiver Emotionen über die psychologischen Auswirkungen des Einsatzes moderner Technologien bis hin zu geeigneten Entwicklungs- und Messmethoden.

Um diese Forschungslücken zu schließen wird das neu entwickelte „Service Fascination Research Model“ vorgestellt, welches neben einem nutzerzentrierten Entwicklungsansatz auch eine Evaluationsmethode beinhaltet. Mit Blick auf das Customer Experience Management zielen beide Komponenten auf holistisch ausgerichtete, digitale Systeme, die dem Kunden neben einem rein funktionalen auch einen emotionalen Nutzen bieten. Unter Verwendung eines Design-Science-Ansatzes werden fünf funktionsfähige Prototypen entlang der Customer Journey eines traditionellen Bekleidungsgeschäfts entwickelt: Ein interaktives Schaufenster, ein kostengünstiger Körperscanner auf Basis der Microsoft Kinect, ein kontext-adaptiver Outfit-Berater, eine interaktive Umkleidekabine sowie ein Spiegel mit Anbindung an soziale Netzwerke. Die Implementierung dieser futuristischen Interaktionskonzepte erfolgt unter Anwendung des aufgezeigten Entwicklungsansatzes und damit unter ständiger Einbindung der Zielgruppe. Die im Praxistest anhand des vorgestellten Messmodells evaluierten Lösungen geben wichtige Impulse für eine erfolgreiche Verbindung von virtuellen und realen Einkaufselementen. Insbesondere mit der Kombination aus funktionalem und emotionalem Kundennutzen werden so neue Möglichkeiten geschaffen, Kundenzufriedenheit zu erzeugen und die Kundenbindung zu stärken. Aus den aufgedeckten Wirkungszusammenhängen werden Implikationen für weitere Forschungsgedarfe sowie Handlungsempfehlungen für die Praxis abgeleitet. Diese bilden wertvolle Ansatzpunkte für den Entwurf, die Evaluation und die Weiterentwicklung neuer, technologiebasierter Dienstleistungssysteme.

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List of Abbreviations

ANSI	American National Standards Institute
ANOVA	Analysis of Variance
ATM	Automated Teller Machine
API	Application Programming Interface
AR	Augmented Reality
AVE	Average Variance Extracted
B2B	Business to Business
B2C	Business to Consumer
BI	Behavioral Intention to Use
CAVE	CAVE Automatic Virtual Environment
cd	Candela
CEM	Customer Experience Management
CMS	Content Management System
CPU	Central Processing Unit
CRM	Customer Relationship Management
CUE	Comparative Usability Evaluation
DVI	Digital Visual Interface
ESM	Experience Sampling Method
FullHD	Full High Definition
GB	Gigabyte
HCI	Human-Computer Interaction
HD	High Definition
HTML	Hypertext Markup Language
ICT	Information and Communication Technology
ID	Identifier
IS	Information Systems

IT	Information Technology
JSON	Java Script Object Notation
LF	Low Frequency
LED	Light-Emitting Diode
LISREL	Linear Structural Relations
LLRP	Low Level Reader Protocol
MP	Megapixel
PEOU	Perceived Ease of Use
PHP	Hypertext Preprocessor
PLM	Product Lifecycle Management
PLS	Partial Least Squares
POS	Point of Sale
PU	Perceived Usefulness
QR	Quick Response
RAM	Random Access Memory
RFID	Radio Frequency Identification
RMS	Root Mean Square
RSS	Rich Site Summary
SEM	Structural Equation Modeling
SDK	Software Development Kit
SNB	Super Narrow Bezel
SST	Self-Service Technology
TAM	Technology Acceptance Model
TPB	Theory of Planned Behavior
TRA	Theory of Reasoned Action
UCD	User Centered Design
UE	Usability Engineering
UHF	Ultra High Frequency
UI	User Interface
URL	Uniform Resource Locator
UTAUT	Unified Theory of Acceptance and Use of Technology
VDT	Visual Display Terminal
VIF	Variance Inflation Factor
VR	Virtual Reality

WPF	Windows Presentation Foundation

Chapter 1

Introduction

1.1 Motivation

> "We are in the middle of a revolution. A revolution that will render the principles and models of traditional marketing obsolete. A revolution that will change the face of marketing forever. A revolution that will replace traditional feature-and-benefit marketing with experiential marketing." [Schmitt 1999, p. 3]
>
> Bernd H. Schmitt, Professor for International Business, Columbia University

In today's world of the consumer goods industry, products and brands increasingly become exchangeable [Kroeber-Riel 1984, pp. 210-211]. A differentiation driven by product quality and price is not sufficient anymore [Salzmann 2007, p. 1; Shaw and Ivens 2002, p. 2], resulting in a lack of uniqueness [Sawtschenko 2005, p. 20]. Driving a successful business does not only require a consistent renewal of the product portfolio but also an attractive presentation of the goods. Especially the provision of experiential value-added services, e.g. at the point of sale (POS), is seen as an appropriate means for differentiation from competitors [Merkle and Kreutzer 2008, p. 21; Grewal et al. 2009, p. 1; Leisching et al. 2012, p. 438]. This leads to service quality being the primary factor to sustain the fierce global competition.

But traditional brick-and-mortar business is facing several challenges: "Retail companies that want to survive among other retailers will have to make sure their store is more than just a collection of products" [Floor 2006, p. 13]. Competition is not only driven by other companies but also exists among different sales channels [Brynjolfsson et al. 2009, pp. 1755-1757]. Online business experiences a continuous growth throughout

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the last years and it is getting harder to reach consumers through traditional channels. Business that previously took place in physical environments finds itself faced with a variety of new channels. Recently, technologies lead to a merge of the real with the digital world. Particularly in the times of "always-on", consumers perceive the channels that brands provide as one holistic construct. Meanwhile researchers and practitioners also describe this "anywhere, anytime, anyhow" omnipresence in which distribution channels seamlessly integrate into each other as "Everywhere-Commerce" [Schneiders 2013, p. 263]. Firms have to keep up with this rapid development in the way people communicate.

Another challenge is shaped by the relentless change of consumer behavior and their expectations towards the vendors. This evolution of consumer needs is often also influenced by the emergence of new technologies that are increasingly able to meet multiple needs at once and that may even influence the importance of consumer needs over time [Voigt 2008, pp. 375-377]. Companies of the modern service-driven economy still strive to be successful mainly by offering a broad choice of products [Zagel and Bodendorf 2012, p. 697]. However, the consumer's experience with the brand is not only determined by the actual product itself. It is rather a combination of all single experiences gained at each and every touch point. These experiences consist of so called experiential features that are either of functional/utilitarian or emotional/hedonic[1] nature [Holbrook 1999, p. 10; Gentile et al. 2007, p. 399]. "By evoking fun, pleasure, and other positive emotions during shopping companies can not only satisfy but fascinate their consumers over their brands and products. And this can happen best, if brands lead their customers back to the touch point where they have most influence: the physical POS" [Zagel et al. 2014b, p. 177].

Independent of a certain business sector, information technology (IT) is already able to impinge upon the perceived value and quality of services offered [Wirtz 2008, pp. 84-85; Spreer 2013, p. 1]. At the stationary POS this can happen with self-service technologies (SST) that enable customers to produce a service independent of direct employee involvement [Meuter et al. 2000, p. 50]. It is proven that this kind of technologies can make stores more interesting, trustworthy, and also more attractive [Pantano and Naccarato 2010, pp. 200-204], thus meeting the challenges mentioned before. Nevertheless, practice often neglects basic psychological aspects, especially the ones regarding usability, user experience, and experienced pleasure during interaction with new media. This inevitably leads to low user acceptance.

[1] The word "hedonic" is derived from the Greek language and implies the natural human desire to strive for pleasure and to avoid pain [Higgins 2006, p. 440; Stevenson 2010, p. 813].

Within the elusive target group of the so called "digital natives"[2], this development is even more important. A differentiation through exceptional utilization of innovative technologies is promising. It is necessary to approach these constantly connected customers which have grown up with technology as their primary means of entertainment in an appropriate way [Palfrey and Gasser 2008, p. 5]. As an ultimate ambition, companies need to target the generation of positive and consistent experiences across all channels.

Through direct and personal contact and the independence of customer owned technology traditional brick-and-mortar stores are particularly suited for realizing outstanding service concepts through technology [Burke 2002, pp. 411-432]. A skilful combination of new technologies and media at the POS, and hence the integration of the digital economy into stationary retail account for a shopping environment that is again attractive for the young buyership. It is necessary to continuously observe consumer behavior (e.g., the use of technology like smart phones and social media) and integrate the implications into the service concepts instead of neglecting them.

The key to success is to understand the consumer in his needs and expectations and to enter the stage as a holistically and consistently acting, high quality service provider. Targeting the thrill-seeking society this new marketing paradigm called "Experiential Marketing" or "Customer Experience Management" [Pine and Gilmore 1999, p. XIII; Schmitt 1999, pp. 22-32; Shaw and Ivens 2002, pp. 3-4; Schmitt and Mangold 2004, pp. 22-45; Gentile et al. 2007, pp. 395-410; Verhoef et al. 2009, p. 31] has the goal of providing the consumer much more than only a variety of functional services: a total customer experience. This customer experience is holistic in nature and comprises all experiences a customer makes with a retailer [Verhoef et al. 2009, p. 32].

Several years passed since Schmitt's statement in 1999 and some companies realized the importance of selling stories and emotions as part of their services or products. Nevertheless, science and practice still demand for research that provides a deeper understanding of experiences and their origins. Especially the detailed assessment of physical stores, acting as the brand's embodiment in the real world, represents an unresolved challenge to date [Verhoef et al. 2009, pp. 31-41; Bagdare 2013, pp. 45-51].

Implementing SSTs is usually bound to high roll-out costs and uncertainty in regards to consumer acceptance: "Ineffective or unsuccessful service encounters can result in significant costs [...], lost customers, and negative word of mouth" [Bitner et al. 2000, p. 139]. To minimize risk and to best differentiate from competitors a company requires

[2]"Digital natives" are sometimes also called "Net Generation" [Prensky 2001, p. 1]. These terms describe people of the generation born between 1980 and 1994, characterized as living their lives "immersed in technology" [Bennett et al. 2008, p. 776].

knowledge on how to design promising SSTs by selecting the right use cases and technology combinations for the chosen target group.

1.2 Objective and Methodology

The goal of this thesis is to assess the effects of experiential technology-enabled self-services towards customer acceptance and emotions. For this purpose, the impact of technology combinations on creating positive consumer experiences is explored. A concept is developed that can be used to strategically design, to measure, and to improve SSTs in order to generate Service Fascination[3] as a means of brand differentiation towards competitors (cf. Figure 1.1). Realized in the form of a human-centered approach the customer's personality is always taken into account.

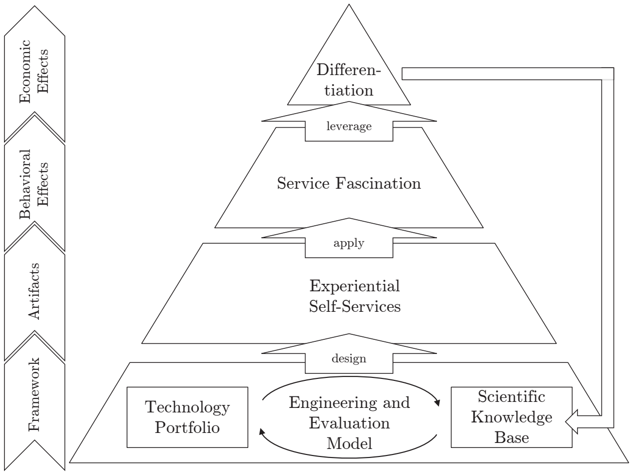

Figure 1.1 – Service Fascination

As part of the conceptual framework, a technology portfolio provides a structured overview about state of the art software and hardware options, design methodologies, and interactive content. It serves as the technical basis for the design of exciting self-service systems. A detailed literature research is applied for creating a scientific knowledge base about consumer experience and technology adoption theories. Both, the theoretical

[3]Service fascination is defined as an extraordinary positive emotional state arising through conscious and subconscious effects of SST use (cf. Chapter 2.1).

and the practical elements, form the basis for developing a service fascination research concept that includes an engineering as well as an evaluation model. While the engineering model presents a structured process for the development of SSTs, the evaluation model uses subjective and objective methods for a detailed assessment along the customer's interaction process. Promising technology combinations are utilized to create experiential self-service systems that not only provide a utilitarian (serving a concrete purpose) but also hedonic value (fun and positive emotions). In this research, fashion retail stores are chosen as the appropriate environment for the implementation of five prototypical artifacts along the respective customer journey. These artifacts are evaluated in order to assess the conscious and subconscious behavioral effects of SST design by applying the evaluation model presented before. Information about strengths and weaknesses of the system's design and the respective technology combinations is finally added to the scientific knowledge base. This allows the improvement of existing self-service systems and finally leads to a constant enhancement of the service design process. The insights of the studies can furthermore be used to derive general knowledge for management decision support, facilitating the goal of brand differentiation (representing the economic effects).

1.3 Related Research

Research focuses on the application and evaluation of consumer experience methodologies within the area of technology-enabled self-service systems for retail business use. Various research domains deal with either the management of services, the design and development of innovative technologies, or the creation of customer satisfaction and emotions. Amongst others the most important are Services Science, Human-Computer Interaction (HCI), and Customer Experience Management (CEM), which provide the conceptual and theoretical foundations for this work. All of these domains offer methods to innovate, to engineer, and to evaluate and improve services, systems, or experiences.

Services account for the major part of the value added in industrialized nations. As an increasingly important element within services science research, recent technological developments lead to a new understanding of the domain. Technology increasingly supports or even replaces traditional human service employees, e.g., in the form of SSTs. In order to ensure customer satisfaction, companies consistently evaluate their services to maximize consumer's desire to make use of them. Behavior and technology acceptance research deals with building theories to predict future behavior dependent on external influences or personal attitudes. Many researchers present models that try to explain people's behavioral intentions. Some of these psychological theories have found their way into the business and technology context. One of the most well-known concepts in information systems (IS) research is the Technology Acceptance Model (TAM) by Davis [1989, pp. 319-340] which builds on the social-psychological Theory of Reasoned Action (TRA) proposed by Fishbein and Ajzen [1975] and the Theory of Planned Behavior (TPB) [Ajzen 1991, pp. 179-211]. With a special focus on perceived usefulness (PU) and perceived ease of use (PEOU), TAM's objective is the prediction of information system acceptance and the detection of design problems. Since its introduction, the TAM was successively extended, refined, adopted, and also used for the assessment of SSTs. Nevertheless and to date, this research is of pure theoretical nature and only includes a very general assessment of experiential aspects. A specific observation of emotional effects of self-service technology use is not part of the research.

Building SSTs usually involves several design and application oriented disciplines. With a strong focus on the development of applications and systems, HCI deals with "studying the interaction between people and computers, concerning [...] the physical, psychological and theoretical aspects of this process" [Dix 2010, p. 3]. The topics in HCI research continuously move from working on functional issues to soft, human-centered facets [Lazar et al. 2010, pp. 2-3]. As a sub-concept of HCI, User Experience (UX) concentrates on the ergonomics, the underlying structure and navigation, the design of interface elements, and other related components [Garrett 2003, pp. 21-36]. UX is meanwhile considered a basic feature of the design process. Nevertheless, the specific integration of aesthetics, emotions, and experiences (the so called "joy-of-use") into services and products is relatively new. Several researchers deal with identifying the quality criteria of joy-of-use and also propose general guidelines for the design of products and services (cf. Hassenzahl et al. [2000, pp. 201-208], Overbeeke et al. [2004, pp. 7-17], Norman [2004, p. 221], Jordan [2003, pp. 1-10]). Nevertheless, most publications focus either on product or on software design. A specific investigation of the experiential effects of certain technology combinations for the development of experiential self-service systems is not part of their research. Furthermore, most of the studies focus on single experiential effects (e.g., multi-modal store design) instead of considering the holistic view of customer experience research within the design process. The need for further research in this area is also emphasized in the works by Verhoef et al. [2009, p. 34] or Pantano and Di Pietro [2012, p. 9].

While providing standard services and products is not sufficient anymore to sustain in a fierce competition, companies need to find new ways to differentiate. As a relatively new research discipline, CEM is regarded as an extension of the more traditional Customer Relationship Management (CRM) [Hippner and Wilde 2006, pp. 491-492]. The assumption is that consumers do not always make rational decisions and increasingly accredit value to the emotional over the pure functional aspects of a product or service [Berry et al. 2002a, p. 85]. CEM covers the management of all single experiences a customer makes with a brand and its products or services, including all possible consumer touch points [Schmitt 2003, p. 17; Schmitt and Mangold 2004, p. 23]. To create experiences at a specific touch point, researchers investigate the effects of different experiential features/dimensions [Schmitt and Mangold 2004, pp. 38-43; Gentile et al. 2007, pp. 395-410]. The more experiential dimensions a service offer contains, the better the experience for the consumer. This enables generating a positive customer value and finally enhancing the probability of a purchase [Schmitt and Mangold 2004, pp. 90-92]. Although technology is identified to play a major role in delivering experiences, theory and practice lack knowledge about the impact of the technological design, measurement models, and practical examples that provide design guidelines.

Interestingly, it is possible to identify common trends and research gaps that are addressed by all three disciplines. They tend to value the customer as the center of all efforts. It is rather about providing positive emotions and experiences than delivering simple products or services. Moreover, researchers of all domains see potential in using technology as an appropriate means for reaching this goal. Consequently, the same motivation for research arises from all three perspectives: services, marketing (represented by CEM), and technology (represented by HCI). Scientists ask for a deeper understanding of how technology influences consumer behavior, for improving the knowledge about the distinct drivers of experiences, for new evaluation methods, as well as for practical studies and experiments to test new concepts. Although first approaches in this direction already exist, they mainly consider SSTs as pure software interfaces and not as stand-alone kiosk systems comprising both, software and hardware components.

This research focuses on a more detailed analysis of the experiential effects of self-service system design. The goal is to narrow the gaps between the disciplines by designing and evaluating SSTs, their software and hardware combinations, and to provide design and management recommendations for SST implementations. In doing so, utilitarian and hedonic elements of different research disciplines are combined in order to develop a model for the holistic assessment of SSTs. This model consists of two parts: a construct used to identify the experiential characteristics of concrete SST instantiations as well as a causal model used to explore interdependencies of the elements relevant for the acceptance and enjoyment of SST [Zagel et al. 2014b, pp. 177-190]. Included is the assessment of the specific technology combinations, taking the customer's personality (e.g., age, gender, technology readiness) into account. By also integrating observations as a means for emotion and acceptance measurement, a substantial limitation of traditional acceptance measurement models, the self-reported use, is mitigated [Legris et al. 2003, p. 202]. A deficit of current acceptance research is also seen in the lack of constitutive goals. Vogelsang et al. [2013, p. 1428] state that today, researchers merely try to explain the acceptance construct itself. However, recommendations for actions that can be taken to improve it are not considered so far. Measuring and evaluating the correlations between positive or negative experiences and emotions towards technology use allows the enhancement of the scientific knowledge base for future utilization. This knowledge enables an iterative enhancement of the utilitarian and hedonic values in order to create or enhance enjoyable service concepts. Traditional brick-and-mortar retail fashion stores serve as an appropriate context for validating the theoretical concept. A customer journey map supports the selection of five specific use cases for the creation of interactive self-service systems, taking into account generally accepted excitement dimensions. Side aspects also influencing the overall customer experience like price, promotion, store employees, previous experiences, the attitude towards the brand, or the general retail atmosphere are not in focus of the research presented.

1.4 Research Questions

Following the discussions disclosed above, this work touches on the research gaps identified. The findings are transcribed into a set of research questions based on the structure disclosed before (cf. Figure 1.2).

The framework section creates the theoretical basis of the research. It is required to first identify the single elements important for the design and development of experiential SSTs (RQ 1). Customer experience is only vaguely defined in current literature and lacks application in the context of SSTs. Hence, it is important to set a foundation in the form of a common understanding of the construct and its functional and experiential elements. This also needs to happen from the perspective of the other two research domains: services science and HCI.

Taking these deliberations into account, the second research question builds on the research demand arising in literature and practice. With the goal of deriving a systematic experience design strategy, special focus is on the creation of technological artifacts for retail business use. In order to assess and to compare different self-service instantiations and their respective technology combinations, an evaluation methodology is required. Consequently, the third guiding question is: "How can service fascination and its dimensions be measured?" In order to answer this question, an evaluation model needs to be created that focuses on the specific context of electronic services. Previously identified elements need to be transferred into latent variables and constructs allowing an in-depth assessment of the experiential dimensions and the identification of interdependencies.

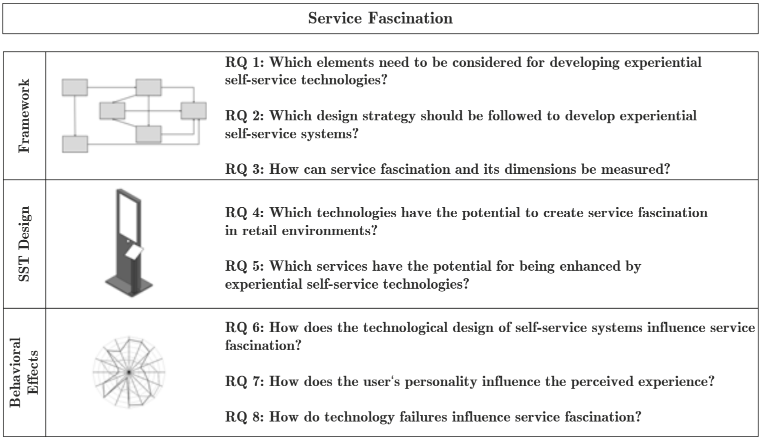

Figure 1.2 – Research Questions

It is important to know which technologies offer the potential for creating positive consumer experiences. SSTs may leverage numerous technologies and digital content, while applying a variety of methodological concepts in the design phase. Therefore it is required to identify technologies for application in the given environmental context. An answer to this research gap (RQ 4) is given through a technology portfolio analysis.

The goal is to transfer the scientific findings to practical use cases. In order to reach the target of differentiation best it is important to define the most qualified services, leading to the next question: "Which services have the potential for being enhanced through experiential self-service technologies?" Customer journey mapping serves as an appropriate method to identify the most relevant customer touch points to be enhanced by experiential SSTs.

Nevertheless, technologies have to be selected that not only fit the given use case but also have the capability of serving functional as well as experiential needs. RQ 6 therefore deals with the impact of the distinct drivers of customer experience towards the overall perception and acceptance of the service: "How does the technological design of self-service systems influence service fascination?" Use cases vary in their functional and hedonic goals. It is required to learn if targeting both, utilitarian and hedonic goals is needed to accomplish user acceptance. The questions are answered by developing and evaluating five selected self-service systems. These systems build on the customer journey and the technology portfolio identified before.

For being able to develop optimized services for specific focus groups the question arises of how the customer's personality (age, gender, technology readiness) will affect the impression of the services created (RQ 7). Technology use always involves the risk of malfunction or failures. As low service quality can lead to customer dissatisfaction, the question is how SST failures will influence the perceived experience.

Ultimately, the goal of providing the consumer with fascinating services and experiences is business-related. Offering high quality services should lead to a more positive perception of the brand and finally to a differentiation from competitors. Hence, the overall goal is to support service designers and brand managers with knowledge for selecting appropriate technology combinations for future developments in consideration of the targeted consumer group.

1.5 Research Design

Within this research artifacts are created and evaluated, serving the purpose of improving the effects of current self-service solutions. Hence, the research design follows the constructivistic paradigm of design science. Instead of trying to understand reality like in social and natural sciences, the goal is to create artifacts that serve human needs [March and Smith 1995, pp. 251-266]. The types of artifacts include constructs, models, methods, and instantiations [March and Smith 1995, p. 255]. As a problem solving paradigm the goal is to meet challenges in an innovative way and to improve effectiveness and efficiency of existing solutions [Hevner et al. 2004, pp. 75-105; Hevner and Chatterjee 2010, p. 5].

Building on the work of March and Smith [1995, pp. 251-266] and Hevner et al. [2004, pp. 75-105], Peffers et al. [2006, pp. 83-106] create a generalized process for design science in IS research. The process depicted in Figure 1.3 includes the following six steps: problem identification and motivation, objectives for a solution, design and development, evaluation, and communication [Peffers et al. 2006, pp. 89-92]. The principal goal is to add on existing knowledge of the respective domain [Gregor 2006, p. 629].

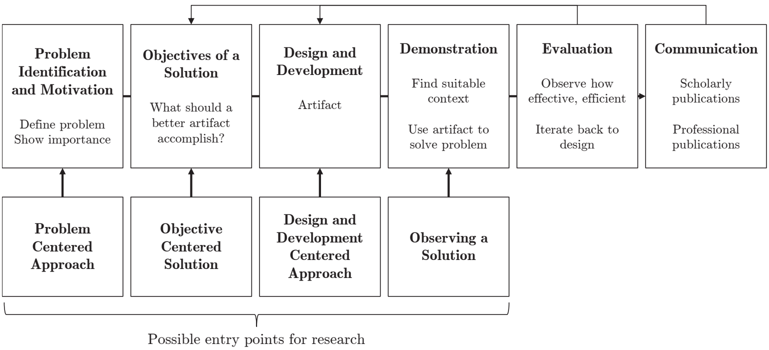

Figure 1.3 – Design Science Research Process Model
adapted from Peffers et al. [2006, p. 93]

The research design (cf. Figure 1.4) furthermore follows a problem centered approach [Peffers et al. 2006, p. 93]. Based on a review of existing literature, research gaps are identified and a new concept for the design and assessment of experiential self-service systems is developed. This model builds on theories of the consumer experience domain as well as commonly accepted research in services science (especially technology adoption) as well as HCI. A modified technology portfolio analysis as well as customer journey mapping are used for the identification of use cases and appropriate technologies for SST design.

To assess the impact of innovative technologies, five service-oriented artifacts in the domain of retail fashion business are developed. Following Wu's proposal of a multi-method approach for the assessment of technology adoption, the resulting self-service systems are evaluated using the previously designed evaluation model, which also includes the observation of consumer behavior [Wu 2009, pp. 1-10]. An analysis and comparison of the experiential effects allows drawing conclusions towards the effectiveness of respective technology combinations. The goal is to provide managerial decision support by deriving recommendations for the development of new as well as the improvement of existing self-service systems. Finally, the findings indicate possibilities for future research.

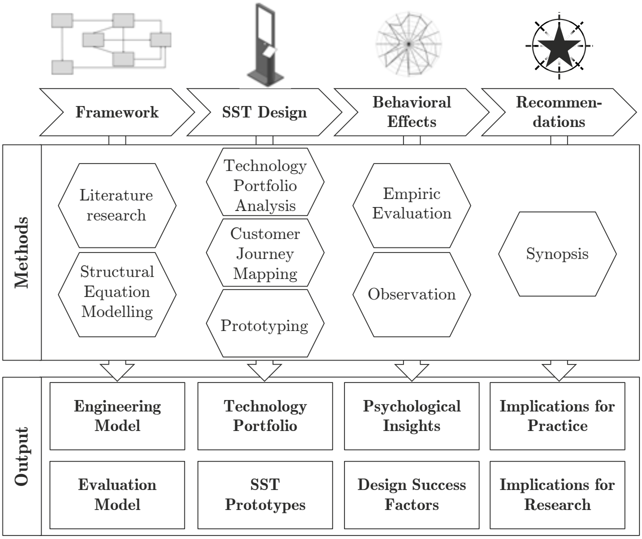

Figure 1.4 – Research Design

1.6 Structure

The structure of the thesis is guided by the research design introduced in the previous chapter (cf. Figure 1.5). The main chapters address the research questions presented in Chapter 1.4. After motivating the research topic, the second chapter provides a conceptual foundation by giving a detailed overview about the state of the art in services science, HCI, and CX research. This includes a detailed illustration of standards, methods, and classifications. Common gaps in current research are disclosed, subsumed, and taken as a basis for the subsequent work.

After identifying the most important elements, Chapter 3 presents the service fascination engineering model. It represents a structured approach that can be used to strategically innovate, design, assess, and refine experiential SSTs. For that purpose existing methodologies of the underlying domains are reused and recombined. Predominant acceptance and emotion research methodologies provide the basis to create a concept for the assessment of utilitarian and experiential factors of SST: the service fascination evaluation model. Divided into a subjective as well as an objective part, it is used to assess strengths and weaknesses of concrete SST artifacts. Observations conducted before, during, and after the user's interaction with the system complement the findings gained through personal, subjective reports. Next to utilitarian and hedonic aspects the evaluation model also includes variables assessing the user's technology readiness and trust. In form of a causal model it can therefore not only be used to derive knowledge about the absolute manifestation of a construct, but also about dependencies amongst the elements.

Chapter	Sections
Chapter 1: **Introduction**	1.1 Motivation
	1.2 Objective and Methodology
	1.3 Related Research
	1.4 Research Questions
	1.5 Research Design
	1.6 Structure
Chapter 2: **Conceptual Foundations**	2.1 Objective and Methodology
	2.2 Services Science
	2.3 Human-Computer Interaction
	2.4 Customer Experience Management
	2.5 Interim Conclusion
Chapter 3: **Service Fascination**	3.1 Objective and Methodology
	3.2 Engineering Model
	3.3 Evaluation Model
	3.4 Interim Conclusion
Chapter 4: **Experiential Self-Service Systems**	4.1 Objective and Methodology
	4.2 Context Analysis
	4.3 Interactive Shopping Window
	4.4 Low-cost Body Scanner
	4.5 Product Experience Wall
	4.6 Interactive Fitting Room
	4.7 Social Mirror
	4.8 Interim Conclusion
Chapter 5: **Conclusion**	5.1 Summary
	5.2 Research Results
	5.3 Implications for Future Research

Figure 1.5 – Thesis Structure

Chapter 4 deals with self-service artifacts supported by the findings of the technology portfolio analysis. The service systems are selected on basis of the customer journey in retail fashion stores. The chapter is split up into sections addressing the following artifacts: an interactive shopping window, a low-cost body scanner, a product experience wall, an interactive fitting room, and a social media mirror. Following the understanding of prevalent literature and the service fascination engineering model, all artifacts are implemented under consideration of the distinct experiential factors. The development of the prototypes follows a user-centered design approach applying den Hertog's 4D model of service innovation. This chapter also includes the assessment of the artifacts based on the proposed evaluation model. The results of each analysis are transferred into improvement recommendations for enhancing the SST's utilitarian and emotional value. The prototype evaluations are summarized, compared, and discussed. A breakdown into the basic and experiential features allows not only a comparison of the artifacts as a whole, but also the deduction of individual effects of technology combinations. The influence of gender and age towards the perception of the SSTs is analyzed.

Finally, Chapter 5 presents a summary of the thesis, an overview about transferable results, and suggests options for future research. Besides the proposal for additional empirical studies, these also include recommendations for improving the theoretical model as well as options to identify the economic value of customer experience concepts.

Chapter 2

Conceptual Foundations

2.1 Objective and Methodology

"The lesson for retailers in this new experiential shopping world is simple: Make sure you define the store in terms of the experiences you deliver to the consumer, not the thing that you sell" [Danziger 2006, p. 257].

The goal of this chapter is to introduce the concept of service fascination as well as its underlying research fields and their terminologies. Based on a detailed literature review, an exposition of current research gaps and challenges provides the foundation for the research presented. As stated before, this thesis focuses on technology-based self-service systems to arouse positive customer emotions and satisfaction with the service provided which in turn differentiates the supplying company from its competitors. Zagel et al. [2014b, p. 180] define service fascination as follows:

Service Fascination

> can be described as an extraordinary positive emotional state arising through conscious and subconscious effects of self-service technology use. The goal is to apply innovative technologies not only to provide better services, but to fulfill the affective, cognitive, behavioral, sensory, and social experience dimensions, leading to active positive promotion and an innovative perception of the service provider.

Based on this definition the concept includes aspects of three underlying fields of research (cf. Figure 2.1): services science, human-computer interaction, and customer experience management. These provide the theoretical foundations, including definitions and a variety of engineering and evaluation methods.

C. Zagel, *Service Fascination,* DOI 10.1007/978-3-658-11673-6_2,

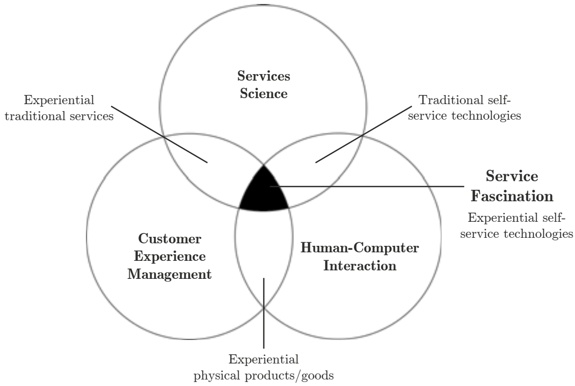

Figure 2.1 – Service Fascination - Classification

Services, and especially self-services, act as the primary object of investigation in the research presented. They are explored within the services science discipline that focuses on designing, engineering, and evaluating new, intangible service concepts instead of dealing with physical goods. The goal of the service fascination concept is to provide the consumer with exceptionally well designed, value-added services and, with a specific focus on retailing, to change the way of how products are presented and sold. Next to solely serving functional purposes, emphasis is placed on the additional delivery of hedonic values. The implementation of solutions for combinations of concrete consumer needs also represents the basis for successful innovation management [Voigt 2008, p. 403].

As a second component the definition above contains a technical element, as the self-services are realized by applying innovative technologies. Within service provision these technologies are not only used for delivering the requested performance but in particular also serve as the respective service interfaces towards the consumer (represented through the HCI research field). These interfaces need to be created in an appealing, intuitive, and easy to use way in order to meet the requirements of the users. Raskin [2001, p. 22] emphasizes that for the user the interface represents the essence of the product or service. Usability, joy of use, ease of use, user experience, and quality of use are only some of the disciplines contained in the HCI research stream [Burmester 2007, p. 246].

Customer experience management finally covers the psychological and marketing-related perspectives. It is used to strategically design holistic experiences by evoking positive emotions and provoking desired consumer behavior. "Experiences [...] connect the company and the brand with the customer's lifestyle and place the purchase occasion in a broader social context. [...] In sum, experiences provide sensory, emotional, cognitive, behavioral, and relational values that replace functional values" [Schmitt 1999, p. 26].

Many practical examples exist for combinations of two of the research areas (cf. Figure 2.1). These traditional combinations can be found for example in exciting non-electronic services like a well executed haircut (combining services and CX), the provision of purely functional self-service technologies like ticketing kiosks (combining services and HCI), or emotional physical products like a visually attractive hifi audio system (combining HCI and CX). Much less attention is paid so far to the rather new combination of all three research areas. Nevertheless, and in consideration of the current development towards an experience economy [Pine and Gilmore 1999, pp. 97-105], it is exactly this combination that offers a high potential for differentiation. Service fascination research therefore focuses on the sweet spot of the interceptions with the goal of creating experiential self-services by applying innovative technologies and state of the art HCI methodologies.

The following sections provide an overview about the three underlying research areas including design, engineering, and evaluation methods of highest relevance for the context of service fascination research. Gaps in current research are disclosed for each domain and overlaps are identified. A combination of the methods discussed is used as a basis for building the theoretical service fascination research model that is applied within the design science process.

2.2 Services Science

2.2.1 Definition

The current understanding of the term "services" is introduced in the 1930s and used to describe the residual economic category next to agriculture and manufacturing [Chesbrough and Spohrer 2006, p. 36]. Today, services represent far more than half of the economy of industrialized nations [Paulson 2006, p. 18]. While "goods increasingly become commodities, service is becoming the key differentiator even in the goods sector" [Rust and Miu 2006, p. 49]. This transition from the traditional, tangible, and source-oriented logic to a service-oriented perspective is also called service-dominant logic [Vargo and Lusch 2004, pp. 1-17; Vargo and Lusch 2006, pp. 43-56; Lusch et al. 2007, pp. 5-18].

Several researchers provide scientific definitions for services. Corsten and Gössinger [2007, p. 21] arrange these approaches into three groups: enumerative definitions (listing examples for services), negative definitions (separating services from physical goods), and explicit definitions based on constitutive aspects. A very general view is that services can be seen as bundles of functionalities that serve a certain need [Brettreich-Teichmann 2007, p. 4]. In literature (cf. Zeithaml et al. [1985, pp. 33-46], Bodendorf [1999, pp. 5-6], and Bruhn [2006, pp. 19-33]), services are characterized by the following features:

- intangibility,
- heterogeneity,
- inseparability,
- perishability,
- and requirement of an external factor.

Being executed as actions and performances, services can be described as intangible. They usually "cannot be counted, measured, inventoried, tested, and verified in advance of sale" [Parasuraman et al. 1985, p. 42]. Intangibility is referred to as the main differentiator in comparison to traditional, physical goods, serving as the foundation for all further differences [Bateson 1977, pp. 1-30]. Services are heterogeneous. The more complex a service is, the harder it is for the service supplier to deliver uniform quality. This means that consistency in service execution is difficult to ensure [Zeithaml et al. 1985, p. 34]. Moreover, the uno-actu principle defines the inseparability of production and consumption of services. Berry et al. [2002b, p. 7] state that inseparability "means that consumers must synchronize their availability with the availability of the service". Services are furthermore produced in interaction with an external factor. This external factor is either used or transformed and is represented by either a person, an object, information, or a nominal good, implying at least an indirect consumer contact [Bruhn 2006, p. 22; Bruhn and Meffert 2012, p. 47].

The majority of authors follows the idea of describing services on basis of the three dimensions (cf. Figure 2.2) elaborated by Hilke [1989, pp. 10-12] and Corsten [1990, pp. 18-19]. This approach, concentrating on the constitutive aspects of services, is widely approved in science and taken as a basis for subsequent work and service definitions.

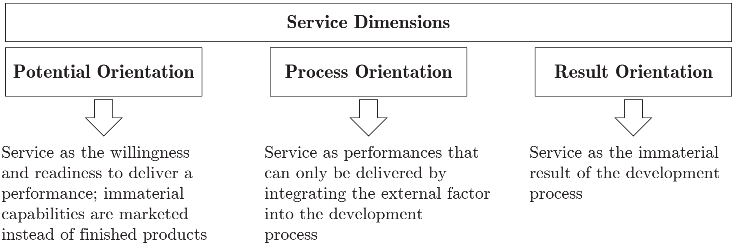

Figure 2.2 – Service Dimensions
adapted from Hilke [1989, p. 10] and Corsten [1990, p. 18]

Based on Raabe [2011, pp. 21-23] it is possible to describe the dimensions as follows:

- **Potential Orientation:** Before being able to deliver a performance, the service provider has to ensure the capability and the resources to do so. The potential dimension therefore includes all prerequisites (internal factors) that enable the supplier to perform the desired task. Next to physical, psychological, and mental skills, these also include the tools and equipment that may be needed to deliver the performance.

- **Process Orientation:** Delivering a service requires the utilization of the external factor, e.g., represented through the consumer. This also implicates the uno-actu-principle described above, stating that production and consumption of a service happen at the same time, preventing the pre-production of services [Corsten 1990, pp. 18-19]. The dimension includes all process steps that lead to the service provided.

- **Result Orientation:** This dimension focuses on the traditionally immaterial result of the service. Nevertheless, as the service delivery process is applied to an external factor that is used, modified, or transformed, the result often also has tangible components.

This specification leads Bruhn and Meffert [2012, p. 25] to provide the following constitutive service definition, taken as a working basis for this thesis: "Services are independent, marketable performances that are linked to the provision and/or the deployment of capabilities (potential orientation). Internal and external factors are combined within the context of the service provision process (process orientation). The factor combination of the service supplier is applied with the objective of providing a benefit to the external factor - humans or their objects (result orientation)."

In the academic community, services and their related innovation efforts are researched within the services science discipline [Bitner et al. 2008, pp. 227-228]. "Services science is a multidisciplinary field that seeks to bring together knowledge from diverse areas to improve the service industry's operations, performance, and innovation. In essence, it represents a melding of technology with an understanding of business processes and organization" [Paulson 2006, p. 18]. The importance of technology is also mentioned by Rust and Miu [2006, p. 49] who make clear that a "computing-driven revolution is under way in the global economy guided by the principle that every business must become a service business in order to survive". While describing service systems as "value-co-creation configurations of people, technology, value propositions connecting internal and external service systems, and shared information", Maglio and Spohrer [2008, p. 18] define services science as "the study of service systems, aiming to create a basis for systematic service innovation" [Maglio and Spohrer 2008, p. 18]. In their work, Bitner et al. [2008, p. 228] finally define the discipline as follows: "Services Science is an emerging discipline that focuses on fundamental science, models, theories and applications to drive innovation, competition, and quality of life through service(s)."

Based on its key research issues, Hidaka [2006, p. 41] describes services sciences as a multidisciplinary field and "significant in that they are aimed at creating innovation in services by fusing all the knowledge and methodology derived from business, natural sciences, engineering, and social sciences, as well as the demand-side (consumer-side) innovations" (cf. Figure 2.3).

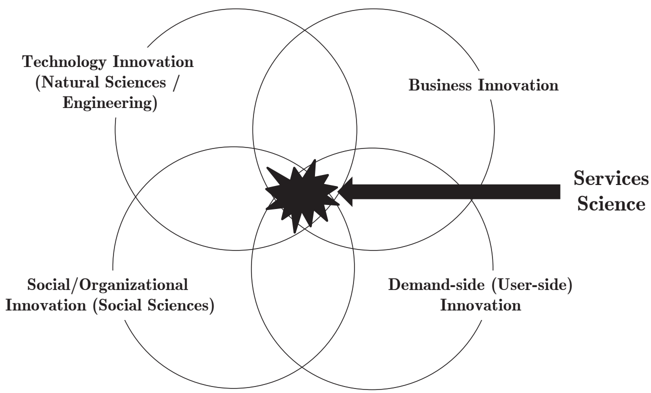

Figure 2.3 – Services Science Research Discipline adapted from Hidaka [2006, p. 41]

Building on these classifications, the following sections provide an overview about current research trends in services science. Special focus lies on electronic services, service engineering, as well as the assessment of service quality.

2.2.2 Research Trends

2.2.2.1 Self-Services

"The traditional boundary between provider and customer can shift toward the self service, with the customer performing many of the tasks previously done by the provider" [Campbell et al. 2011, p. 173]. Meuter et al. [2000, p. 50] explain self-services by stating that they "are technological interfaces that enable customers to produce a service independent of direct service employee involvement". The same argumentation is followed by Salomann et al. [2006, p. 66] who argue that "customers themselves perform tasks that were once done for them by others". Building on these definitions it becomes obvious, that self-service providers outsource tasks to the consumer, while the role of the service employee, e.g. in the physical shop, is increasingly repressed.

The recent technological developments, especially in the area of information and communication technology (ICT), lead to a new understanding in the service domain. Meffert [2001, p. 943] describes the evolution of ICT and especially the Internet as an important driver of modern services marketing. This development leads to the emergence of self-services that are realized by using different kinds of technologies, not only to substitute the service encounter, but also to provide the consumer with digital contents in a fast, time and location independent manner.

Hence, and in contrast to traditional services, these electronic services (also called e-services) make use of ICT to deliver the intended results. This can happen for example by using electronic networks. Most authors associate e-services with services that are provided through the Internet as a time and space bridging media [Grönroos et al. 2000, p. 245; de Ruyter et al. 2000, p. 186; Breithaupt 2002, p. 185; Gillig 2011, p. 1]. Nevertheless, there is also another understanding, taking the definition to a more general level and the technology mediation (independently from the Internet as a medium) as the basis for a definition (cf. Wegmann [2002, p. 247], Wirtz and Olderog [2002, p. 515], Rowley [2006, p. 341], Meffert and Bruhn [2012, pp. 275-276]). Bruhn [2002, p. 6] clarifies the differences between traditional and electronic services using the delimitation presented in Figure 2.4.

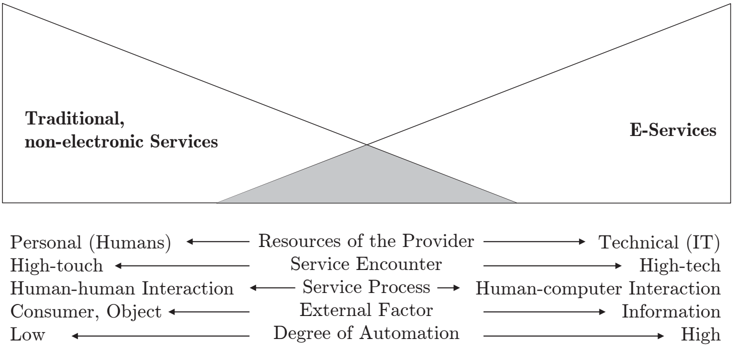

Figure 2.4 – Delimitation of E-Services
adapted from Bruhn [2002, p. 12]

While with traditional services the service encounter, constituting the interface between provider and consumer, is represented by human service personnel, e-services use electronic platforms that are provided via modern communication technology. Consequently, the consumer is interacting with a computer system instead of a human. Also electronic services involve the integration of an external factor. E-services require the consumer to functionally contribute, providing information to the system. Furthermore providing services in a digital form necessitates a standardization of the performance at least in the phase of interaction, making it possible to automate the process. [Bruhn 2002, pp. 8-13]

Introducing electronic self-services leads to benefits, but also may involve shortcomings on the provider as well as the user side. Next to saving costs and time, the goal for companies is to improve customer satisfaction [Bitner et al. 2002, p. 98; Salomann et al. 2006, p. 73]. But also an increased freedom of choice for the consumers as well as the elimination of media conversions is mentioned [Salomann et al. 2006, p. 73].

Technologies take on a special role in services science. They can support the process of service creation, either representing alternative possibilities for service delivery as a whole or acting as support tools for improving service delivery [Meffert and Bruhn 2012, p. 143].

2.2.2.2 Self-Service Technologies

The definition of self-service technologies is closely linked to the one of electronic self-services. Beatson et al. [2006, p. 853] describe SSTs as "where customers deliver service themselves using some form of a technological interface". While research in e-services focuses on the services and which traditional tasks can be improved through electronic media, SST research has a stronger focus on the technological components. SSTs represent a relatively new service delivery method [Beatson et al. 2006, p. 854], gaining more and more importance as technology advances [Beatson et al. 2006, p. 854; Beatson et al. 2007, p. 75; Jia et al. 2012, p. 209].

SSTs traditionally represent IT systems that are used to automate processes in a company's front office and to replace manual human activities. Tasks that have been performed by the service supplier before are are now handed over to the customer in a do-it-yourself manner [Mertens et al. 2012, pp. 106-108]. Today, most e-services provided through SSTs follow utilitarian goals. Implementations can be done through electronic platforms, for example provided through the Internet and using the consumer's own interaction devices (e.g., home banking or travel booking applications), or in form of a combination of hardware and software (e.g., ATM machines or information kiosks). [Bodendorf 1999, pp. 23-25; Meuter et al. 2000, p. 52; Mertens et al. 2012, pp. 108-122; Meffert and Bruhn 2012, p. 359]

In their foundations article, Meuter et al. [2000, p. 52] categorize the types of SSTs using a matrix of interface (the technology) vs. purpose (the service), providing an overview about the range of different SSTs based on previous literature. This classification, depicted in Table 2.1 is still valid today and applied in subsequent research (cf. Nysveen and Pedersen [2011, p. 2] or Bruhn and Meffert [2012, p. 359]).

For automating as well as for refining services, the internal factor is of particular importance. This requires the service provider to ensure the availability and performance of the internal capabilities [Meffert and Bruhn 2012, pp. 251-253].

Lee and Allaway [2002, pp. 553-554] state that "firms that replace or augment service personnel with SSTs can lower delivery costs and release service personnel from routine tasks [...]. In addition, these technology-based service innovations can potentially meet customer service needs across a wider range", additionally enhancing customer satisfaction "and fascination with the capabilities of the SST". The independence of service provider availability also leads to what Berry et al. [2002b, p. 7] call "access convenience". "Technologies specifically designed to improve customer convenience can affect each type of service convenience" [Berry et al. 2002b, p. 9]. The use of SSTs can also lead to an improved brand image, e.g. by positioning the company as an innovation leader, or by providing extraordinary services leading to positive customer experiences [Salomann et al. 2006, p. 73].

Table 2.1 – Categories and Examples of SSTs in Use
adapted from Meuter et al. [2000, p. 52]

Purpose/ Interface	*Customer Service*	*Transactions*	*Self-Help*
Telephone/ Interactive Voice Response	• Telephone banking • Flight information • Order status	• Telephone banking • Prescription refills	• Information telephone lines
Online/ Internet	• Package tracking • Account information	• Retail purchasing • Financial transactions	• Internet information search • Distance learning
Interactive Kiosks	• ATMs • Hotel checkout	• Pay at the pump • Hotel checkout • Car rental	• Blood pressure machines • Tourist information
Video/CD			• Tax preparation software • Television/ CD-based training

Nevertheless, the acceptance of technology-based service encounters heavily depends on a reliable functionality [Bitner 2001, pp. 10-11; Meffert and Bruhn 2012, p. 359]. As shortcomings of SSTs researchers identify the potential lack of acceptance, e.g. because tasks now have to be fulfilled by the consumer himself/herself instead of the traditional service supplier. Also missing attractiveness and ease of use are mentioned as a back-draw. Poor interface design leads to anxiety of non tech-savvy consumers and the experience of stress. Finally, consumers might perceive a lack of personal contact when interacting with SSTs. [Salomann et al. 2006, pp. 73-74]

The integration of SSTs with traditional customer touch points, e.g. in the form of in-store kiosks in retail environments, is one of the major trends in the self-service domain [Salomann et al. 2006, p. 81]. With the traditional understanding of e-services, e.g. provided through the Internet, "customers have to rely entirely on sight and sound" due to the missing face-to-face interaction with a human employee in the respective physical environment [Rowley 2006, p. 341]. With physical self-service encounters (for example represented through kiosk systems) applying innovative technologies and interaction types, it is possible to bypass this drawback. It is the service supplier that decides on the technologies to be used in order to create an attractive and multisensory environment for the consumer [Zagel et al. 2014b, p. 177].

2.2.2.3 Service Excellence

An important step towards an intensive customer orientation is done within the paradigm of service excellence. The aim is to provide the customer with exceptionally well designed services through a holistic alignment of the company's organization and processes on quality delivery [DIN Deutsches Institut fuer Normung e.V. 2011b, p. 12]. Instead of being able to once reach and keep an excellent service level companies need to consistently keep up with rising consumer expectations to ensure a long-term competitive advantage [Cina 1990, p. 40].

The service excellence concept is standardized in DIN SPEC 77224 and focuses on personal as well as surprising services exceeding usual performance and levels (cf. Figure 2.5). Referring to Johnston [2004, p. 131], service providers first need to fulfill the general service requirements before being able to differentiate through exceptional add-ons.

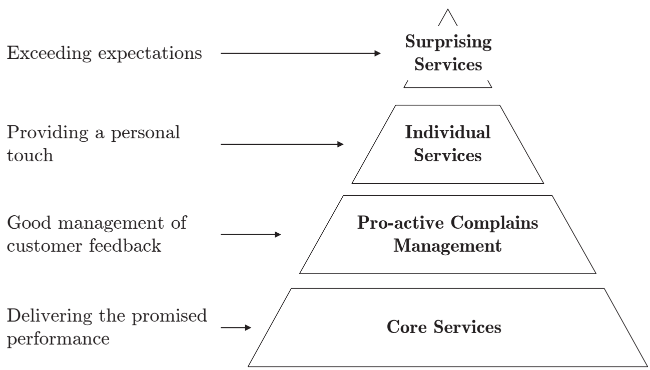

Figure 2.5 – Service Excellence Pyramid
adapted from DIN Deutsches Institut fuer Normung e.V. [2011b, p. 7]

In total, and referring to the definition of DIN EN 77224 [DIN Deutsches Institut fuer Normung e.V. 2011b, pp. 12-14], service excellence can be described with a model consisting of seven elements (cf. Figure 2.6). First of all, the top management needs to actively support the excellence strategy in order to form a service excellence oriented culture. As a second step, all internal and external resources need to live the new culture.

This applies especially to all employees being in direct contact with the customers. An excellence orientation furthermore includes mechanisms to identify and to prevent failures and waste. For providing positive experiences it is required to identify and analyze the relevant moments of truth[1]. The customer's expectations need to be compared to the supplier's performance, also for gaining knowledge about previous experiences. This leads to the fact that the overall perception of services is strongly affected by surprising service moments. Innovating services allows companies to come up with exceptional offers and to provide a sense of newness. This service innovation process includes all tasks from identifying relevant innovations for selected target groups up to the implementation of an internal innovation culture. For a persistent improvement of the service experience consistent evaluations are required. These not only include an assessment of the customer's excitement, but also of the employee's. Finally, a profitability analysis based on key performance indicators allows to judge the effectiveness of the actions in comparison to its costs. [DIN Deutsches Institut fuer Normung e.V. 2011b, pp. 12-13]

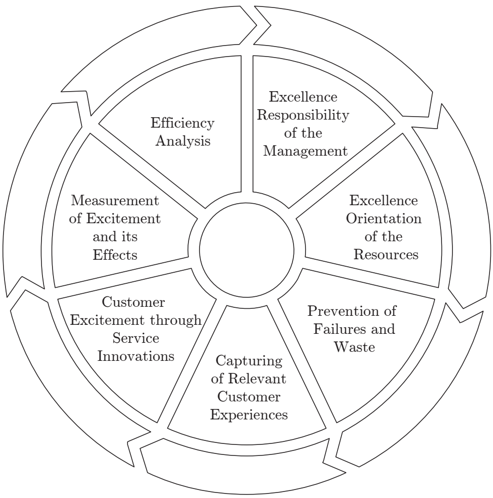

Figure 2.6 – Service Excellence Model
adapted from DIN Deutsches Institut fuer Normung e.V. [2011b, p. 14]

[1]Albrecht [1988, p. 26] defines a moment of truth as "any episode in which the customer comes into contact with the organization and gets an impression of its service".

Although the concept as such includes various aspects and a holistic view on the topic, the employee is considered the most important component, leading to the fact that many authors focus on researching the influence of the service employee towards the customer's perception of the service (c.f. Cina [1990, p. 41], Coenen [2007, pp. 423-440], Gouthier [2007, pp. 383-397], or Wirtz et al. [2008, pp. 4-19]). While the importance of human personnel in delivering excellent services is intensively researched since decades, this is hardly the case for the role of IT [Jackson and Humble 1994, pp. 36-40; Wiertz et al. 2004, pp. 424-436].

2.2.3 Service Engineering

2.2.3.1 Process Model

In contrast to the development of physical goods, the design of services is largely handled in an unstructured way [Schreiner and Strauß 2004, p. 14; Meyer et al. 2008, p. 47]. Nevertheless, adjusting the service development activities to a logically structured process is especially important for designing innovative services [Bullinger and Meiren 2001, pp. 149-175]. As an interdisciplinary research field, service engineering (cf. Figure 2.7) deals with the systematic development of services, applying process models, methods, and tools, as well as with managing the service development processes [Fähnrich and Opitz 2006, pp. 97-98].

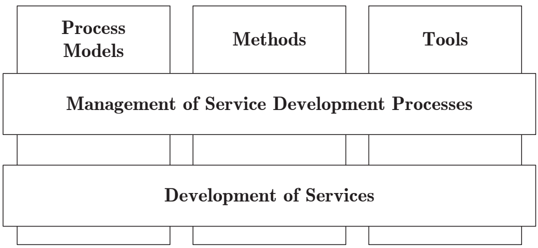

Figure 2.7 – Service Engineering Components adapted from Fähnrich and Opitz [2006, p. 97]

While service engineering is still considered to be a relatively young discipline, several approaches have been taken to define linear (cf. Edvardsson and Olsson [1996, pp. 140-164], Scheuing and Johnson [1989, pp. 25-34], DIN Deutsches Institut fuer Normung e.V. [1998, p. 34], and Ramaswamy [1996, p. 27]) as well as iterative (cf. Kingman-Brundage and Shostack [1991, pp. 243-261], or Jaschinski [1998, p. 93]) process or phase models for developing services [Bullinger and Meiren 2001, p. 160]. A comprehensive overview is provided in Daun and Klein [2004, pp. 43-67]. A prominent example is the DIN process from 1998 (cf. Figure 2.8), which is often taken as a basis for modifications or transferred to a circuit model [Daun and Klein 2004, p. 60].

Figure 2.8 – Service Engineering Phase Model
adapted from DIN Deutsches Institut fuer Normung e.V. [1998, p. 34]

Most of the models used for the strategic design of services show weaknesses like insufficient levels of detail, a lack of configurability, missing field-tests, or a lack of IT support. Daun and Klein [2004, pp. 43-67] therefore recommend to use modular models. An example is the process model by Meiren and Barth [2002, p. 20] that builds on the DIN process, but breaks down each process step into a number of modules. In addition to increased flexibility, these modules also allow the use of IT technologies to support the service development process [Herrmann and Klein 2004, pp. 175-203].

There are numerous methods that can be used in the service engineering process. They can be applied to analyze, to model, and to design products and processes, to support the service innovation management and to integrate customers into the design processes [Meyer et al. 2008, p. 48]. As only a few service-specific methods exist (e.g., service blueprinting or roll-concepts), most of them are adopted from other disciplines like traditional engineering or business administration (e.g., cost/benefit or competitor analyses, process modeling, or prototyping) and used to support single process steps. Deciding on a specific method usually depends on the complexity of the service to be developed and the current situation of the company. [Fähnrich and Opitz 2006, p. 98; Meyer et al. 2008, pp. 47-49]

Development processes and methods can be supported by tools. These can be realized as software platforms and systems that may facilitate the entire service engineering process [Fähnrich and Opitz 2006, p. 99].

2.2.3.2 Service Innovation

Within the service engineering process, generating new service ideas is leading the way for service excellence and thus for differentiating from competitors. While product innovation is researched since decades, service innovation draws interest just recently. Several models are presented by researchers that can be used to characterize innovation, particularly in the service area (cf. Gallouj and Weinstein [1997, pp. 537-556] or Barras [1986, pp. 161-173]). One of them is the four-dimensional (4D) innovation model by den Hertog and Bilderbeek [1999, pp. 2-30] respectively den Hertog [2000, pp. 491-528]. The basic idea is that, "[a]ccording to this model, effective service innovation may require changes across four major dimensions": the service concept, the client interface, the service delivery system, and new technological options [Menezes 2011, p. 29].

The conceptual model depicted in Figure 2.9 presents the four dimensions of service innovation and their intercorrelations [den Hertog 2000, pp. 491-528]. This model and its dimensions can be used to systematically describe the "practical development of new services" [den Hertog 2000, p. 494]. In den Hertog [2000, pp. 494-498] and den Hertog and Brouwer [2000, pp. 11-12] the authors describe the dimensions and their respective links to each other as follows:

- **New Service Concept:** The service concept represents the intangible characteristic of a service. It is either implemented in the form of a completely new idea, or as a concept that is transferred from another industry. Conceptual innovations usually deal with new service core tasks or innovative methods of how the core task is realized.

- **New Client Interface:** Another type of innovations is represented by the interfaces between the client and the service provider. As with many services the consumer acts as the external factor for service production, this type of innovation includes co-design and co-production of services just as the way of how consumers are addressed.

- **New Service Delivery System:** Many innovations involve changes to the internal organizational arrangements. This dimension includes the management of all internal factors (e.g., human employees, personal capabilities, and skills) as well as the backend tasks and systems required to deliver high quality services.

- **New Technological Options:** The technology dimension reflects the fact that many services require the usage of technologies. While not being relevant for all kinds of services, technologies often include a tremendous potential for innovation, either resulting in the creation of completely new or the improvement of existing services. [den Hertog 2000, pp. 494-498; den Hertog and Brouwer 2000, pp. 11-12]

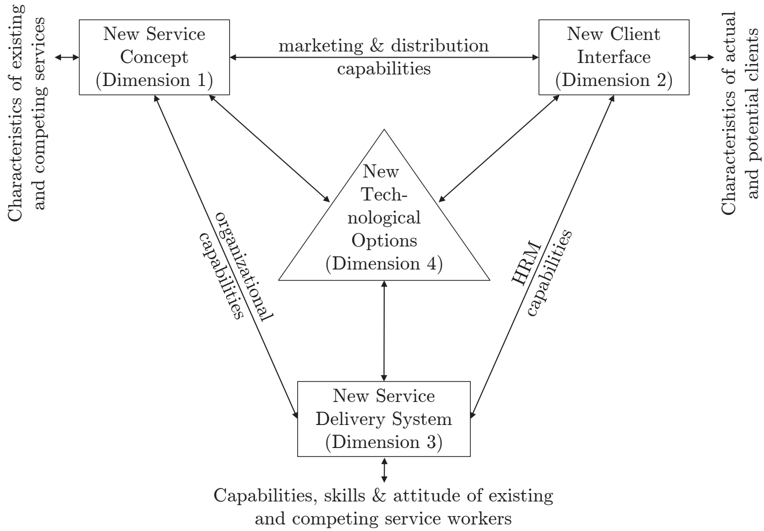

Figure 2.9 – 4D Model of Service Innovation
adapted from [den Hertog 2000, p. 495]

Nevertheless, it is often "hard to judge which of the four dimensions is most important for innovation as most innovations appear to be combinations of conceptual, technological and organisational innovations, often combined with new ways of relating to the consumer" [den Hertog and Brouwer 2000, p. 11]. This means, that an innovation in one of the domains also effects the others, represented through the linkages between the dimensions. While certain service innovations might be dominant in one of the dimensions, "it may be the combination of the four dimensions that ultimately characterizes each particular service innovation" [den Hertog 2000, p. 499]. In literature, the model is not applied to innovations related to SSTs, yet.

2.2.3.3 Evaluation Methodologies

2.2.3.3.1 Service Quality

Assessing the quality of services is an essential step, not only as part of the service engineering process, but within the whole services science discipline. The main aspect of service quality lies on the identification and description of the service dimensions and characteristics, and particularly in the derivation of implications for action for the upper management [Breithaupt 2002, p. 179]. With the rising importance of services as a means for economic differentiation it is getting even more important to ensure a high level of service quality to satisfy the customer. As in today's business customers expect the faultless functionality of products and add-on services as a standard element of any company's portfolio, an exceptional level of quality is in many cases the only possibility to differentiate [Bruhn 2006, p. 4].

Due to its intangibility and the fact that in comparison to a physical product a service cannot be assessed before purchase, it is hard to define measurements that explain the construct of service quality. Bruhn [2006, p. 27] as well as Meffert and Bruhn [2012, p. 88] explain it as a provider's ability to produce a primarily intangible service with the collaboration of the customer and meeting the customer's performance expectations. It is therefore made up of the sum of service characteristics needed to fulfill specific requirements. "Perceptions of the dimensions of service quality are viewed to be a function of a customer's prior expectations of what will and what should transpire during a service encounter, as well as the customer's most recent contact with the service delivery system" [Boulding et al. 1993, p. 7].

It is obvious that all service quality approaches follow the goal of comparing expected with delivered performances. Nevertheless, it is possible to identify two types of methods: event-oriented and feature-oriented ones. While event-oriented approaches deal with the identification and analysis of critical incidents, feature-orientation is used to create a final judgment by combining the outcome of individual characteristics analyses. Following the constitutive definition of services (cf. Chapter 2.2.1), especially the feature-oriented quality approaches are of importance. [Mörschel and Kopperger 2004, p. 123]

These approaches define quality based on the service dimensions, as illustrated in Figure 2.10. They are linked to the service dimensions explained in Chapter 2.2.1.

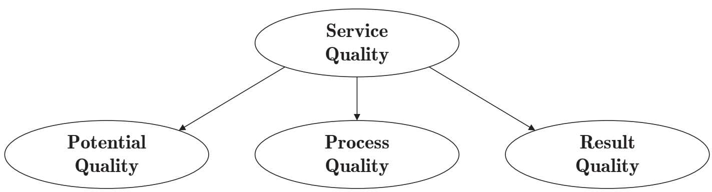

Figure 2.10 – Dimensions of Service Quality
adapted from Luczak [1999, p. 66]

Taking into account that not only the result of a service is of importance for satisfying a customer, also the company's service potential as well as the process quality are included in the assessment. This also takes the integration of the customer as the external factor within the service delivery process into consideration [Luczak 1999, p. 66]. A variety of methods can be used to analyze the manifestation of service quality in the respective dimensions. A comprehensive overview can be found in Bruhn [1997, p. 61] as well as in Bruhn [2001, pp. 87-147] (cf. Figure 2.11).

Nevertheless, the most well-known concept is the SERVQUAL model by Parasuraman et al. [1988, p. 23], which represents a multi-attributive approach. The authors propose a multiple-item instrument to measure service quality in the form of five dimensions, which could also be sorted into the potential, process, and result dimensions mentioned above: tangibles, reliability, responsiveness, assurance, and empathy. The tangibles dimension covers the appearance of the personnel and the physical environment the service is performed in. Reliability describes the level of how sure a customer can be that the service provider delivers what is promised. Prompt and courteous service as well as competence, friendliness, and trustworthiness are regarded important quality measures. Finally, empathy includes the willingness of the supplier to deliver to individual wishes and preferences. [Parasuraman et al. 1988, p. 23]

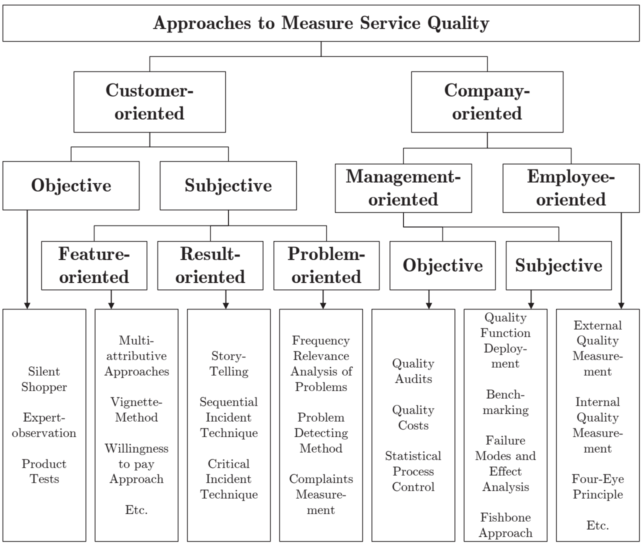

Figure 2.11 – Approaches for Service Quality Measurement adapted from Bruhn [1997, p. 61] and Bruhn [2001, pp. 87-147]

2.2.3.3.2 Technology Acceptance Model

The general models for the assessment of service quality cover a wide range of methods. However, there is a strong focus on the delivery of traditional services through human service encounters. With the emergence of e-services and SSTs, the methods need to be applied to the new context. Beatson et al. [2007, p. 86] for example suggest "quantitative methods such as a survey of customers or experimental research" as appropriate methods for assessing SST use, which have been proven to be successful in previous investigations (cf. Meuter et al. [2000, pp. 50-64] or Dabholkar and Bagozzi [2002, pp. 184-201]).

Especially for analyzing technology use and adoption, studies of the early 1980s propose the transfer and application of models of the empirical social research (e.g., Christie [1981]). Hence, for identifying potential issues in the design and acceptance of technology-based systems, researchers have begun to build on theories of innovation diffusion [Rogers 1962]. The focus of most studies is on identifying the influence of user's perceptions on the adoption of new IT solutions. The Technology Acceptance Model (TAM) by Davis, Bagozzi and Warshaw [Davis 1985, pp. 24-41; Davis 1989, pp. 319-340; Davis et al. 1989, pp. 982-1003] is one of the most frequently used adoption and intention models to explain the usage of technology and the acceptance of information systems (cf. Figure 2.12). It is based on Fishbein and Ajzen's Theory of Reasoned Action (TRA) [Fishbein and Ajzen 1975].

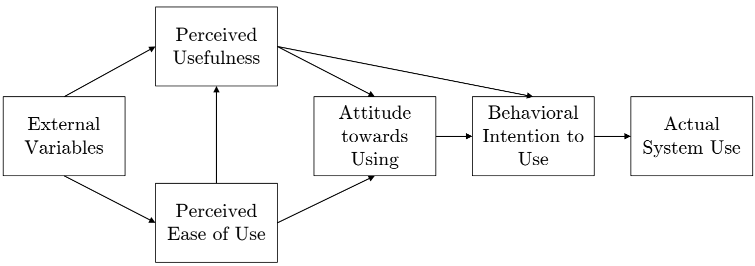

Figure 2.12 – Technology Acceptance Model
adapted from Davis [1985, p. 24], Davis [1989, pp. 319-340], and Davis et al. [1989, p. 985]

TRA explains a person's behavioral intention to use a technology through dependencies on the person's attitude as well as subjective norms. Theorizing the linkage between beliefs and behavior, the Theory of Planned Behavior (TPB) was developed to enhance the predictive validity of TRA by including the perception of behavioral control [Ajzen 1991, pp. 179-211]. Both act as underlying theories for numerous continuative models, theories, and concepts. Refining TRA, Perceived Ease of Use (PEOU) and Perceived Usability (PU) are considered the primary determinants of system usage. In this context Davis defines PU as "the degree to which a person believes that using a particular system would enhance his or her job performance", whereas PEOU is described as "the degree to which a person believes that using a particular system would be free of effort" [Davis 1989, p. 320].

Both, PU as well as PEOU, are influenced by certain system design features, called external variables. Comparably to the TRA, the user's perceptions originating through interaction with a technology determine his/her attitude towards using the system. This attitude determines the behavioral intention to use (BI) and in turn also the actual system use.

Since many decades the traditional TAM is subject to several modifications and extensions. In 2000, Venkatesh and Davis propose the so called TAM2 that integrates social influence processes (e.g., subjective norm, voluntariness, and image) as well as cognitive instrumental processes (e.g., job relevance, output quality, and result demonstrability) [Venkatesh and Davis 2000, pp. 186-204]. It is possible to explain the influence of peers on the adoption of new services. As in the original TAM "attitude towards using" is found to only partially mediate the effect of PU on BI, it is not adopted in TAM2 or most of the other TAM modifications. Additionally to the Unified Theory of Acceptance and Use of Technology (UTAUT) [Venkatesh et al. 2003, pp. 425-478], Venkatesh and Bala develop TAM3, a refined model used to "to understand how various interventions can influence the known determinants of IT adoption and use" [Venkatesh and Bala 2008, p. 273]. It includes eleven determinants of PU and PEOU as well as voluntariness and (previous) experience as moderating factors.

The importance of behavioral models and especially the TAM for the assessment of technologies is reflected in the numerous modifications and extensions for various fields of acceptance research. Lee et al. [2003, pp. 752-780], Legris et al. [2003, pp. 191-204], as well as Pantano and Di Pietro [2012, pp. 1-19] provide detailed overviews on TAM literature. Most extensions of the traditional TAM deal with the explanation of how specific external variables influence or mediate PU and PEOU and finally the willingness to use systems. Legris et al. [2003, pp. 196-197] state that "there is no clear pattern with respect to the choice of the external variables considered". Nonetheless, they can be used to better understand "what influences PU and PEOU". In early publications authors concentrate on the investigation of subjective norms (c.f. Venkatesh and Davis [1996, pp. 451-481] or Venkatesh and Davis [2000, pp. 186-204]), on education (c.f. Agarwal and Prasad [1997, pp. 557-582]), or on prior experiences with the system (c.f. Taylor and Todd [1995, pp. 561-570]). A large number of variables is found to affect general information system satisfaction [Legris et al. 2003, p. 203; Pantano and Di Pietro 2012, pp. 1-19]. More recent studies also focus on security aspects of interactive systems or online platforms (cf. Chen et al. [2004, pp. 8-31], Tsanakinjal et al. [2010, pp. 36-47], Gupta [2010, pp. 22-37]).

While for a long time treated as a side-topic, also the assessment of hedonic factors, like enjoyment and fun, now find their way into technology adoption research (cf. Venkatesh [2000, pp. 342-365], Childers et al. [2001, pp. 511-535], van der Heijden [2003, pp. 541-549], Hsu and Lu [2004, pp. 853-868], Kim and Forsythe [2007, pp. 502-514], Söderlund and Julander [2009, pp. 216-226], Chiu et al. [2009, pp. 761-784], Huiying et al. [2010, pp. 298-301], and Tseng and Lo [2011, pp. 74-86]).

Nevertheless, a specific measurement model for assessing the combination of functional and hedonic components under consideration of the frame conditions of SST application (e.g., security aspects) is not available so far. This provides the starting point for the evaluation model presented in the subsequent chapters.

2.2.4 Challenges and Research Gaps

As mentioned before, researchers already identified the potentials of SSTs positively influencing brand image and customer experiences [Salomann et al. 2006, p. 73]. Several authors ask for further research in the area of SSTs and their effects on the service experience: "While there are a number of studies investigating consumers' intentions to use self-service technology, and the factors influencing consumer adoptions of self-service technology, there is limited research focusing on its impact on the service experience" [Beatson et al. 2007, p. 86]. As stated in Chapter 2.2.2.2, a reliable functionality is essential for the acceptance of SSTs. While usefulness and usability are already studied in acceptance research since many years, the specific assessment of hedonic factors and emotions is relatively new. Most of the research done is of pure theoretical nature and only includes a very general assessment of the factors responsible for the generation of substantial customer experiences. Also analyses focusing on the emotional aspects of SST use, considering the systems as a combination of software and hardware components, are not conducted so far. This fact is reflected in the work of Nysveen and Pedersen, who analyze numerous articles in the SST research area. While these articles deal with assessing the dependent variables attitude/intention/use, satisfaction, and loyalty, "[n]one of the articles reviewed are studying the effects of SST on customer experience and/or brand experience" [Nysveen and Pedersen 2011, p. 17]. With the rising interest for customer experiences, the authors expose the need for contributions in this research field. They also point out, that "the effects of feelings as antecedents of attitude to and satisfaction with self service technologies seem to be a relevant and interesting path for future research" [Nysveen and Pedersen 2011, p. 18].

A similar research demand also arises from the services excellence domain. Johnston [2004, p. 133] mentions that a "direction for future research would be to study the 'how' - how do the successful organisations go about delivering service excellence?" Also Chase and Dasu point out the missing link between the services science discipline and the behavioral sciences discipline. They ask for an in-depth analysis of the customer's experiences, also on a subconscious level [Chase and Dasu 2008, pp. 35-40].

2.3 Human-Computer Interaction

2.3.1 Definition

Human-Computer Interaction represents the scientific and creative domain addressing issues of how humans interact with machines or, in more detail, how humans interact with systems based on computer technologies [Dix 2010, pp. 3-4]. Hence, the research stream is influenced by several other disciplines: informatics, design, psychology, ergonomics, cognitive sciences, and human factors science [Card et al. 1983, pp. 9-19]. The design and development of useful and usable devices and systems, and how people can interact with them is the core of the efforts [Burmester 2007, p. 253].

Many researchers build their work on a broad foundation, focusing on one or several of the following central aspects of HCI [Burmester 2007, pp. 253-254; Sears and Jacko 2008b, p. XIX]:

- the human,
- the computer,
- the interaction between human and computer,
- special fields of application (domain specific design), or
- special user groups (diversity).

Each of the different aspects is studied in various theories. Based on the work of Jacko and Sears [2003] and Carroll [2003], Burmester [2007, p. 254] summarizes as follows: The human component covers research regarding motoric behavior [MacKenzie 2003, pp. 27-54], human perception [Ware 2003, pp. 11-26], information processing [Proctor and Vu

2008, pp. 43-62], mental models [Payne 2008, pp. 63-76], emotions [Brave and Nass 2008, pp. 77-92], and the activity theory [Frese and Zapf 1994, pp. 271-340; Bertelsen and Bødker 2003, pp. 291-324]. Input technologies and techniques [Ziegler and Burmester 1997, pp. 567-572; Hinckley 2008, pp. 161-176] as well as information output [Schlick et al. 2008, pp. 201-227; Brewster 2008, pp. 247-264] constitute the technological elements in relation to computers. The usage of multimedia content [Sutcliffe 2008, pp. 393-411], multi-modality [Oviatt 2008, pp. 413-432], and adaptivity [Jameson 2008, pp. 433-458] are examples for important theories describing the interaction between humans and computers. Special user groups can be children [Buckman et al. 2008, pp. 793-809], different genders [Cooper and Kugler 2008, pp. 763-775], seniors [Czaja and Lee 2008, pp. 777-792], or people with physical disabilities [Sears et al. 2008, pp. 829-852]. Finally, the designer has to consider the specific domains or systems like for example in the healthcare sector [Sainfort et al. 2008, pp. 661-678] or aerospace applications [Landry 2008, pp. 721-740]. [Burmester 2007, p. 254]

These examples illustrate, how diverse HCI research is. Its fundamentals build the framework for research in the area of user experience (UX) and its sub-disciplines.

2.3.2 Research Trends

2.3.2.1 Ergonomics

The term "ergonomics" is coined in 1857 by the Polish scientist Wokciech Jastrzebowski [Jastrzebowski 2006, pp. 161-175]. It can be seen as the high-level basis for modern HCI research, combining physiological with psychological human factors. While in Europe research on ergonomics "has its roots in work physiology, biomechanics, and workstation design", U.S. American efforts concentrate on "experimental psychology, where the focus was on human performance and systems design" [Helander 2006, p. 3]. The main purpose of human factors and ergonomics research is design related. This requires interdisciplinary knowledge in the areas of biomechanics, cognitive psychology, and systems design methodologies when designing new or improving existing systems [Helander 2006, pp. 3-5]. Figure 2.13 depicts an overview of the relevant design aspects related to the definition by Helander [1997, p. 4]: "[E]rgonomics and human factors use knowledge of human abilities and limitations to the design of systems, organizations, jobs, machines, tools, and consumer products for safe, efficient, and comfortable use".

Especially in relation to business environments ergonomic design increasingly gains attention. While the complexity of computer-based systems and interactive applications is constantly rising, the challenges for the users increase. One of the biggest demands appears to be the interface between man and machine [Long and Whitefield 1989, p. 1]. An interactive system, and herewith the combination of hardware and software, has to be designed in a way that a simple and effective operation is possible, without representing an adamant challenge or even a health risk [Arcularius 2010, p. 10; Fahlbruch et al. 2012, pp. 21-38].

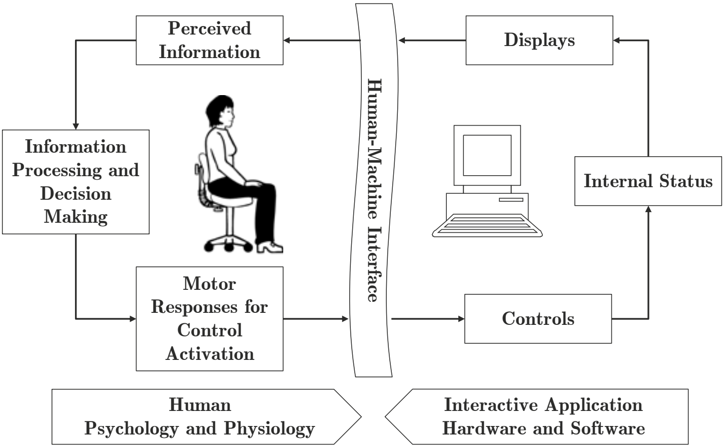

Figure 2.13 – Ergonomics in Man-Machine Interaction adapted from Helander [2006, p. 4]

The goal of ergonomics in HCI is to "define principles and derive requirements for human-centered design of tools, work places, and environments" [Cakir and Dzida 1997, p. 407]. Many approaches are taken to transfer these principles into a standardized format. Ergonomic standards can be found in a constant interplay with state of the art technology. "[T]he requirements of an ergonomic standard refer to the applicable current state-of-knowledge in ergonomics, not to a state of technology. An ergonomic standard thus should be expected to survive many steps of the technological evolution" [Cakir and Dzida 1997, p. 408]. As a consequence and instead of providing clear guidelines, standards in ergonomics are usually only vaguely defined. An example is DIN EN ISO 9241 which can be seen as the most sophisticated standard for ergonomics in HCI, covering requirements for working environments as well as for hardware and software elements.

Another aspect of ergonomics research is accessibility. The primary goal is to make software systems usable by as many people as possible, irrespectively of potential physical, sensory, or cognitive abilities. Barrier-free design provides several advantages, not only for the disabled, but also for users with age-related or temporary limitations [Stapelkamp 2007, p. 528]. Since 2008, part 171 is included in DIN EN ISO 9241 [DIN Deutsches Institut fuer Normung e.V. 2008b], which addresses a wide range of software in interactive systems like office, Web, or learning support applications. Referring to Zimmermann [2005, pp. 38-41], the following principles are covered by the norm:

- **Equality:** All users are treated equally and everyone is able to use all of the system's features.
- **Flexibility:** The system considers the user's abilities and requirements.
- **Perceptibility:** The application presents information in a for the user perceptible way.
- **Comprehensibility:** The system presents information and interaction elements in an easy to understand way.
- **Interoperability:** All interaction elements can be used by all users, taking a broad range of user abilities into consideration.
- **Fault tolerance:** The application prevents dangers that may occur through faulty user interaction.
- **Robust technologies:** The application uses robust and standardizes technologies, allowing a maximum interoperability. [Zimmermann 2005, pp. 38-41]

These factors are of particular importance for combinations of hardware and software components, as ergonomics consequently needs to be considered for both elements.

2.3.2.2 Usability and User Experience

2.3.2.2.1 Overview

"It is user experience that forms the customer's impression of the company's offerings, it is user experience that differentiates the company from its competitors, and it is user experience that determines whether your customer will ever come back" [Garrett 2003, p. 13]. If the consumer does not like the offer, is not able to find the desired information, or simply not able to correctly control the system in the intended way, he might stop the interaction or buying process and switch to an alternative [Garrett 2003, pp. 13-18].

While the importance of usability and user experiences as such are commonly accepted, a review of state of the art literature reveals that there is no common definition and delimitation of the concept in relation to other disciplines. Some authors consider user experience as a side-goal of usability, others as an extension to the usability paradigm, and still others see usability as being part of the user experience. Sometimes both concepts are even equated (cf. Figure 2.14). [Grudno 2011, p. 11]

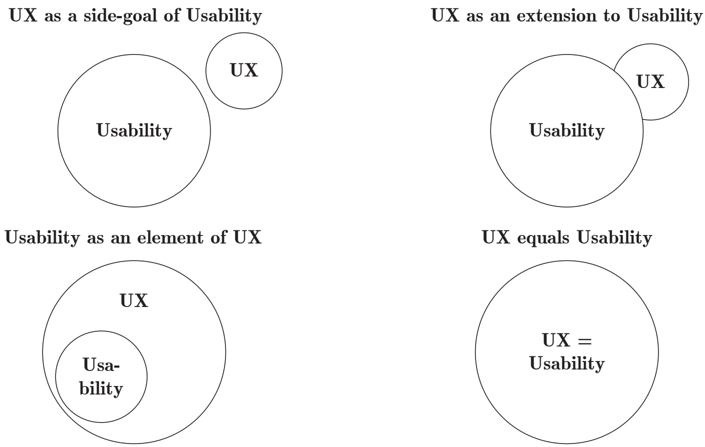

Figure 2.14 – Usability vs. User Experience
adapted from Grudno [2011, p. 12]

Moreover, usability strongly influences the definition of user experience. There are different definitions and opinions, e.g. the one of Arndt [2006, pp. 63-87] or the one defined in DIN EN 9241-11 [DIN Deutsches Institut fuer Normung e.V. 1999]. The following sections introduce and compare both concepts and also address further classifications.

2.3.2.2.2 The Model of Arndt

In his work Arndt [2006, p. 77] refers to Nielsen's "Attributes of System Acceptability" (cf. Figure 2.15) as one of the first user centered models of UX in interactive applications. Research done before, starting at the beginning of the 1970s, merely considers ergonomic criteria as basic user requirements. This only allows the fulfillment of a small part of all user requirements [Bürdek 1997, pp. 122-125]. Nielsen's approach considers additional aspects, indicating a more holistic view towards UX. Together with the utility criterion, usability is credited a sub-attribute of what he calls usefulness. "Usefulness is the issue of whether the system can be used to achieve some desired goal" [Nielsen 1994c, p. 24].

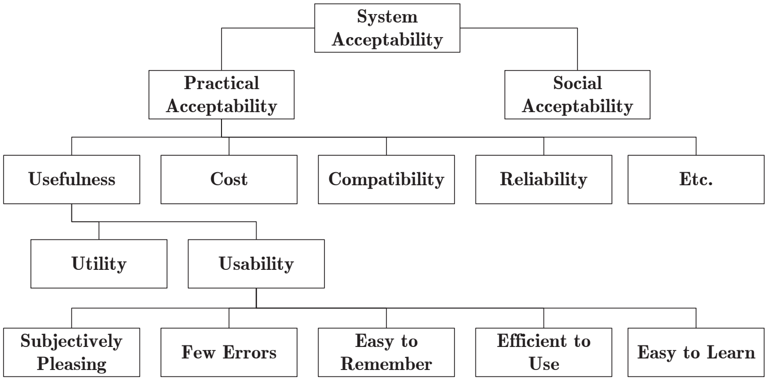

Figure 2.15 – Attributes of System Acceptability adapted from Nielsen [1994c, p. 25]

While utility refers to "the question of whether the functionality of the system in principle can do what is needed, [...] usability is the question of how well users can use that functionality" [Nielsen 1994c, p. 25]. Taking Nielsen's concept as a basis, Arndt [2006, p. 80] adds "joy of use" as a third element next to utility and usability (cf. Figure 2.16). In this context, joy is considered not simply as a consequence of using a system but as experiencing fun as an end in itself.

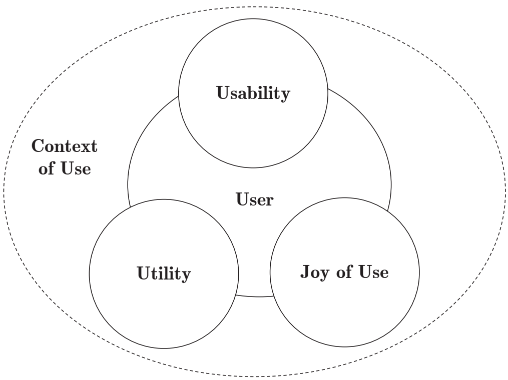

Figure 2.16 – The Elements of User Experience adapted from Arndt [2006, p. 85]

Usability

As noted above, Nielsen sees usability as one of the two kinds of usefulness of a product. While utility places special emphasis on the functionality of the product, usability concentrates more on how this functionality can be accessed. Arndt [2006, p. 82] quotes the following aspects as important elements constituting usability and being oriented on the basics of dialog design of DIN EN ISO 9241-110 [DIN Deutsches Institut fuer Normung e.V. 2008a].

- **Self-descriptiveness:** A system is called self-descriptive if it, at any time in the process, provides the user with the number and type of all possible inputs and outputs.
- **Replicability:** An application is replicable, if it tells the user at any time which input (type and order) is needed to create the current state of the application. This for example means, that a user has to be able to reproduce the steps made to reach the current option of the menu.
- **Context sensitivity:** The interactive application needs to be able to identify and use the user's respective context during data entry. An example is a display that automatically adjusts its brightness depending on the surrounding light situation.
- **Consistency:** Identical contents always need to be presented in the same way. The same applies for interactions and the system's reaction. All interfaces should be structured in a predictable manner.
- **Fault tolerance:** An application is considered fault tolerant, if an obviously faulty interaction does not lead to a negative consequence regarding the intended goal of the action performed. This can be for example realized by an automatic typing error correction.
- **Individualizeability:** In order to realize individual preferences and to reach personal goals the user is able to choose from various types of presentations, content, or interaction types. [Arndt 2006, pp. 82-83]

Utility

Utility defines the extent to which an application is inherently able to fulfill a desired practical task [Arndt 2006, p. 78]. Arndt [2006, p. 83] equals utility with the effectivity in accomplishing goals and identifies the following elements of the construct:

- **Relevance:** An application is relevant, if it fulfills the user's concrete, personal requirements.
- **Completeness:** An application needs to cover all requirements of the user which can be expected within a defined and commonly accepted context.
- **Correctness:** Correctness is given if the application is able to meet the requirements in a socially or scientifically admitted manner.
- **Actuality:** Only if the requirements are met according to the most recent state of knowledge it is considered being actual.
- **Integration:** If requirements are met that consider the other applications utilized by the users, the system is integrative. This is for example the case, if a website can be accessed through different web browsers.
- **Cooperation:** The interactive application should proactively support the user in accomplishing his/her tasks. Wrong entries should be automatically marked to better inform the user about the required correction steps. [Arndt 2006, pp. 83-85]

Joy of Use

Representing the individual, positive perception towards an application or system, joy of use includes elements relevant when it comes to aesthetics and evoking emotions:

- **Innovation:** New, yet unknown options of data input and output form the essence of an innovative application. Herewith the content as well as the way of its presentation can be the innovative component.
- **Exclusivity:** If an application is only accessible for a selected user group, it is exclusive.
- **Symbolism:** An interactive system has a symbolic character, if it is able to illustrate personal status, the belonging to a social group, personal convictions, as well as personal memories of a user. At first the application is only symbolic towards the user, but it can also have a symbolic character towards observers.
- **Trustworthiness:** Trustworthiness is given, if the risk while using the application is reduced to a minimum. Examples are data encryption or references.

- **Personalizability:** A personalizable system allows the user to adjust it with personal tools. If possible, these tools are not available for others. An example is the creation of a personal profile. [Arndt 2006, pp. 86-87]

All of the elements of UX follow the principles of inevitability and simultaneity. This means, that an interactive application always has some kind of utility, is always useable to a certain extent, and that it always provides joy of use to some degree. Nevertheless the importance and weights of the single elements differ for every application and use case. In some cases the elements even interrelate in an adversarial way. [Arndt 2006, pp. 80-81]

2.3.2.2.3 DIN EN ISO 9241

In March 2010 the ISO 9241-210 is published, nominating UX as an extension to usability. Herein, UX is defined as a "person's perceptions and responses resulting from the use and/or anticipated use of a product, system or service" [DIN Deutsches Institut fuer Normung e.V. 2011a, p. 7]. The general definition is complemented by three additional notes:

- User experience includes all the user's emotions, beliefs, preferences, perceptions, physical and psychological responses, behaviors and accomplishments that occur before, during and after use.
- User experience is a consequence of brand image, presentation, functionality, system performance, interactive behavior and assistive capabilities of the interactive system, the user's internal and physical state resulting from prior experiences, attitudes, skills and personality, and the context of use.
- Usability, when interpreted from the perspective of the user's personal goals, can include the kind of perceptual and emotional aspects typically associated with user experience. Usability criteria can be used to assess aspects of user experience. [DIN Deutsches Institut fuer Normung e.V. 2011a, p. 7]

According to that definition, UX includes all the effects and emotions a user experiences before, during, and after use of an interactive system (cf. Figure 2.17). Before use, a person at least has a vague idea of how the interaction would feel and expects concrete effects as a result of the interaction. During use, the user experiences the usability of the system. Finally, the user evaluates the actual process of having used the system which leads to emotions and a reflected perception of the system. These emotions can be understood as a result of comparing the actual use with the anticipated use. While UX is influenced also by many other criteria, a strong interrelation between the usability of a system and the perceived experience is obvious. On the one side usability can be seen as a part of UX, influencing the subsequent emotions and user behavior. On the other side the expectations towards a system also influence the perceived usability during use. Consequently, UX can be considered an extension to usability. While usability is used to describe the quality of interaction during use, UX also includes the effects before and after use. Both elements furthermore depend on the respective context of use.

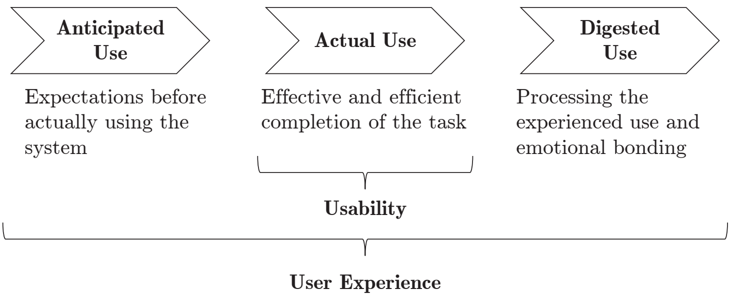

Figure 2.17 – User Experience as defined in DIN EN ISO 9241 adapted from DIN Deutsches Institut fuer Normung e.V. [2011a, p. 7]

The definition of the usability element in DIN EN ISO 9241 differs from the one proposed by Arndt. He describes the term by using several elements. This conveys the impression of referring to product features: if a product features certain elements, then it offers usability/utility. An implication is that usability can be achieved simply by having enough knowledge about how to design a user interface (UI). Burmester [2007, p. 246] takes issue with this perspective and claims that usability cannot be regarded a product feature. This perception is also shared by [Bevan 1995, pp. 1-7] who deems it as quality of use. In his work he mentions that "there is no such thing as a 'usable product' or 'unusable product'. For instance a product which is unusably by inexperienced users may be quite usable by trained users" [Bevan 1995, p. 4]. Simply considering specifications during engineering a system does not necessarily lead to usability.

This point of view is transferred to DIN EN ISO 9241-11. Specified therein, usability is described as the extent to which a product can be used by specific users in a specific context in order to reach defined goals in an effective, efficient and satisfying way [DIN Deutsches Institut fuer Normung e.V. 1999, p. 4]. In this coherence "extent" implies that usability is measured on a scale. This means that the question is not, if a system or product offers usability, but to which degree. As a product, ISO 9241 understands a "combination of hardware, software and/or services that receives input from, and communicates output to, users" [DIN Deutsches Institut fuer Normung e.V. 2011a, p. 6]. Interaction with the system is realized through a UI that includes all components of the interactive system: hardware and software, control elements, and information. The usage context encompasses the user as well as all other factors relevant for interaction. This includes the user's physical and psychological abilities, the social ecosystem, but also the task itself. Especially when it comes to systems engineering, the consideration of the context and human factors play a major role for creating attractive solutions. As goals, Burmester [2007, p. 247] describes the desired results of interacting with a system. The application should support the user in achieving these results in an effective, efficient, and satisfying way. Referring to the definition of DIN EN ISO 9241, these criteria also reflect measurement instruments for the extent of usability. According to Burmester [2007, p. 322], effectivity means the accurate and complete achievement of a task, and efficiency refers to the effort required. Both components lead to user satisfaction if well executed.

In Arndt's model, joy of use is included as a third element for defining UX. In contrast, DIN EN ISO 9241 is limited to just satisfying the user instead of having the vision of explicitly creating positive emotions or excitement. The focus lies more on preventing interferences.

2.3.2.2.4 Further Definitions

Next to the definitions stated above, further approaches can be found in literature for assessing the UX construct.

Richter and Flückiger [2010, p. 122] note that the UX discipline follows the goal of optimizing the holistic usage experience that comes along with utilizing a service or product. They envision UX as an extension to usability, incorporating factors like design and aesthetics, and increasing enjoyment (joy of use). It is furthermore argued that UX is closely linked to service marketing as both disciplines follow the same goal of providing the user with an optimal experience.

In his work, Garrett refers to UX mainly with reference to websites. He says that UX is defined through "how the product behaves and is used in the real world. [...] User experience is not about how a product works on the inside (although that sometimes has a lot of influence). User experience is about how it works on the outside, where a person comes into contact with it and has to work with it" [Garrett 2003, p. 10].

"[D]efining 'user experience' is difficult since it can extend to nearly everything in someone's interaction with a product, from the text on a search button, to the color scheme, to the associations it evokes, to the tone of the language used to describe it, to the customer support" [Kuniavsky 2003, p. 43]. This broad interpretation leads Kuniavsky to stating that it is very hard to design the UX with all of its facets. For this reason, the creation of experiences is divided into the categories information architecture, interaction design, and identity design [Kuniavsky 2003, pp. 43-53].

Hassenzahl and Tractinsky [2006, pp. 91-97] and Burmester [2008, pp. 343-344] follow the path of understanding UX as a separate design goal next to usability. Joy of use (fun), emotional design (evoking emotions), as well as persuasive design (influencing the customer's behavior) are mentioned as its subgoals. Nevertheless, they also state that UX is a complex discipline that still requires deeper research.

2.3.2.3 Joy of Use

While in more general research streams of HCI, joy and emotions in technology use are mainly treated as a side topic, more and more researchers consider joy of use as a research stream on its own. "Practitioners and researchers are now as likely to be concerned with how enjoyable a new technology is as how useable and useful it might be" [Blythe et al. 2004, p. 37].

Already since the 1980s, authors demand for a broader interpretation of usability research. Carroll and Thomas [1988, p. 23] explicitly ask for differentiating fun from the ease of use of a system and "to develop a research program in fun and motivation." Many researchers follow this goal by either concentrating on fun in consideration of physical products, in software, or in the combination of both. Norman underlines the importance of convenient handling of products [Norman 1988] and notes, that usability should not be the only quality criteria of products [Norman 2004]. Kurosu and Kashimura [1995, pp. 292-293] furthermore find that the aesthetics perceived before actually using the system have an influence on the anticipated use of which.

Interactive systems should be engaging, not only in a private context, but also when designed for work environments. "[T]he boundaries between work and play are increasingly being called into question and blurred" [Blythe et al. 2004, p. 37]. In one of their studies Igbaria et al. [1994, pp. 349-361] identify fun being especially important for increasing acceptance, readiness to assimilate, and satisfaction for newly introduced systems. But especially consumers pay a lot of attention to the aesthetics of a system: "No matter how good a site's content, the visual aspects of a Web site will have a significant impact on how people assess credibility" [Fogg et al. 2003, p. 13].

The joy of use research community does not use homogeneous terminologies. Blythe and Hassenzahl [2004, p. 91] for example differentiate fun from pleasure: "It is argued that pleasure is closely related to degrees of absorption while fun can be usefully thought of in terms of distraction. The distinction has important implications for design. It is argued that repetitive and routine work can be made fun through design while non-routine and creative work must absorb rather than distract if they are to be enjoyable." Norman [2004] however discerns attractiveness from beauty: while the superficial appearance can be attractive, beauty is a deeper perception that can for example also be influenced by culture. A further point of view is described by Jordan [1999, pp. 208-209]: While pure satisfaction "is limited to the avoidance of physical or cognitive discomfort", pleasure "considers emotional and hedonic issues". In the context of products, he defines pleasure as "[t]he emotional, hedonic and practical benefits associated with products" [Jordan 1999, p. 209]. Based on Maslow's hierarchy of human needs [Maslow 1943, pp. 370-396; Maslow et al. 1987], Jordan [1997, p. 251] presents a model adjusted to the requirements of interactive products and systems (cf. Figure 2.18).

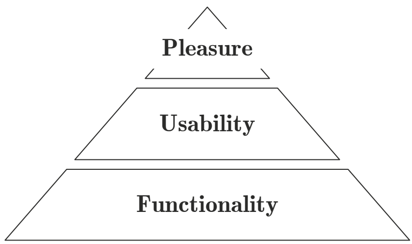

Figure 2.18 – Hierarchy of User Needs adapted from Jordan [1997, p. 251]

Following the approach of treating joy of use as a quality criteria on its own, Hassenzahl [Hassenzahl 2004a, pp. 319-349; Hassenzahl 2004b, pp. 31-42] distinguishes pragmatic from hedonic product features. Products usually contain both, which constitute the respective pragmatic and hedonic quality. While pragmatic features focus on functionality and usability, the goal of hedonic aspects is stimulation (attention, motivation, curiosity), identification (individuality, group affiliation), and evocation (provoking memories) [Hassenzahl 2004b, pp. 334-336]. Taking these assumptions into account, Burmester and Dufner [2006, p. 219] create a theoretical model for the design of attractive products (cf. Figure 2.19). The model proposes a direct coherence of the final usage behavior (usage frequency) based on the perceived pragmatic and hedonic quality.

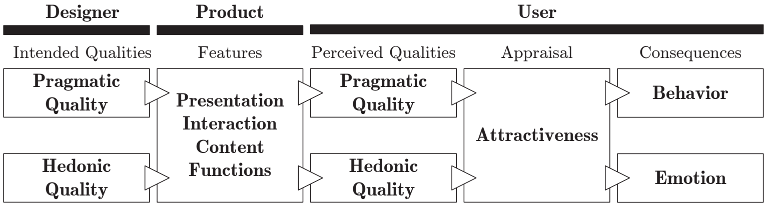

Figure 2.19 – Model of Product Attractivity
adapted from Burmester and Dufner [2006, p. 219]

2.3.2.4 Systems in the Context of HCI

In his work Michael Burmester [2006, pp. 175-178], the well-known usability engineer, introduces a model to describe the interaction between humans and so called interactive knowledge media (cf. Figure 2.20). Using this term he subsumes interactive products that do not only act as a tool, but additionally fulfill communication aspects, supporting the individual goals of the supplier as well as the ones of the user. While the goals and the individual configuration of the knowledge media can be manifold, usability is considered a central element ensuring the effective support of and the acceptance by the users [Burmester 2006, p. 176].

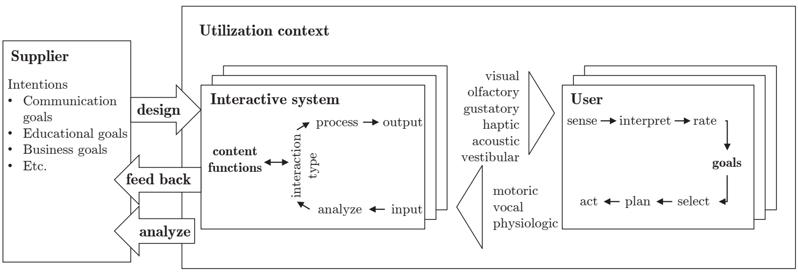

Figure 2.20 – Model of Interactive Systems Use
adapted from Burmester [2006, p. 178]

Concentrating on the interactive elements of systems and building on previous models and theories like the DIN Deutsches Institut fuer Normung e.V. [1999], DIN Deutsches Institut fuer Normung e.V. [2002], Norman [1988], and Oberquelle [1994, pp. 95-144], the model contains the elements supplier, user, knowledge media, modalities, interaction types, and usage contexts [Burmester 2006, pp. 177-180].

- **Supplier:** By offering the interactive system the service supplier pursues a defined target which can be for example of commercial or educational nature. The goal is to design the system in a way that the desired targets can be reached in an effective manner. Information about the usage context as well as knowledge about how people interact with the device can be used to improve the current state.
- **User:** The usage of the system is also dependent on the user's individual goals. Applying input devices provided by the system, the user is able to control the device and receive information.
- **Knowledge media:** Representing an interactive product, the knowledge media is able to provide information in various ways. As reactions to user interactions it is possible to display content based on text, videos, animations, pictures, sound, etc. The system's UI contains input and output devices and all interaction techniques that together allow an interaction initiated by humans.
- **Modalities:** Various input and output devices can be used to control the system and show desired information. Besides classical tools (e.g., keyboard and mouse), also novel interaction elements like face detection techniques are considered modalities.
- **Interaction types:** Regular interaction behavior covers the combination of input and output. An example is the repeated use of menus to perform certain actions.
- **Usage context:** How a system is designed, utilized by different users, and how/which goals are pursued heavily depends on the usage context. For example an application for home use may follow other design guidelines than one for business use. [Burmester 2006, pp. 178-180]

The interactive system represents the tool that accepts user interaction by utilizing input devices, analyzes it, and generates output provided through output devices. Both, input devices and output devices can support multiple modalities, e.g., visual, acoustic, olfactory, vestibular, and haptic interactions [Burmester 2007, pp. 258-259].

2.3.3 Usability Engineering

2.3.3.1 Human-Centered Design

Referring to Mayhew [1999, p. 2], usability engineering is defined as "a discipline that provides structured methods for achieving usability in UI design during product development". It therefore helps to create user experiences by focusing on a high system usability. The engineering approach is followed by the strategic use of defined methodologies. Usability engineering mainly deals with systematically integrating the user's perspective into the development process [Richter and Flückiger 2010, p. 2]. The key procedure follows the so called human-centered design (HCD) approach, which is put down in DIN EN ISO 9241, part 210 [DIN Deutsches Institut fuer Normung e.V. 2011a]. UX is explicitly mentioned in this norm. HCD does not only cover the generation of UX by focusing on usability during use, but also involves the phases before and after use. [Grudno 2011, pp. 30-32]

HCD is also sometimes called user-centered design (UCD). Already the name makes clear that the user takes a special role in the process. Burmester [2007, pp. 268-271] refers to the standard DIN EN 13407 [DIN Deutsches Institut fuer Normung e.V. 2000]. Since 2011 this norm is replaced by part 210 of the DIN EN ISO 9241 [DIN Deutsches Institut fuer Normung e.V. 2011a]. According to Burmester [2007, pp. 268-271], DIN EN 13407 defines the user-centered design process as follows:

- The user is in the center of all efforts. To reach a high degree of usability, the system is adapted to him/her and the respective social, organizational, physical, and technical context of use.
- The process is accomplished by an interdisciplinary group of engineers, with the composition of the group being dependent on the respective system or task to be designed.
- Designing a system follows a sequence of four process steps: context analysis, layout and design, prototyping, and evaluation.
- The process is supported by established methods. Based on scientific foundation and practical experiences, these methods constitute manuals describing the single tasks and rules for their execution.
- All process steps follow an iterative execution. [Burmester 2007, pp. 268-271; DIN Deutsches Institut fuer Normung e.V. 2000]

The new standard DIN EN ISO 9241-210 does not render these principles inactive. In fact, the UX criteria as well as the integration of the user into the design process are explicitly mentioned [Grudno 2011, p. 30]. The principles of HCD, documented in DIN Deutsches Institut fuer Normung e.V. [2011a, pp. 9-12], read as follows:

- The design is based on an explicit understanding of the consumers, their tasks, and their context.
- The user is integrated into the design and development process.
- The design is driven by and refined through a user-centered evaluation.
- The process follows an iterative execution.
- The design addresses the entire user experience.
- The development team is characterized by interdisciplinary skills and perspectives. [DIN Deutsches Institut fuer Normung e.V. 2011a, pp. 9-12]

Figure 2.21 depicts the single process steps specified in DIN Deutsches Institut fuer Normung e.V. [2011a, p. 15]. Initially, the design process is planned.

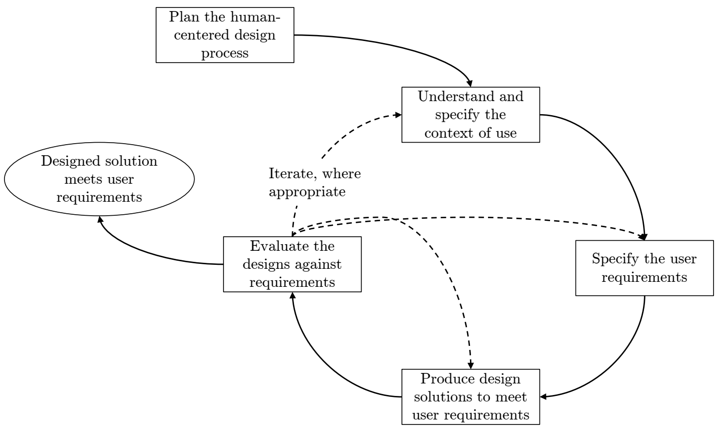

Figure 2.21 – Human-Centered Design Process
adapted from DIN Deutsches Institut fuer Normung e.V. [2011a, p. 15]

This step is followed by the analysis and documentation of the usage context. A possible methodology to efficiently reach this goal is customer journey mapping [Davis 2010, pp. 379-380; Martin and Hanington 2012, pp. 196-197]. Subsequently, the user requirements are specified. On this basis, design solutions are prepared and evaluated. If a solution meets the requirements specified before, the process is successfully completed. Otherwise, the process is re-established and iteratively passed through on basis of the evaluation results. In contrast to the old standard, DIN EN ISO 9241-210 allows a revival of the activities in any process step.

2.3.3.2 Prototyping

An important part of the HCD process is working with prototypes. In various physical representations, they take a vital role for the iterative development of systems and their continuous improvement in collaboration with the respective focus groups.

In the context of HCI, Beaudouin-Lafon and Mackay [2008, p. 1018] define prototypes "as a concrete representation of part or all of an interactive system. A prototype is a tangible artifact, not an abstract description that requires interpretation. Designers, as well as managers, developers, customers, and end users, can use these artifacts to envision and reflect on the final system". Using prototypes significantly improves the probability of developing useful applications [Mason and Carey 1983, p. 347]. This especially applies to the design of interactive systems [Benyon et al. 2005, pp. 253-267].

Figure 2.22 depicts the evolutionary character of the development process of products and systems. Concentrating on physical products, Bertsche et al. [2007, p. 3] state that it is important to generate various design solutions already in the early steps of development in order to generate knowledge, to adjust to changing market requirements, and to avoid undesirable or malfunctioning solutions.

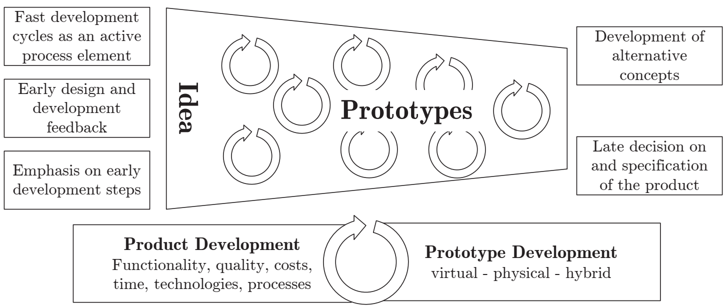

Figure 2.22 – Concept of Rapid Product Development adapted from Bertsche et al. [2007, p. 3]

They furthermore differentiate between physical, virtual (only existing in the computer environment, e.g., in form of a 3D model), and hybrid (augmenting physical artifacts with digital data) prototypes [Bertsche et al. 2007, p. 4], whereas rapid prototyping describes the approach of quickly creating artifacts in early phases [Bertsche et al. 2007, p. 2; Beaudouin-Lafon and Mackay 2008, p. 1025].

It is possible to describe prototypes according to four dimensions. The criterion "representation" defines the type of the prototypical implementation. This could for example be a paper-based or video-based description up to a fully implemented system. "Precision" defines in which detail a prototype is implemented, as prototypes can be realized either in a raw (e.g., paper sketches) or a very detailed format (e.g., also including the design of a corporate identity). The "interactivity" dimension defines the degree to which interaction is possible. While video-based artifacts provide no possibilities to interact, a HTML prototype may be clickable and highly interactive. Finally, "evolution" specifies in which phase of the design process the artifact is created. [Beaudouin-Lafon and Mackay 2008, pp. 1018-1020]

Prototypes represent intermediary design results that support the designer's creativity, the communication between the different stakeholders and of course the evaluation of the respective design solution [Bevan and Bogomolni 2000, p. 1195; Beaudouin-Lafon and Mackay 2008, p. 1020; Lazar et al. 2010, p. 192].

Besides proving desired functionalities of the systems as part of the design process, prototypes also officiate as a foundation for user evaluations. Already early prototypes can be applied in user testing. The results can be iteratively integrated into further design solutions and improved artifacts. [Grudno 2011, pp. 56-57]

Nielsen [1994c, p. 92] introduces a two-dimensional model of prototyping, opposing the different features of a system with their corresponding functionality. The goal of saving time and cost can either be realized by "cutting down the number of features in the prototype or reducing the level of functionality of the features such that they *seem* to work but do not actually *do* anything" [Nielsen 1994c, p. 92]. As a result either horizontal prototypes with a full-featured UI but reduced functionality, or vertical prototypes with a limited number of features at in-depth functionality are possible. A combination of both approaches leads to scenario-based artifacts that are limited to realistic usage situations [Nielsen 1994c, p. 95; Grudno 2011, p. 56].

In their work, Beaudouin-Lafon and Mackay [2008, pp. 1025-1031] furthermore differentiate offline and online prototypes, based on their type of representation (cf. Figure 2.23). Not involving the use of software, offline techniques are "considered a tool for thinking through design issues, [...] thrown away when they are not longer needed" [Beaudouin-Lafon and Mackay 2008, p. 1025]. In contrast, and involving software technologies, online methods offer a higher precision and "may prove useful to better communicate ideas to clients, managers, developers, and end users" [Beaudouin-Lafon and Mackay 2008, p. 1028].

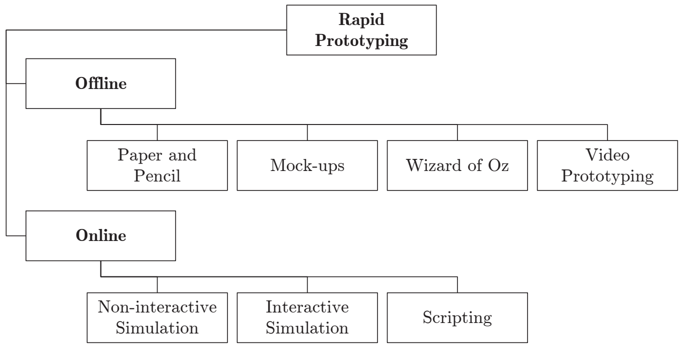

Figure 2.23 – Prototyping Techniques
adapted from Beaudouin-Lafon and Mackay [2008, pp. 1025-1031]

Paper prototypes are created by using paper, pens, post-it labels, and optionally transparent foils. This method is suitable for quickly documenting possible design solutions and to provide a first glance of how these could look like. Instead of fixed drawings, paper prototypes can also be interactive, e.g. by moving elements and simulating system functionality. Snyder [2003, p. 4] defines the method as follows: "Paper prototyping is a variation of usability testing where representative users perform realistic tasks by interacting with a paper version of the interface that is manipulated by a person 'playing computer', who doesn't explain how the interface is intended to work."

Mock-ups are described as physical prototypes of an interactive system. When considering hardware and software combinations, this could be three-dimensional illustrations of the system, represented through a paper prototype with the shape and size of the final product (e.g., a mobile phone) [Beaudouin-Lafon and Mackay 2008, pp. 1025-1026]. Of course the mock-ups can also be constructed of other materials like wood or using a 3D printer. Based on Rosson and Carroll [2002, p. 199], Burmester [2008, p. 342] mentions that the main goal is to model the shape of the hardware and its elements.

"Wizard of Oz" is a method to illustrate complex systems by using human assistants Burmester [2008, p. 342]. The goal is to simulate the system's interactivity through actors and by using prototypes of any evolutionary phase, e.g. paper prototypes or mock-ups [Beaudouin-Lafon and Mackay 2008, p. 1026].

Finally, video prototyping represents a method in which the intended interaction between a user and the system is taped. Also here, prototypes of any process step are called into action. A storyboard is used to narrate and comment usage scenarios and the respective interaction steps [Rosson and Carroll 2002, p. 199; Beaudouin-Lafon and Mackay 2008, pp. 1026-1028; Burmester 2008, p. 342].

As a first online prototyping technique Beaudouin-Lafon and Mackay [2008, pp. 1029-1030] mention non-interactive simulations. The method uses simulations to visualize prototypes on a computer screen. It is usually applied when it is not possible to visualize certain aspects of the interaction with offline methods. Usually, every graphically oriented application can be used to create simulations, even Excel would be suited [Berger 2009, pp. 120-147].

Interactive simulations use processes comparable to the Wizard of Oz, indicating interactivity and making the computer-based artifacts clickable. They can be created by integrating interaction panes and linking the elements of non-interactive artifacts. This includes for example the implementation of digital content, dialogue screens, or control buttons. Rosson and Carroll [2002, p. 199] refer to them as "scenario machines", in case a specific usage scenario is represented. Based on their respective evolutionary phase, they can be designed either in a rough or in a realistic manner. [Beaudouin-Lafon and Mackay 2008, p. 1030; Grudno 2011, p. 60]

The most advanced type of online prototyping is represented by the scripting technique. It can be used to create software artifacts with additional functionality, rendering the prototype even more realistic and making it possible to provide a very detailed foundation for user evaluations. Scripting methods are especially suited for combinations of software and hardware prototypes, as both components can be optimally adjusted to each other [Beaudouin-Lafon and Mackay 2008, p. 1031].

2.3.3.3 Evaluation Methodologies

Evaluation takes a central role in HCI research and the UCD process. The goal is to decide if the targeted usability goals for the respective usage context can be reached and if another iteration is required [Burmester 2007, p. 283]. In fact, evaluation is not only about assessing the final solution, but also an integral and recurrent part of the design process. Lawson [2006, p. 47] even states that evaluations are part and parcel of every design process.

Authors differentiate between summative and formative goals as well as analytical and empirical evaluation methods (cf. Figure 2.24) [Arndt 2006, pp. 247-261; Burmester 2007,

p. 284; Richter and Flückiger 2010, pp. 60-76]. While summative goals focus on applying predefined criteria (e.g., norms or industry standards) to the final product or system, formative goals target the optimization of design [Burmester 2007, p. 284]. Analytical approaches are also called expert-oriented methods or inspection methods. A rather small group of usability experts is asked to take the user's perspective and to evaluate the system with the help of checklists [Arndt 2006, p. 249]. Empirical approaches in contrast integrate the end-user into the evaluation process and are consequently also called user-oriented methods, or simply user testing [Arndt 2006, p. 254].

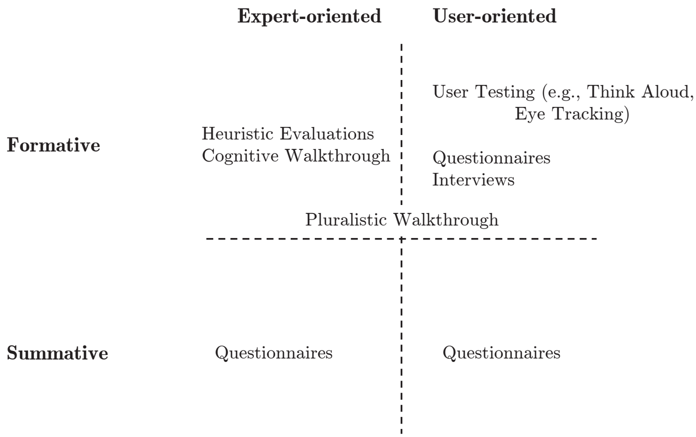

Figure 2.24 – Usability Evaluation Methods
adapted from Grudno [2011, p. 68], based on Arndt [2006, pp. 247-261], Burmester [2007, p. 285], and Burmester [2008, pp. 343-350]

One of the most well-known and most effective analytical methods [Burmester 2008, p. 344] is the so called heuristic evaluation by Nielsen and Molich [1990, pp. 249-256]. Experts use a checklist (called heuristics) to test finalized products or prototypes in terms of usability criteria and principles. These heuristics consist of nine elements and intend to allow assessing the system from all perspectives, including visual design as well as its functionalities [Nielsen 1994a, pp. 245-272; Nielsen 1994b, pp. 25-62]. A small number of experts (three to five) are initially introduced to the system and the characteristics of the users. As a second step, every expert notes down potential usability issues based on the user's tasks and the heuristics. The experts then discuss their results and prioritize the usability issues [Arndt 2006, p. 250].

A second analytic method is the cognitive walkthrough by Wharton et al. [1994, pp. 105-140]. Using scenarios that cover the most relevant use cases, experts take the user's perspective and interact with the system. The focus lies on how easy it is to learn to control the system, on the user's expectations towards the system, and if the system is able to meet these expectations. Burmester [2008, p. 345] mentions design deficits that prevent users from easy learning as the targeted usability issues. Although the main focus is solving formative goals, also summative elements are present [Burmester 2007, p. 285]. Summative oriented questionnaires can be used with experts. An example is the ErgoNorm questionnaire that contains a section to test the compliance with parts 10 resp. 110 and part 11 of DIN EN ISO 9241 [Dzida et al. 2001, pp. 25-46].

User-oriented methods focus on interviewing or observing the user. One of the most well-known is usability-testing, also called user-testing [Holzinger 2005, p. 73]. Based on Dumas [2003, pp. 1093-1117], Burmester [2008, p. 345] characterizes formative usability-tests as follows:

- The focus of the evaluation is usability.
- All subjects are representative users.
- An artifact (product or prototype) is used as a subject for evaluation.
- Realistic use cases are evaluated, keeping the respective context of use in mind.
- All subjects think aloud while interacting with the system. Emotions should be verbalized.
- Critical incidents are recorded.
- The results are presented to the design team. [Burmester 2008, p. 345]

Video equipment, mouse-tracking and eye-tracking systems, or audio tapes can be used to record usage behavior and used for further analysis and the derivation of user insights [Burmester 2007, p. 284]. While mouse-tracking is used to record movements and click-paths, eye-tracking mechanisms are applied to record movements of the user's view towards the system interface [Arndt 2006, pp. 258-261; Dumas and Fox 2008, p. 1139]. This can for example help to identify "exact sources of confusion or errors" [Dumas and Fox 2008, p. 1139]. Referring to Burmester [2007, p. 285], more advanced methods additionally include physiological data [Hazlett 2003, pp. 734-735] or mimics [Mangold et al. 2000, pp. 58-61]. Thomas and Bevan [1996, p. 1] state that usability tests should be conducted under realistic conditions, "representative of those in which the product will actually be used."

Next to observing users during use, questionnaires and interviews represent further methods for following formative as well as summative goals. Various standardized surveys have been developed. While the ErgoNorm [Dzida et al. 2001, pp. 81-146], the ISONORM [Prümper and Anft 1993, pp. 145-156], and the IsoMetrics2 [Hamborg et al. 1996; Hamborg 2002] concentrate on verifying the conformity with norms, the AttrakDiff [Hassenzahl et al. 2003, pp. 187-196] can be used to measure the hedonic and pragmatic attractivity of a product.

A combination of expert-based and user-based assessment is the so called pluralistic walkthrough [Bias 1994, p. 65-78]. The method is comparable to the cognitive walkthrough, but involves multiple stakeholders with different backgrounds into the evaluation process. Team members, developers, designers, usability experts, and users first individually assess the system and subsequently discuss and document the results [Burmester 2008, pp. 345-347].

Holzinger [2005, p. 74] mentions another user-focused method, called "field observation". Users are being observed when interacting with a product or system in an unobtrusive way. The observer acts in the background and notes down all incidents and problem situations. Other authors also mention the importance of free exploration, that happens without an observer's influence [Dumas and Fox 2008, pp. 1140-1141].

There are many discussions about the effectiveness of the various evaluation methods. Coining the expression "discount usability engineering", Nielsen [1994c, pp. 17-21] states that a great number of usability issues can be identified by a small number of usability professionals. In contrast, the results of various expert-oriented usability studies performed in 2001, the so called Comparative Usability Evaluation (CUE) studies, show that even a rather large number of usability experts is not able to identify a sufficiently large number of common usability issues. It might even be the case, that experts identify potential issues, that in fact are none for the users [Hertzum et al. 2002, pp. 662-663]. Based on these studies, the effectiveness of expert-oriented methods can be regarded as refuted: "I think, the study results indicate that usability testing is ineffective for finding all usability problems in an interface. Our results also indicate that it's ineffective even for finding all the serious usability problems in an interface. [...] Heuristic inspections are cheap, simple to explain, and deceptively simple to execute. However [...] inexperienced inspectors working on their own often produce disastrous amounts of 'false alarms'" [Perfetti 2003]. In comparative tests (e.g., CUE-4) it is possible to learn that the results of expert-reviews are almost similar to those of user tests. Interpreting these results could mean, that both methods performed individually do not lead to a sufficient solution.

Although it is generally hard to judge on the effectiveness of the different evaluation methods, Sarodnick and Brau [2011, pp. 199-204] disclose that user-oriented methods are better suited to identify usability issues that require usage knowledge, and expert-oriented methods provide advances when it comes to the adherence of norms. Furthermore, it is also a commonly accepted perception, that the quality of the assessment results enhances, if users are involved and asked for feedback. Referring to Lawson [2006], Burmester [2007, p. 283] states that designers judge design results only in an unsystematic way and based on their personal knowledge.

Several authors argue that every evaluation has its advantages and drawbacks. Consequently, for a holistic assessment authors ask for a combination of multiple methods [Holzinger 2005, p. 74; Dumas and Fox 2008, p. 1141; Roto et al. 2009, p. 3]. By for example combining observations with questionnaires one can also reduce the probability of interferences or social desirability (e.g., a user provides a wrong answer for shame) [Arndt 2006, p. 256]. Also a combination of indirect (questionnaires) with direct methods (thinking aloud or observation) is postulated [Holzinger 2005, p. 74].

In addition, one has to differentiate evaluating usability vs. evaluating UX, which takes place on a broader level: "not just achieving effectiveness, efficiency and satisfaction, but optimising the whole user experience from expectation through actual interaction to reflection of the experience" [Bevan 2009, p. 1]. The fact that UX is context-dependent and subjective [Law et al. 2009, p. 719; DIN Deutsches Institut fuer Normung e.V. 2011a, p. 7] requires a specific selection of evaluation methods to answer the question "how users feel about using a designed system" [Obrist et al. 2009, p. 2764]. Bevan [2009, p. 1] asks for a distinction between "usability methods that have the objective of improving human performance, and user experience methods that have the objective of improving user satisfaction with achieving both pragmatic and hedonic goals", while in practice usability is often subsumed within UX [Ketola and Roto 2008, pp. 23-26; Roto et al. 2009, pp. 1-5].

2.3.4 Challenges and Research Gaps

Most of the research done in HCI concentrates on traditional graphical user interfaces (GUIs) in software systems or websites. Few research considers the combination of the physical and the digital worlds so far [Beaudouin-Lafon and Mackay 2008, p. 1036]. While most authors focus on assessing the usability and ease of use, some researchers deal with identifying the quality criteria of joy-of-use and also propose general guidelines for the design of products and services (cf. Hassenzahl et al. [2000, pp. 201-208], Jordan [2003, pp. 1-10], Overbeeke et al. [2004, pp. 7-17], or Norman [2004, p. 221]). Nevertheless, a specific investigation of the experiential effects of selected hardware and software technology combinations in relation to a holistic UX is not part of current investigations. The need for research in this area is also emphasized in the work of Verhoef et al. [2009, p. 34] and Pantano and Di Pietro [2012, p. 9].

The assessment of holistic experiences within HCI research is pointed out as a major field for further investigation as well: "Although the term UX is widely used, the methods and tools for evaluating UX are still inadequate" [Obrist et al. 2009, p. 2763]. It is furthermore not only the UX construct and its measurements that are of interest. Law and van Schaik [2010, p. 320] emphasize that "even if UX measurement is successful, it becomes more useful when structural models are developed that help building the theoretical understanding of (causal) relations between UX constructs and design characteristics as a basis for informing (practical) system design". With the rising importance of fun and emotions in using computers, one of the major challenges in HCI research mentioned is "to develop new technologies that impact user experience" [Sears and Jacko 2008a, p. 1283]. Further experts call for exploring "new areas to understand and formalize the knowledge of what makes a design more acceptable, appealing, and fun to users" as well as for HCI methods and tools that focus on linking the physical with the digital world [Sears and Jacko 2008a, p. 1284].

2.4 Customer Experience Management

2.4.1 Definition

"'Experience' is a term that has spread throughout the business world with increasingly frequency over the course of the past decade - somewhat to detriment of the concept. Phrases like 'experience marketing,' 'experience branding,' 'experience design,' 'experience economy,' and '360 degree branding' (a form of experience design) have proliferated, reflecting a recognition that customers relate to products and services in ways that go beyond their perception of the fundamental value of those offerings" [Diller et al. 2006, p. 3].

Companies continuously attempt to find new ways for differentiating their brands from competitors. Traditional mechanisms like "price, features, quality and service [...] are loosing their ability" to reach this goal [Shaw and Ivens 2002, p. 1]. New concepts try to put the customer in the center of attention (cf. Figure 2.25). Nonetheless, while traditional customer satisfaction methodologies like CRM aim to provide managers and practitioners with concepts and methods to better understand their consumers, most of these approaches miss their target of generating exceptional offers. This is due to the fact that the endeavor of improving existing products and services by applying knowledge about the consumer is usually only taken from the company's point of view [Schmitt and Mangold 2004, p. 22]. Prahalad and Ramaswamy [2004, p. 137] mention that "value is now centered in the experiences of consumers". Providing holistic experiences instead of standard products and services on a high quality level is found to be an appropriate means to stimulate the consumer's emotions, forming starting points to differentiate and build brand loyalty [Berry et al. 2002a, pp. 85-90].

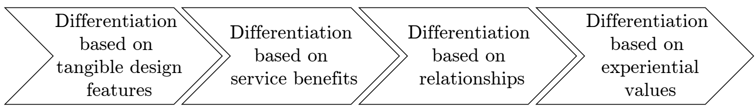

Figure 2.25 – Evolution of Differentiation Strategies
adapted from Rösler [2014, p. 11], based on Christopher et al. [1991, pp. 2-21] and Pine and Gilmore [1998, p. 98]

In order to design memorable experiences, developers now also follow a more human-centered approach. They design new solutions from the customer's perspective with the goal of concentrating on personal and subjective events as a result of external stimuli occurring before, during, and after a purchase [Schmitt and Mangold 2004, p. 23]. This approach, called Customer Experience Management, is increasingly gaining attention by researchers and practitioners. Referring to Bruhn and Mayer-Vorfelder [2011, p. 1] the concept gains its attention especially through the increasing experience-orientation of the society [Pine and Gilmore 1998, pp. 97-105; Knutson and Beck 2003, pp. 23-35], that manifests through an experience-oriented consumption [Holbrook and Hirschman 1982, pp. 132-140; Addis and Holbrook 2001, pp. 50-66; Harris and Reynolds 2003, pp. 144-161].

Referring to Gadamer [1972, p. 329], Mayer-Vorfelder [2011, p. 4] states that the experience terminology is still one of the least explained constructs in literature, resulting in a variety of different interpretations in literature and a diverse understanding. This leads to the fact, that "[i]n literature, concepts such as [...] experience are often only vaguely defined" [Sandström et al. 2008, p. 113].

Consequently, there is no universally accepted definition for customer experience in literature (Table 2.2 provides an overview of the most cited ones). In fact, authors (cf.

Palmer [2010, pp. 196-208], Mayer-Vorfelder [2011, pp. 3-5], Bruhn and Mayer-Vorfelder [2011, pp. 1-3], or Bruhn and Hadwich [2012a, pp. 9-10]) identify the existence of two different meanings of what is understood when talking about experiences. While for some researchers the construct defines the knowledge and expertise that a consumer generates over time with the products and services a brand provides, a more recent approach is to see experiences as an own marketing stream, focusing on the subjective and emotional consequences of using a product or service [Bruhn and Mayer-Vorfelder 2011, pp. 2-3].

Table 2.2 – Definitions of Customer Experience

Definition	*Author*
"An experience occurs when a company intentionally uses services as the stage, and goods as props, to engage individual customers in a way that creates a memorable event."	Pine and Gilmore [1998, p. 98]
"Experiences occur as a result of encountering, undergoing, or living through situations. They are triggered stimulations to the senses, the heart, and the mind. [...] In sum, experiences provide sensory, emotional, cognitive, behavioral, and relational values that replace functional values."	Schmitt [1999, pp. 25-26]
"[A]n experience occurs when a customer has any sensation or knowledge acquisition resulting from some level of interaction with different elements of a context created by a service provider. Successful experiences are those that the customer finds unique, memorable and sustainable over time, would want to repeat and build upon, and enthusiastically promotes via word of mouth."	Pullman and Gross [2004, p. 553] based on the definitions of other authors
"Customer Experience is the internal and subjective response customers have to any direct or indirect contact with a company. Direct contact generally occurs in the course of purchase, use, and service and is usually initiated by the customer. Indirect contact most often involves unplanned encounters with representatives of a company's products, service or brands and takes the form of word-of-mouth recommendations or criticisms, advertising, news reports, reviews and so forth."	Meyer and Schwager [2007, p. 118]

The table is continued on the next page

"The Customer Experience originates from a set of interactions between a customer and a product, a company, or part of its organization, which provoke a reaction. This experience is strictly personal and implies the customer's involvement at different levels (rational, emotional, sensorial physical and spiritual). Its evaluation depends on the comparison between a customer's expectations and the stimuli coming from the interaction with the company and its offering in correspondence of the different moments of contact or touch-points."	Gentile et al. [2007, p. 397], based on the definitions of other authors
"A Customer Experience is an interaction between an organization and a customer as perceived through the customer's conscious and subconscious mind. It is a blend of an organization's rational performance, the senses stimulated and emotions evoked, and intuitively measured against customer expectations across all moments of contact."	Shaw et al. [2011, p. 3]

By taking a look at the range of definitions it is clear that they indicate a shift from a utilitarian view towards one that is oriented on hedonic aspects [Rösler 2014, p. 11]. While the definitions vary in some of their characteristics, they all focus on the user as well as the emotional, conscious, and subconscious elements of an interaction between a company and its customer. Gentile et al. [2007, p. 397] provide the most comprehensive explanation of the construct. Their definition is used as a basis in this thesis. Transferring services into experiences, CEM also takes on an important role in modern technology-driven business environments [Reckenfelderbäumer and Arnold 2012, pp. 85-105].

2.4.2 Research Trends

2.4.2.1 Categorization

2.4.2.1.1 Overview

Experiences are part of research in a variety of disciplines since decades or even centuries. They are studied in psychology (cf. Csikszentmihalyi [1975], Csikszentmihalyi [1990], or Echterhoff [2009, p. 275]) and neuroscience (cf. Plutchik [2001, pp. 344-350], Lee et al. [2007, pp. 199-204], or Żurawicki [2010]), in philosophy (e.g., by Arisoteles [Böhme and Potyka 1995, p. 3]), in education, in business administration, and in marketing. Mayer-Vorfelder [2011, pp. 11-78] provides a detailed overview and categorization of the research streams. Novel business- and application-oriented studies typically base their knowledge on traditional psychological and neuroscience research.

Especially in marketing, experiences are addressed in various subareas (cf. Figure 2.26). The respective fields of application range from brand experience, product experience, service experience, and shopping experience up to a general customer oriented discipline. While all of these disciplines focus on a specific usage context or marketing area, their common goal is to analyze and to stimulate the customer's perception. [Mayer-Vorfelder 2011, pp. 46-62]

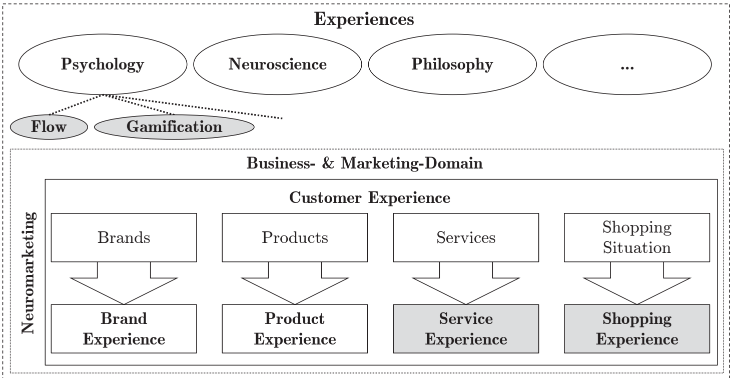

Figure 2.26 – Classification of Experiences in Marketing adapted from Mayer-Vorfelder [2011, p. 61]

The thesis at hand focuses on the generation of positive experiences through technical innovations in the context of retail environments. For that reason and in the specific marketing context, service and shopping experience research are of particular importance. Both will be discussed in the subsequent chapters. Their modes of operation are based on fundamental biological and neurological processes researched within neuroscience and with a business focus also in neuromarketing.

As a theory of primarily psychological nature the concept of "flow" found its way into the assessment of electronic systems. It is used to describe subjective experiences and represents the theoretical foundation for motivational aspects in system usage. The theory is closely linked to the concept of gamification, which describes the application of game elements to foster motivation and to make services more engaging [Deterding et al. 2011, p. 9]. Due to their importance and impact on the hedonic aspects of e-services, they are included in the examination as well.

2.4.2.1.2 Neuromarketing

Emotions and their effects towards everyday activities are intensively researched within the neuroscience discipline. Żurawicki [2010, p. 1] describes the research field as "a fusion of various disciplines embodying the molecular biology, electrophysiology, neurophysiology, anatomy, embryology and developmental biology, cellular biology, behavioral biology, neurology, cognitive neuro-psychology, and cognitive sciences". By assessing neuronal activities, especially of the human brain, researchers try to better understand human behavior and cognition. While several of the findings on basic brain functionality already found their way into other, especially business-related areas, the usage for marketing purposes is only at its beginning [Lee et al. 2007, p. 199]. The application of knowledge about the procedures of human information processing (e.g., gathered through neuroimaging techniques) in the marketing field is called neuromarketing [Merkle and Kreutzer 2008, p. 22]. Morin [2011, p. 132] defines this combination of neuroscience and marketing as follows: "While neuropsychology studies the relationship between the brain and human cognitive and psychological functions, neuromarketing promotes the value of looking at consumer behavior from a brain perspective".

Next to basic biological procedures (e.g., signal transmissions), neuromarketing research focuses on aspects of cognition, memory processing and learning, the human senses (in particular as receptors for external stimuli through the environment), consciousness and unconsciousness including the rationality of human behavior, as well as emotions and motivations and how they can be stimulated [Żurawicki 2010, pp. 1-42].

Frijda [1988, pp. 349-358] describes emotions as "lawful phenomena" that are subjective to every being. "The important implication of emotions is that they lead to action readiness in most cases" [Żurawicki 2010, p. 38]. This relation is also reflected by Plutchik, who presents a sequence model to explain the interactions leading from an initial stimulation as an origin to the effects of emotions. The person tries to make sense out of stimuli perceived through the senses, which leads to feelings and emotions (cf. Figure 2.27). Corresponding to the feelings evoked, the subject triggers a desired behavior which results in specific effects [Żurawicki 2010, pp 38-40][2].

[2]Following the sequence of stimulation, mental processing, and resulting consequences, Schmitt [2003, pp. 111-117] proposes a comparable process with focus on the generation on customer experiences, the "S-P-C Model of SENSE".

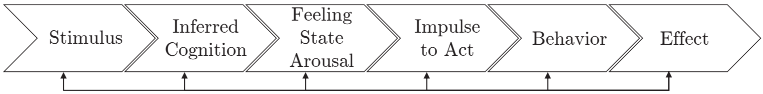

Figure 2.27 – Origin and Outcome of Emotions
adapted from Żurawicki [2010, p. 39], based on Plutchik [2001, p. 347]

Strategically triggering positive emotions, pleasure, and desires in regards to product or service offers can lead to a stimulation of the decision processing system. This finally results in the possibility of being able to steer the consumption behavior of the consumers [Żurawicki 2010, pp. 55-103].

In turn, this is also the reason why neuromarketing finds itself confronted with several arguments regarding ethical questions. Due to the fact that consumers could be subconsciously influenced in their buying decision, some authors even talk about a loss of the consumer's free will. [Wilson et al. 2008, pp. 389-410; Murphy et al. 2008, pp. 293-302]

2.4.2.1.3 Service Experience

Service experience is gaining increasing attention by researchers, especially in the area of services marketing [Grove and Fisk 1992, pp. 455-461; Lovelock and Wirtz 2010, p. 27]. As with CX, the service experience terminology is subject of multiple meanings [Otto and Ritchie 1996, pp. 165-174; Sandström et al. 2008, pp. 112-126]. In literature it is either regarded as a determinant of service quality [Hui and Bateson 1991, p. 174; Ramaswamy 1996, p. 14; Berry et al. 2006, p. 53] or as the generation of positive emotions by providing exceptional services [Sandström et al. 2008, pp. 112-126]. Authors identify an increasing number of publications dealing with the service experience construct, that focus on the assessment of utilitarian services. In contrast to hedonic services, whose primary intention is to create experiences (e.g., visiting a cinema or an amusement park), utilitarian services involve day-to-day tasks. Service experience methods should help to deliver these utilitarian services in an exciting way. [Mayer-Vorfelder 2011, p. 49]

Also due to the developments in services science (cf. Chapter 2.2), technology is becoming more important for providing exceptional services. A theoretical model (cf. Figure 2.28) for "illustrating the total technology-based service experience, highlighting the importance of both, the functional and the emotional dimensions, as well as how the service experience is linked to value in use" is presented by Sandström et al. [2008, p. 113].

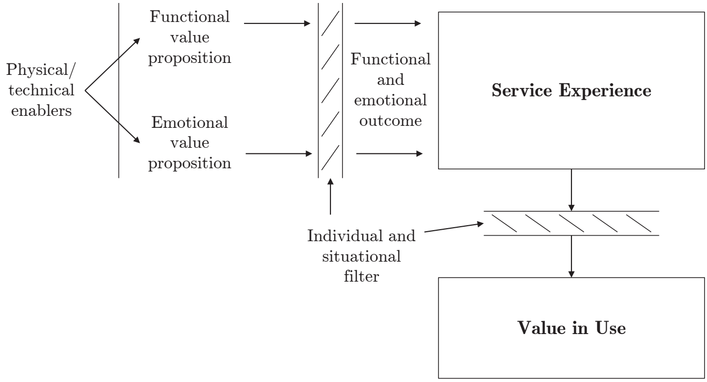

Figure 2.28 – Service Experience Framework
adapted from Sandström et al. [2008, p. 121]

The basic idea is that companies can provide value propositions that are either of functional (utilitarian) or of emotional (hedonic) value. To realize these values, physical or technological enablers are applied that, in the case of technology-based services, consist of an underlying system (e.g., a SST). Referring to Bitner [1992, pp. 57-71], Normann [2001], and Rafaeli and Vilnai-Yavetz [2004, pp. 671-686], Sandström et al. [2008, p. 115] state that "the functionality of a value proposition includes what is possible to do using the physical/technical enablers available. The emotional value proposition provides the non-physical features and may also include mental images, brand reputation, and themes". A potential functional and emotional outcome is mediated by the so called individual and situational filters that may consist of the user's demographic characteristics, skills, attitude towards technology, the surrounding business context, and others. These filters also lead to the fact, that different user groups will perceive offerings differently. "The sum total of all the clues compose the service experience by influencing customers' thoughts, feelings, and behavior" [Sandström et al. 2008, p. 118]. Service experience is thus defined as the combination of the functional and emotional outcome of a service, that "is always individual and unique to every single customer and every single occasion of consumption, and it assumes that the customer is an active co-creating part of the service consumption process" [Sandström et al. 2008, p. 118]. Ultimately, value is created if the service experience is evaluated by the customer based on his/her individual judgment of the perceived functional and emotional outcomes. [Sandström et al. 2008, pp. 112-126; Fließ et al. 2012, pp. 163-167]

2.4.2.1.4 Shopping Experience

Also the shopping process itself is regarded to offer enormous potential for differentiation [Gobé 2001, pp. 159-184; Grewal et al. 2009, pp. 1-14]. Simply offering a variety of products and quality is not sufficient anymore [Danziger 2006, p. XVI]. Providing customers with "great experiences across channels" is considered to be "one of the central objectives in today's retailing environments" [Verhoef et al. 2009, p. 31]. This endeavor leads to a new sub-discipline in CX research, called "shopping experience"[3]. It is holistic in nature and emerges before, during, as well as after the purchase [Leisching et al. 2012, p. 430]. Referring to Holbrook [1994, pp. 21-71], Mayer-Vorfelder [2011, p. 56] clarifies, that the value in shopping does not only lie in the physical product, but to a major part also in going through the whole shopping process, starting with interactions like product search.

In this context, high importance is attached especially to the retail atmosphere and all of its determinants [Donovan 1994, pp. 283-294; Spies et al. 1997, pp. 1-17; Wakefield and Baker 1998, pp. 515-539; Machleit and Eroglu 2000, pp. 101-111; Baker et al. 2002, pp. 120-141; Kaltcheva and Weitz 2006, pp. 107-118]. Several authors mention the relevance of touching the consumer's senses by using a smart environment design strategy, thus also subconsciously influencing behavior [Gobé 2001, pp. 69-70; Hultén et al. 2009, pp. 1-23; Hultén 2011, pp. 256-273; Wiedmann et al. 2012, pp. 332-346]. "[S]ensory expressions aim at characterizing a brand's identity and uniqueness in relation to each of the five senses", thus allowing a company to "be closer and more deeply imprinted in the customer's mind" [Hultén 2011, p. 265]. Figure 2.29 depicts the interplay of sensory elements and their effects towards the overall CX. Sensory design elements for example include the application and impact of sound and music [Yalch and Spangenberg 2000, pp. 139-147; Grewal et al. 2003, pp. 259-268], scent [Mattila and Wirtz 2001, pp. 273-289; Chebat and Michon 2003, pp. 529-539], visual attractiveness [Gobé 2001, pp. 77-84], tactile [Wiedmann et al. 2012, pp. 340-341], as well as gustatory aspects [Gobé 2001, pp. 85-90]. Nevertheless, research on the determinants of shopping experiences is still rare [Leisching et al. 2012, p. 432].

[3] Shopping experience is also referred to as "buying experience" [Gobé 2001, p. 179] or "retail experience" [Grewal et al. 2009, p. 1; Mayer-Vorfelder 2011, p. 55].

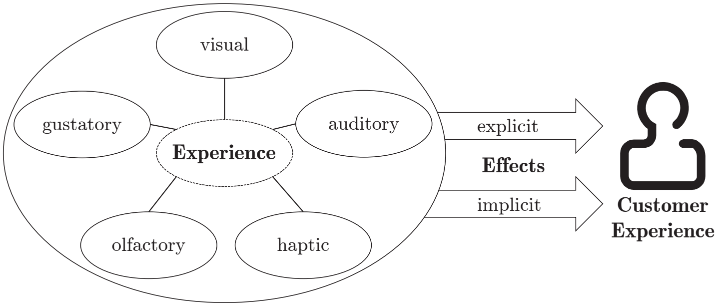

Figure 2.29 – Multisensory Elements of Experiences
adapted from Wiedmann et al. [2012, p. 338]

As depicted in relevant literature (and comparable to the service experience framework by Sandström et al. [2008, p. 121] described in Chapter 2.4.2.1.3), shopping contains a strong affective component, with emotions and pleasure as the driving forces [Mathwick et al. 2001, pp. 39-56; Arnold et al. 2005, pp. 1132-1145; Danziger 2006, pp. 6-10; Mayer-Vorfelder 2011, p. 56]. The co-existence of utilitarian and hedonic aspects in shopping is intensively researched in relation to the various channels, recently focusing on the Internet in particular [Babin et al. 1994, pp. 644-656; Childers et al. 2001, pp. 511-535; Sarkar 2011, pp. 58-65].

Finally it is also technology, that plays an increasingly important role when it comes to shopping experiences [Gobé 2001, pp. 175-179; Verhoef et al. 2009, pp. 31-41]. "Tomorrow's mall will be a place where reality and virtual reality (VR) merge. [...] [Nevertheless,] we will not live in a world of technology so much as technology will live around us" [Gobé 2001, p. 175].

2.4.2.1.5 Flow Experience

A psychological model describing subjective experiences [Mayer-Vorfelder 2011, p. 21] that is often referred to as one of the basic research works of the CX discipline, especially in regards to technology and self-services, is the flow concept by Csikszentmihalyi [1975]. The author defines flow as "the holistic sensation that people feel when they act with total involvement" [Csikszentmihalyi 1975, p. 32]. Several authors come up with slightly modified definitions[4]. However, all definitions describe flow as a holistic experience based on activities, that result from intrinsic motivation [Schallberger and Pfister 2001, p. 178]

[4]Riedl [2014, pp. 81-83] provides a comprehensive overview.

and that a user can experience flow, if immediate feedback is given and challenges are appropriate to one's capacities [Nakamura and Csikszentmihalyi 2002, p. 90]. Flow can only be maintained if the activity is balanced with the inherent challenge of the activity and the user's ability to cope with it [Chen 2007, pp. 32-33]. This balanced state is called the flow-channel (cf. Figure 2.30).

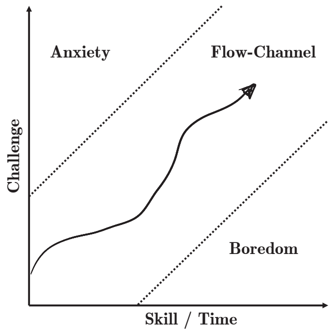

Figure 2.30 – The Model of Flow Experience
adapted from Csikszentmihalyi [1990, p. 74]

All together, Csikszentmihalyi refers to eight characteristics of flow experiences: melting of action and consciousness, clarity of goals, immediate feedback, a high level of concentration on the task at hand, the balance between skills and challenge, a sense of control, an altered sense of time, and a loss of self-consciousness [Chen 2007, pp. 31-32; Csikszentmihalyi 2010, pp. 61-72]. In his research Csikszentmihalyi also expresses that "every flow activity, whether it involved competition, chance, or any other dimension of experience had this in common: It provided a sense of discovery, a creative feeling of transporting the person into a new reality" [Csikszentmihalyi 1975, p. 74]. This state of feeling like being part of another world is also referred to as a state of "immersion" [Nacke and Lindley 2008, p. 81], which is often mentioned in relation to virtual realities, computer games, and technology use (cf. Brown and Cairns [2004, pp. 1297-1300], Cheng and Cairns [2005, pp. 1272-1275], or Jennett et al. [2008, pp. 641-661]).

Bauer et al. [2006, p. 867] state that design aspects of virtual service encounters can trigger emotional responses: "The fact that affective reactions are of crucial importance for the evaluation of e-services is reflected in the finding that fun and enjoyment, which characterize a flow experience, are major determinants of Internet usage behavior". This is also reflected in further studies. Consequently and due to its focus on interactivity and immersion, the concept is increasingly applied to designing, assessing, and improving interactive systems, especially in the Web environment. Examples are online games [Chou and Ting 2003, pp. 663-675; Hsu and Lu 2004, pp. 853-868; Chen 2007, pp. 31-34], online shopping [Childers et al. 2001, pp. 511-535; Bauer et al. 2006, pp. 866-875], financial services [Xin Ding et al. 2010, pp. 96-110], or online self-services in general [Xin Ding et al. 2011, pp. 508-515]. The flow concept also finds application in the assessment of general computer-mediated environments [Hoffman and Novak 1996, pp. 50-68], as well as of self-service kiosks [Keeling et al. 2006, pp. 49-76].

2.4.2.1.6 Gamification

A new application-oriented trend closely linked to the theory of flow uses knowledge gained within psychology, social sciences, and games-design research for the improvement of marketing concepts and to make services more attractive: gamification [Huotari and Hamari 2012, p. 17; Hamari et al. 2014, p. 3025]. Deterding et al. [2011, p. 9] describe gamification as the use of "game design elements in non-game contexts to motivate and increase user activity and retention". The concept's primary goal is to translate common services and tasks into entertaining experiences that in turn lead to enhanced engagement, loyalty, and finally to additional revenue [Zichermann and Cunningham 2011, pp. XII-XIV]. While several similar approaches partly existed before (e.g., within design or serious gaming), the emergence of gamification as a commonly accepted service design method started not before 2010 [Deterding et al. 2011, p. 9]. Numerous examples show that the method can be applied to company internal processes (e.g., Hense et al. [2013, pp. 206-213] for logistics) but also to consumer-facing applications (e.g., in fitness and sports applications [Brauner et al. 2013, pp. 349-362]).

Next to its intended goal the definition of gamification contains two important components: game design elements and their application in non-game contexts. Deterding et al. [2011, p. 12] propose a classification split up into five levels containing both the functional components as well as visual and methodical design patterns (cf. Table 2.3).

Table 2.3 – Game Design Elements
adapted from Deterding et al. [2011, p. 12]

Level	*Description*	*Example*
Game interface and design patterns	Successful interaction design components and design solutions for a known problem in a context	Badges, leaderboards, levels
Game design patterns and mechanics	Reoccurring parts of the design of a game that concern gameplay	Time constraints, limited resources, turns
Game design principles and heuristics	Evaluative guidelines to approach a design problem or analyze a given design solution	Enduring play, clear goals, variety of game styles
Game models	Conceptual models of the components of games or game design experience	MDA[5]; challenges, fantasy, and curiosity; game design atoms; CEGE[6]
Game design methods	Game design-specific practices and processes	Playtesting, playcentric design, value conscious game design

These design elements (or "ingredients" [Reeves and Read 2009, pp. 63-90]) are manifold and usually taken from traditional games and video-games. Nevertheless, a classification of what is considered "game design" or a "game element" is often blurry, leading to different understandings in dependence of subjective perceptions [Deterding et al. 2011, pp. 11-12]. All of them focus on the delivery of experiences by addressing the subjective perception of the user. Realizations may include multiple elements like the use of virtual environments, social aspects, or competitive challenges. Nevertheless, the mixture of components needs to be targeted to the specific user group and the intended goal of the service [Zichermann and Cunningham 2011, pp. 12-14].

A method that can be used to identify the "player type" of a user group is the so called Bartle test. Each player is assigned a gaming personality consisting of a mixture between the player types explorer, achiever, socializer, and killer [Bartle 1996]. In general, it is especially the digital generation, that "is of particular interest with respect to game

[5]Hunicke et al. [2004, pp. 1-5] refer to MDA (mechanics, dynamics, and aesthetics) as a framework for bridging "the gap between game design and game development, game criticism, and technical games research". It can be understood as the approach of breaking down games into their distinctive parts and understanding their interdependencies.

[6]The abbreviation CEGE stands for "Core Elements of the Gaming Experience". These elements are considered "the necessary but not sufficient conditions to provide a positive experience while playing video-games" [Calvillo-Gámez et al. 2010, p. 47].

mechanics" as they have grown up with video games as their primary form of entertainment and thus are used to solve everyday problems in different ways [Burke and Hiltbrand 2011, pp. 9-10].

As non-game contexts researchers understand services, tasks, and systems whose primarily intended goal is not game experience itself. However Deterding et al. [2011, p. 12] suggest not to delimit gamification "to specific usage contexts, purposes, or scenarios", as the improvement of user experiences can happen in any application area. While the positive effects of gamifying tasks are proven through several studies [Muntean 2011, pp. 323-329; Blohm and Leimeister 2013, pp. 275-278; Hamari et al. 2014, pp. 3025-3034], some authors criticize the short-term effects of simply "pointifying" existing applications [Thom et al. 2012, pp. 1067-1070; Deterding 2012, pp. 14-17]. This means that for a long-lasting user experience, the application of game design and game mechanics requires a well-conceived gamification approach.

2.4.2.2 Classification

2.4.2.2.1 Realms of Experiences

Just as diverse as the definitions of CX as many attempts are done to classify experiences. The most well-known is the concept of "The Four Realms of an Experience" by Pine and Gilmore [1998, pp. 101-105]. According to the authors, experiences can be classified along two major dimensions (cf. Figure 2.31).

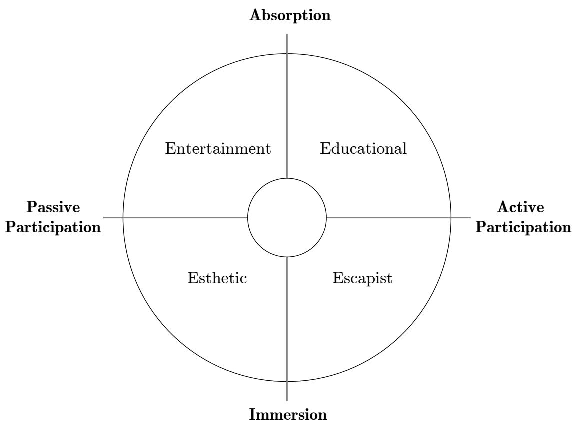

Figure 2.31 – The Four Realms of an Experience adapted from Pine and Gilmore [1998, p. 102]

Based on customer participation (passive vs. active) and connection/environmental relationship (absorption vs. immersion) experiences can be sorted into four realms: entertainment, educational, esthetic, and escapist. Nevertheless, it is stated, that the richest experiences cover all four aspects at once [Pine and Gilmore 1998, p. 102]. During a service provision, participants can either act as passive observers or play an active role in the creation of an experience. It is furthermore possible to either just consume a story or being completely immersed, hence feeling like being a part of it [Pine and Gilmore 1998, p. 101]. The realms can be described as follows:

- **Entertainment** is constructed out of a passive consumption of services. An example is listening to a song.
- **Educational** experiences are created out of an active consumption. As the term indicates, this could be a seminar that demands for active mental participation, but also doing sports.
- **Esthetic** is a passive, but immersive experience. It occurs for example during sightseeing, when the customer has little or no effect on the activity and acts as an immersed consumer.
- **Escapist** experiences involve participation and immersion. They can be generated if a person is taking an active part in the action/story being performed. Examples are acting in a role play, playing video games, or interacting with a self-service system. [Pine and Gilmore 1998, pp. 97-105; Stamboulis and Skayannis 2003, pp. 35-43; Brown and Cairns 2004, pp. 1297-1300; Zagel and Bodendorf 2012, pp. 697-704]

As part of the experience economy paradigm [Pine and Gilmore 1998, pp. 97-105] the concept of the four realms is often taken as a basis for research in the context of tourism (cf. Stamboulis and Skayannis [2003, pp. 35-43], Oh et al. [2007, 119-132], or Kim et al. [2011, pp. 12-25]). Nonetheless, it also finds application in the context of self-services and technology (cf. Kim and Kim [2007, pp. 45-62], Sims et al. [2007, p. 12], or Park and Lee [2012, pp. 855-862]).

2.4.2.2.2 Determinants of Experiences

There are many aspects that influence the overall perception of a company's performance. As part of the CEM efforts, Schmitt and Mangold propose an examination of the central factors that influence the context of the respective situational environment, in which experiences should be created. This examination is described as a 360° perspective that is required for the development of holistic services. The result is a variety of tools (experience drivers) that can be used to design "integrated experiences". While the tools can be manifold, the authors emphasize that all of them can be controlled by the company and are of relevance for the customer [Verhoef et al. 2009, p. 32]. Figure 2.32 provides an overview about the determinants considered most important. [Schmitt and Mangold 2004, pp. 29-30]

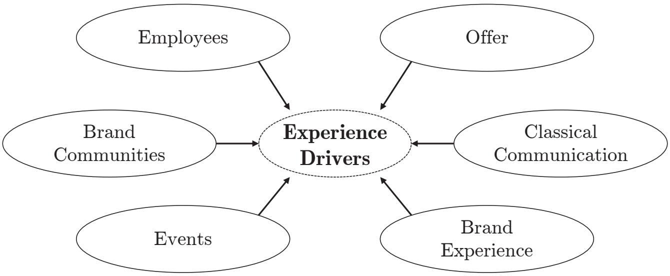

Figure 2.32 – Experience Drivers
adapted from Schmitt and Mangold [2004, p. 29]

A more detailed model (cf. Figure 2.33) with a strong focus on retailing is presented by Verhoef et al. [2009, pp. 31-41]. Based on existing research, the authors build a conceptual model of customer experience creation, integrating a number of determinants influencing the overall CX. In the model all determinants are shown on the left hand side. The social environment criterion includes all the interactions with others that happen throughout the process. This might be the case before visiting a store (e.g., through reviews) or during shopping by interacting with companions or other visitors. Special emphasis is also put on the service interface component that can be either represented through a human employee but also through technology (e.g., in form of a SST). Wielding strong influence on the customer's perception during shopping, the retail atmosphere is considered an important element. Based on the shopping experience theories (cf. Chapter 2.4.2.1.4), the authors ask for a stimulation of multiple senses instead of merely concentrating on visual aspects. Product assortment and price are determinants strongly influenced by the targetted shopper type (e.g., task-oriented vs. fun-oriented shoppers). The authors also consider the existence of additional contact points in today's multi-channel environment and the intercorrelation between those channels. Furthermore, CX is influenced by the overall perception of the retail brand and its image towards the outside world as well as by previous experiences gained through interaction with the brand. Two moderators affect the overall CX provided by the company: situational moderators (e.g., type of store, culture, or competition) as well as consumer moderators (e.g., socio-demographics, or personality traits). Verhoef et al. [2009, pp. 31-41]

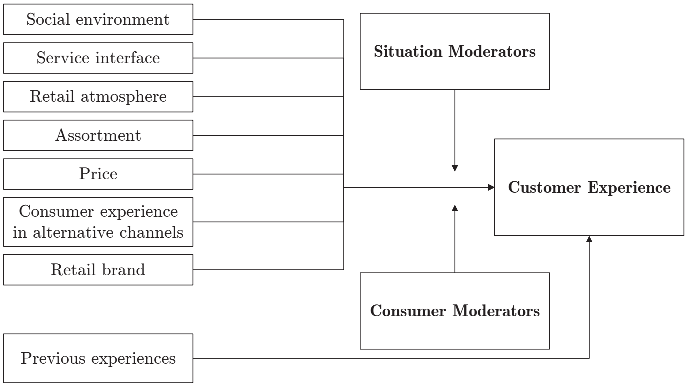

Figure 2.33 – Determinants of Customer Experience Creation
adapted from Verhoef et al. [2009, p. 32]

Having discussed the aspects of this model, it is obvious that a variety of independent factors influence the perceived CX. Nevertheless, especially the technological component has become an integral part not only of shopping but as a design element on its own which is reflected in the discussions about innovative service encounters, increasingly being realized as SSTs (cf. Bitner [2001, pp. 10-11], Curran and Meuter [2005, pp. 103-113], Forbes [2008, pp. 316-327], or Zagel and Bodendorf [2012, pp. 697-704]).

2.4.2.2.3 Experiential Dimensions

Up to now, there are only some authors that deal with an operationalization of the CX construct. They usually regard CX as a multidimensional and situative construct that is composed of so called elementary experiential dimensions [Bruhn and Hadwich 2012a, p. 12]. Pullman and Gross [2004, p. 553] state that "[p]roperly executed experiences will encourage loyalty not only through a functional design but also by creating emotional connection through engaging, compelling, and consistent context".

CX literature proposes various criteria supposed to positively influence the perception of products and services. Applying an explorative factor analysis, Novak et al. [2000, pp. 22-42] introduce a valid scale for the construct of CX in the Internet context. Their work is based on Csikszentmihalyi's flow concept [Csikszentmihalyi 1975; Csikszentmihalyi 1981; Csikszentmihalyi 1985; Csikszentmihalyi 1990]. However, a large number of experience concepts (cf. Novak et al. [2000, pp. 22-42], Knutson and Beck [2003, pp. 23-35], Schmitt and Mangold [2004, pp. 38-43], Mascarenhas et al. [2006, pp. 397-405], Gentile et al. [2007, pp. 395-410], or Verhoef et al. [2009, pp. 53-64]) underline that there is no consent on a widely accepted theory. Nevertheless, the excitement criteria proposed by Schmitt [1999, pp. 63-69] and Schmitt and Mangold [2004, pp. 38-43] serve as a basis for subsequent research and therefore can be regarded a prevailing opinion [Mascarenhas et al. 2006, p. 399; Gentile et al. 2007, p. 397; Verhoef et al. 2009, p. 32; Mayer-Vorfelder 2011, p. 113]. Accordingly, holistic experiences build on a stimulation of sensory, social, behavioral, cognitive, as well as affective modules (cf. Figure 2.34).

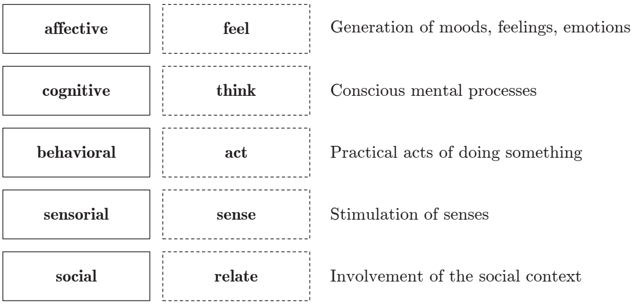

Figure 2.34 – Customer Experience Dimensions
adapted from Schmitt [1999, pp. 63-69] and Schmitt and Mangold [2004, pp. 38-43]

In detail and based on Schmitt and Mangold's work these modules are also described as experiential dimensions and interpreted as follows:

- **Affective Dimension:** The affective dimension covers the customer's reactions in the form of emotions and moods resulting in a positive feeling towards the service and the service provider. The strongest feelings occur while using a product or service and can manifest in joy, fun, or even pride.

- **Cognitive Dimension:** Cognitive criteria focus on the consumer's intellect. They promote a person's creativity and target the mental confrontation with the service and its provider. Technologies are particularly suited for delivering cognitive experiences.

- **Behavioral Dimension:** Alternative lifestyles, materialized experiences, a variety of possibilities to interact, as well as different types of using a product or service are implemented through the behavioral experience dimension. It often also addresses changes of a customer's lifestyle on top of pure rational behavioral effects.

- **Sensory Dimension:** The sensory dimension reflects all impressions gathered through the sensory organs, may they be of visual, auditory, haptic, gustatory, or olfactory nature. Touching one or multiple senses is regarded as the basis of all marketing approaches.

- **Social Dimension:** Social experiences concentrate on interpersonal relationships and all interactions related to the customer's social network. Added value should be generated through social identity, a sense of belonging, and interaction with others. [Schmitt 1999, pp. 63-69; Schmitt and Mangold 2004, pp. 38-43]

In their work, several authors identify the potentials of certain design aspects for creating experiences. Pine and Gilmore [1998, p. 104] for example clarify the importance of stimulating all five senses: "The more senses an experience engages, the more effective and memorable it can be." Similar examples can be found for the other dimensions. Most researchers take a perspective that covers not only one, but a combination of multiple dimensions. Therefore, Schmitt and Mangold [2004, p. 45] state that the experiential dimensions in the optimal case form one holistic construct. This results in the fact that users discern the effects of these stimuli as a complex and integrated feeling, often not being able to consciously separate the elements [Gentile et al. 2007, p. 398].

Gentile et al. [2007, pp. 395-410] furthermore provide a general framework that explains the process of value generation through CX (cf. Figure 2.35). The idea is that the value of a company's offerings (described as artifacts) is facilitated through the experiential dimensions perceived by the consumer.

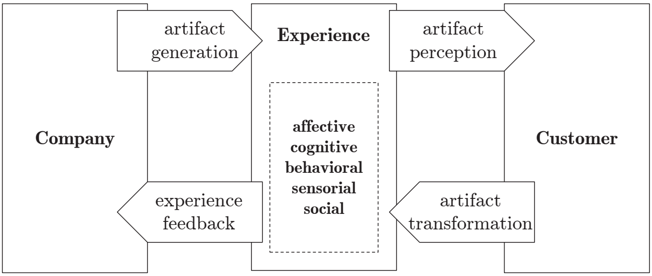

Figure 2.35 – Transformation of Experiential Dimensions
adapted from Rösler [2014, p. 15], based on Reckenfelderbäumer and Arnold [2012, p. 90] and Gentile et al. [2007, p. 400]

2.4.3 Experience Engineering

2.4.3.1 Process Model

CEM is defined as "the process of strategically managing a customer's entire experience with a product or a company" [Schmitt 2003, p. 17]. Nevertheless, research on strategically building experiences is still at its beginning. Schmitt [2003, p. 25], resp. Schmitt and Mangold [2004, p. 43] propose a five-step CEM-model (cf. Figure 2.36) that also finds its way, sometimes modified, into subsequent research (cf. Reckenfelderbäumer and Arnold [2012, p. 102] or Bruhn [2013, pp. 72-76]). Parallels can even be found in the service excellence standard [DIN Deutsches Institut fuer Normung e.V. 2011b, p. 14; Gouthier et al. 2012, pp. 63-83]. The concept considers the importance of innovation, the analysis of customer experiences and the corresponding customer interfaces, the relevance of human service employees and internal resources, as well as further components.

CEM - Model

1. Analyzing the experiential world of the customer
2. Building the experiential platform
3. Designing the brand experience
4. Structuring the customer interface
5. Engaging in continuous innovation

Figure 2.36 – CEM-Model
adapted from Schmitt [2003, p. 25] and Schmitt and Mangold [2004, p. 43]

In detail Schmitt [2003, pp. 25-31] describes the steps as follows:

- **Analyzing the experiential world of the customer:** At first it is important to select the specific target group and to get detailed insight on the respective customers. Differentiating between business-customers (B2B) and end-consumers (B2C), it is required to analyze their sociocultural context, their habits, as well as to identify the most relevant customer contact points.

- **Building the experiential platform:** The experiential platform represents the company's experiential positioning towards the customer and therefore forms the primary connection between the experience strategy and its implementation. It transforms the experiential dimensions as well as the utilitarian and hedonistic value propositions for intended executions.

- **Designing the brand experience:** After deciding for the experiential platform, the concrete implementation is executed. The selection of the experiential drivers needs to be done in alignment with prevalent customer needs.

- **Structuring the customer interface:** The customer interface, also called "moment of truth", constitutes a crucial part of the experience, representing the primary point of reference for the customer. Used for the dynamic exchange of information and direct interaction with the customers, three types can be distinguished: personal, individual, and electronic interfaces.

- **Engaging in continuous innovation:** In order to deliver long-lasting brand experiences it is important to continuously engage in planned (small and major) innovations linked to the experiential strategy. By providing something that improves the customer's lives they can be a tool to attract new and retain existing customers, as well as to increase sales. [Schmitt 2003, pp. 25-31; Schmitt and Mangold 2004, pp. 43-45]

Schmitt [2003, pp. 30-31] also mentions that the steps do not necessarily follow the predefined sequence and may also be worked on in parallel. This provides a certain flexibility when designing engaging service offers.

2.4.3.2 Experiences Through Innovation

The experiential power of innovation is intensively discussed as part of the service excellence research in Chapter 2.2.3.2. But apart from services authors investigate the influence of innovation towards the perceived utilitarian and hedonic value. In this context, Crosby and Masland [2009, p. 10] understand CX innovation as happening apart from pure product innovation, e.g. as new business models. This can happen either in the form of an inside-out (e.g., through research teams) or as a consumer-driven outside-in innovation. They describe a process that follows three steps and deeply integrates the consumer as an important element into the development process. After setting priorities (e.g., identifying the value of a CX strategy in comparison to alternative methods) extensive consumer insight needs to be gained in order to best develop and evaluate ideas [Crosby and Masland 2009, p. 11].

This mindset is also supported by other authors (cf. Kleinaltenkamp and Hellwig [2007, pp. 197-216], or Piller [2008, pp. 399-430]). As stated in the previous section, Schmitt [2003, p. 29] asks for "continuous innovation", whereas innovation is understood as "anything that improves customers' personal lives". The potential value for the customer is also considered one of the most important criteria for selecting the best innovation alternative [Voigt 2008, pp. 402-403]. Schmitt also considers innovation as a means to attract new and to keep existing customers by demonstrating experiential value on an ongoing basis. Instead of working on technology-push or market driven innovations, managers should focus on experience driven innovations, as they more likely meet the customers' needs [Gentile et al. 2007, p. 405]. Furthermore, the service interface is mentioned as a key to successful CX innovation [Sawhney et al. 2011, p. 32], and the use of technology as a means for improving the experience delivered through this interface [Schmitt and Mangold 2004, p. 150].

2.4.3.3 Evaluation Methodologies

Finally, all innovation and CX efforts require an ongoing and systematic measurement of the experiences created [Faullant 2007, pp. 76-99; Reckenfelderbäumer and Arnold 2012, p. 101; Fließ et al. 2012, p. 163]. Nevertheless, research on the assessment of customer experiences is only at its beginning. One of the reasons is that experience is described as a hypothetical construct that defies a direct measurement and can only be assessed through its effects [Schermer 2006, p. 19; Mayer-Vorfelder 2011, pp. 3-4]. Even though CX is in general attributed a high relevance, empiric research in this area is still rare [Verhoef et al. 2009, pp. 31-41; Bruhn and Hadwich 2012b, p. V]. In addition, measuring customer satisfaction and experiences can only be used to assess a certain state and the effectiveness of the efforts, thus leading to insights on which methods or designs work. It "does not tell anyone how to achieve it" [Meyer and Schwager 2007, p. 2].

Especially for the application of technological artifacts used for the creation of experiences, Reckenfelderbäumer and Arnold [2012, pp. 101-102] suggest systematic analysis, planning, application, and measurement processes, as well as the repatriation of insights into the development (cf. Figure 2.37).

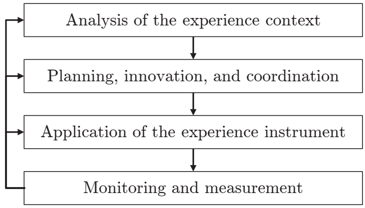

Figure 2.37 – Systematic Process of Customer Experience Creation adapted from Reckenfelderbäumer and Arnold [2012, p. 102]

Holistic experiences include functional as well as emotional components (cf. Chapter 2.4.2.1.3). How they are measured is dependent on the respective field of application (cf. Fließ et al. [2012, pp. 161-183] for service experience, or Machleit and Eroglu [2000, pp. 101-111] for shopping experience), and the degree of delimitation from traditional customer satisfaction evaluation. Many of the authors build their research and by association also their assessment concepts on fundamental psychological models for measuring emotions [Russel and Pratt 1980, pp. 311-322; Machleit and Eroglu 2000, pp. 101-111]. Also some concrete methods for experience evaluation like the Experience Sampling Method (ESM) by Csikszentmihalyi and Larson [1992, pp. 43-57] are presented throughout the years.

Most of the approaches use structural models and factor analyses to identify cause-effect relationships in regards to emotions, but the specific theoretical explications vary in number and type of emotions assessed [Faullant 2007, pp. 77-99]. Referring to Scherer [2005, p. 709] "there is no gold standard" for the measurement of emotions. "While both nonverbal behavior (e.g. facial and vocal expression) and physiological indicators can be used to infer the emotional state of a person, there are no objective methods of measuring the subjective experience of a person during an emotion episode. [...] [T]here is no access other than to ask the individual to report on the nature of the experience" [Scherer 2005, p. 712]. Consequently, a combination of objective and subjective measures is preferred by many researchers. Due to the explorative nature of CX research, also qualitative and quantitative data are often combined [Mink and Georgi 2012, pp. 186-201]. Meyer and Schwager [2007, p. 4] for example suggest surveys, targeted studies, observations, and voice of customer research as methods for monitoring experiences and to capture the subjective attitude towards the company and service provided.

Particular importance is ascribed to measuring experiences originating from technology use. One of the first and most cited papers for CX measurement in regards to technologies is the one presented by Novak et al. [2000, p. 22]: Based on the concept of flow experiences, the authors design a structural model to explain the factors that "make using the Web a compelling experience". The concept contains 13 constructs based on previous research by other authors and contains elements to chiefly measure emotional aspects like pleasure and flow.

The importance of statistical analyses (e.g., with the aid of structural/causal models) to assess experiences is also reflected through the increasing application in recent research. Instead of focusing on pure utilitarian aspects and general satisfaction, researchers put strong emphasis on a combined assessment of utilitarian and hedonic aspects (cf. Gentile et al. [2007, pp. 395-410], Bruhn and Mayer-Vorfelder [2011, pp. 1-18], or Pantano and Di Pietro [2012, pp. 1-19]).

2.4.4 Challenges and Research Gaps

Although CX research is a relatively new discipline much work has been done in this area throughout the last two decades. Most researchers of prevalent literature treat the topic of customer experience on a broad scale (cf. Schmitt [1999], Schmitt and Mangold [2004], Gentile et al. [2007, pp. 395-410], Mayer-Vorfelder [2011], DIN Deutsches Institut fuer Normung e.V. [2011b]). As a side-topic, also the use of technology found its way into relevant CX literature (cf. Burke [2002, p. 430], Danziger [2006, pp. 260-261], Pantano and Di Pietro [2012, pp. 1-19]). Self-service technologies increasingly replace the traditional interfaces between company and customer. Verhoef et al. [2009, p. 35] state that next to other antecedents, "[t]echnology-based service delivery systems are becoming an integral part of shopping and hence are critical to examine in terms of their impact on customer experience". Nevertheless, research on the experiential aspects of SSTs is rare and in most cases restricted to self-services executed through the Internet [Novak et al. 2000, pp. 22-42; Curran and Meuter 2005, pp. 103-113]. Moreover, current research does not value SST kiosks as a combination of hardware and software technologies, with both components influencing the overall perception of the service [Bitner et al. 2000, p. 147]. Also the specific assessment of self-service design in regards to technology selection is not part of their work.

The deficit of research in these areas, especially in the retailing context, is identified by several authors [Bruhn and Mayer-Vorfelder 2011, pp. 17-18; Bagdare 2013, pp. 45-51]. Thus, Verhoef et al. [2009, pp. 34-37] indicate the need for work regarding the influence of consumer's technology readiness, the system's interactivity, technology failures, as well as for the evaluation of the distinctive drivers of customer experiences in general. Authors also ask for new methods to measure experiences in order to predict future consumer behavior and to strategically design technology-based solutions [Verhoef et al. 2009, p. 34; Pantano and Di Pietro 2012, p. 11]. It is encouraged to perform empirical studies and experiments to analyze the effectiveness of CX determinants and to create and refine promising solutions [Burke 2002, p. 431; Gentile et al. 2007, p. 405; Sandström et al. 2008, p. 122; Leisching et al. 2012, p. 438]. Also the need for studies to identify the effects on different consumer groups is elucidated [Bagdare 2013, p. 50].

2.5 Interim Conclusion

The previous sections motivate research in the field of experiential SSTs from three different perspectives and research areas: services science, HCI, and CX (cf. Figure 2.38). Each of them shows a strong focus on the customer, who is playing a major role throughout the delivery and interaction process. It is possible to identify a shift towards soft factors, which to a greater degree consider the process (the how) over the result (the what) of a service or system provided. Emerging technologies increasingly support or even replace the traditional human employees, thus opening up possibilities to create innovative interfaces between companies and their consumers. While the elaboration of consumer touch points varies depending on the individual company, consumer segment and system provided, the use of technology is in general found a means to generate additional value for the consumer [Wirtz 2008, pp. 84-85]. Also, each of the research fields offers methods and processes to innovate, to engineer, and to evaluate services and systems. Nevertheless, these are usually applied within the limits of the respective research field, which leads to shortcomings when combinations are considered. The following overview provides a summary of the most important research gaps identified through the literature reviews and that will serve as a guideline for this thesis.

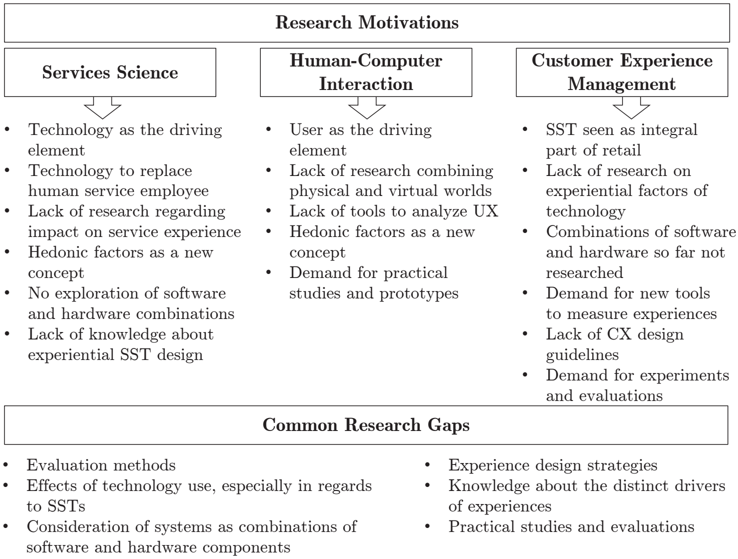

Figure 2.38 – Research Motivation

While each of the research fields values the investigation of functional/utilitarian as well as hedonic/emotional aspects, evaluation methods are still rare. This in particular applies to methods for the assessment of feelings and the holistic manifestation of consumer experiences. As a consequence, theories lack in knowledge about the distinctive drivers of positive experiences and, considering the area of interactive self-service systems, about the effects of technologies applied. This fact is even intensified by not considering SSTs as combinations of hardware and software components. Knowledge obtained can in turn be used to develop an experience engineering process that is also not part of current research. Researchers therefore ask for the development of new evaluation methods and to conduct explorative and empirical studies analyzing innovative design solutions. The foundations presented in this chapter provide a state-of-the-art overview about the most relevant research trends as well as innovation, engineering, and evaluation methods of the considered research fields. While some similarities can be disclosed in the engineering and evaluation methodologies, none of the current approaches covers all aspects required for the design and assessment of experiential SSTs. In order to address this deficit as well as the research gaps identified (cf. Figure 2.38), new methods and strategies need to be defined that facilitate holistic service experience innovation, engineering, and improvement.

These deliberations provide the starting point for the development of the service fascination research methodology as well as for the design and evaluation of experiential SSTs demonstrated in the subsequent chapters (cf. Figure 2.39).

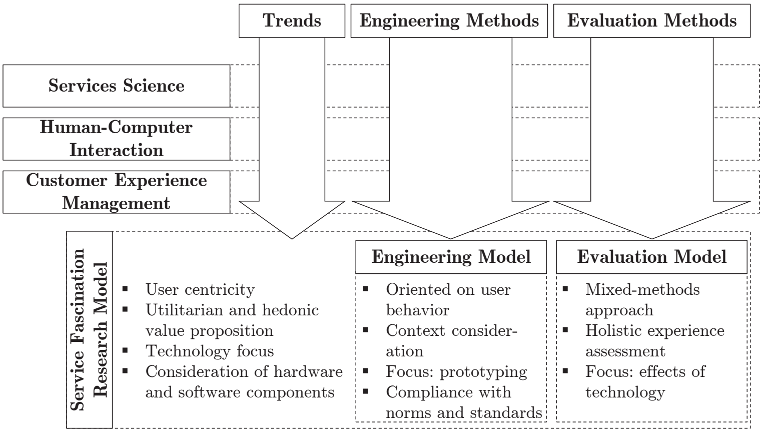

Figure 2.39 – Conclusion and Approach

Instead of innovating the methodology from scratch, the new model draws on and recombines existing theories and methods presented before. By doing so, the new concept needs to consider the general trends identified in literature: The user has to be the center of all efforts. This also implies that the user's experience must be approached in a holistic manner, including not only utilitarian but to a notable degree also hedonic value propositions. Due to the technological nature of electronic self-service systems, technology needs to play a major part in this comprehensive value delivery. The user does not discern between software and hardware components as his/her perception is holistic in nature. Therefore, and instead of treating SSTs as either software or on the hardware components it is important to consider them as a combination of both.

As a consequence, a service fascination engineering model (to be presented in Chapter 3.2) also needs to be oriented on the user's behavior in the given context. This not only includes the core task to be improved by a SST, but also the environmental conditions influencing the overall experience perceived. While general norms and standards of services science, HCI, and CX engineering approaches need to be complied with, strong emphasis needs to be placed on prototyping. This allows an early integration of the user into the design process and increases the probability of service acceptance and excitement.

The second part of the research concept is the service fascination evaluation model to be presented in Chapter 3.3. As experiences emerge before, during, and after application of the system and as they are influenced by contextual frame conditions, a mixed-methods approach needs to be followed. This allows capturing the entire conscious and subconscious effects of technology application from a subjective (e.g., asking the user) as well as an objective (e.g., observing the user) perspective, finally leading to a holistic assessment of the SST designed.

Chapter 3

Service Fascination

3.1 Objective and Methodology

"The customer experience is the key. Emotional content is essential, as is the quality of the service, both upon delivery and after sales. [...] [I]t is of paramount importance to enrich and enhance traditional retail through constant innovation" [Perrey and Spillecke 2013, p. 292]. Based on the conceptual foundations and the research gaps motivated in the previous sections, this chapter[1] presents a novel approach for systematically innovating, designing, evaluating, and improving experiential SSTs. The service fascination research model (cf. Figure 3.1) consists of two distinct but affiliated models, the service fascination engineering model as well as the service fascination evaluation model.

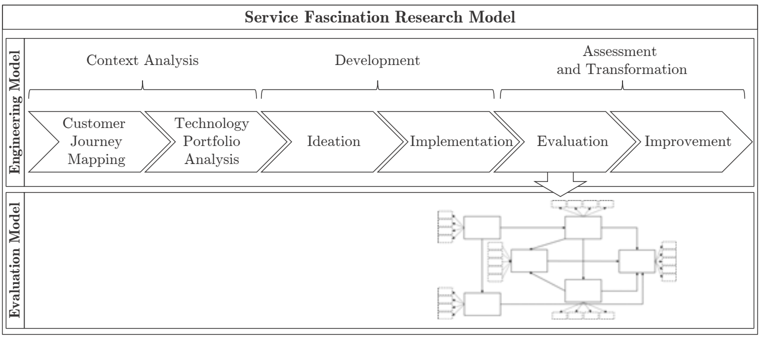

Figure 3.1 – Service Fascination Research Model

[1]Parts of this research are published in Zagel and Bodendorf [2012, pp. 697-704], Zagel et al. [2014b, pp. 177-190], Zagel and Bodendorf [2014, pp. 537-548], and Zagel [2014a, pp.311-314].

C. Zagel, *Service Fascination,* DOI 10.1007/978-3-658-11673-6_3,

Currently, research lacks knowledge in the area of experience design strategies. This notably applies for the development of electronic services and systems. The service fascination engineering model represents the first of two elements within service fascination research. Based on the research gaps identified (cf. Chapter 2.5) a new engineering process is presented that specifically focuses on the creation of experiential self-service systems. This happens by following a human-centered design approach and by targeting an integration of both utilitarian and hedonic values into the service provided. For this purpose the concept utilizes the five experiential dimensions proposed by Schmitt [1999, pp. 63-69] (cf. Chapter 2.4.2.2.3). Within service fascination engineering the goal is to cover all five dimensions in the form of one holistic experience. In addition experiential SSTs are deemed as combinations of hardware and software technologies, design methodologies, and digital content. As experiences are believed to be the results of a holistic interaction with the service system, this combination needs to be reflected in the SST's individual implementation. Also the consideration of the device's ergonomics is part of the endeavor. The objective of developing a strategy for the design of experiential self-service technologies implies a consideration of engineering methods used within the underlying research areas services science, HCI, and CX. Selected methods are reused and recombined in order to provide answers to the following research questions:

- **RQ 1:** Which elements need to be considered for developing experiential self-service technologies?
- **RQ 2:** Which design strategy should be followed to develop experiential self-service systems?

Another major research gap is the absence of evaluation methods that can be used to assess customer experiences in electronic systems. This not only includes the user's emotions as such, but especially relates to all components that are crucial for the evocation of these emotions. In order to assess the effects of SST use as well as the experiential characteristics of SSTs, a novel assessment method is introduced: the service fascination evaluation model. It enables researchers and practitioners to gain knowledge about the distinct drivers and mediators of experiences, as well as about their correlations. Effects of the SST's concrete realization in regards to technologies applied towards the creation of utilitarian and hedonic values can be examined. Next to general demographic elements, the human component includes dependencies on the user's personality (e.g., technology readiness), potential barriers (e.g., trust in technology and data security), as well as emotional effects of technology use (e.g., fun and enjoyment). Developing interactive systems furthermore provides the basis for a deep involvement of the user, hence, facilitating the emergence of a state of immersion and flow (cf. Chapter 2.4.2.1.5). Derived insights provide starting points for the improvement of the assessed systems in two phases: during initial development and as a constant monitoring tool after the system's roll-out. Hence, the service fascination evaluation model provides an answer to the following research question:

- **RQ 3:** How can service fascination and its dimensions be measured?

Finally, both components of the service fascination research model support the bigger goal of differentiating a company from its competitors through the offer of experiential self-services. Hereby it is important to not only offer new or improved service concepts, but also to implement them with a service excellence mentality (cf. Chapter 2.2.2.3).

3.2 Engineering Model

3.2.1 Overview

The service fascination engineering process is embodied in the form of iterative process loops (cf. Figure 3.2). It is subdivided into the steps context analysis (customer journey mapping and technology portfolio analysis), development (ideation and implementation), as well as assessment and transformation (evaluation and improvement). Each of the steps applies either existing methods or new, modified techniques, that draw on prevailing literature.

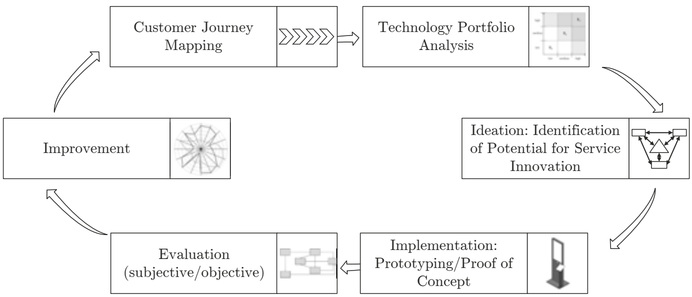

Figure 3.2 – Service Fascination Engineering Model

Customer journey mapping helps to identify relevant touch points worth considering an experiential improvement. In doing so, it is either possible to select and improve existing traditional services or to develop new services from scratch. Nevertheless, the goal is to select services with the highest potential impact, while reflecting upon the need for delivering a holistic and balanced brand experience. Technology profiling covers the second part of the context analysis. It is carried out in the form of expert interviews and used to identify an initial set of promising technologies that can be used in consideration of the given application environment. For ideating service innovations, the 4D model of service innovation by den Hertog [2000, p. 495] is used. Slight adjustments make it possible to adapt the model to the specific field of SSTs. It allows describing the utilitarian service value as part of the service concept as well as the UIs and interaction concepts, the content creation and delivery, and the technological setup. This theoretical service concept is then transferred to the implementation phase, in which interactive systems are built. These apply the standardized usability engineering methods, particularly a HCD approach, placing the consumer into the center of all efforts. In order to comply with common usability norms and standards user tests are carried out and feedback is consecutively included in the further development. An essential part is the evaluation step, that is represented by a novel experience measurement approach, including objective and subjective evaluation methodologies. It constitutes aspects and insights of all three underlying research domains. Executed in the form of a survey in combination with a behavioral observation, the service fascination evaluation model (cf. Chapter 3.3) allows the identification of correlations between the observed variables and derives knowledge about the individual characteristics of the observed SST. Strengths and weaknesses of the service design identified within the evaluation phase can be used as a basis for refining the SST concept and to improve the manifestation of the distinct experiential dimensions.

3.2.2 Context Analysis

3.2.2.1 Customer Journey Mapping

The research concept at hand places the consumer into the center of all efforts. Services as interactive processes involve an interplay between customer and service provider (cf. Chapter 2.2.1). "In service design, this process is approached from the customer's point of view by constructing a customer journey which is a chronological representation of the activities of the service participants in a given service situation" [Kronqvist and Korhonen 2009, p. 9]. As part of the HCD process (cf. Chapter 2.3.3.1), analyzing and designing the service's context and flow is called user journey mapping[2] [Martin and Hanington 2012, pp. 196-197]. Next to shifting "an organization's focus from an operational, system-centered view to the larger context in which products and services are used in", customer journey mapping "also helps teams pinpoint distinct moments that elicit strong emotional reactions and are ripe for redesign and improvement" [Martin and Hanington 2012, p. 196]. It furthermore "considers both the functional and emotional needs of the customer and plots the interactions that occur and the feelings aroused at each 'touchpoint'" [White et al. 2008, p. 122]. The method can therefore also be used as a tool to analyze the experiential world of the customer (cf. Chapter 2.4.3.1). In contrast to the traditional requirements analysis, journey mapping captures "all activities and events related to the delivery of a service from the customer's perspective" [Zomerdijk and Voss 2010, p. 74]. This means that instead of merely identifying "an appropriate set of resources to satisfy a system need" [Grady 2006, p. 18], the focus is "to understand how customers behave across a journey, what they are feeling, and what their motivation and attitude are across the journey" [Zomerdijk and Voss 2010, p. 74]. Identifying the relevant moments of truth can happen through observations of user behavior as well as by interviewing customers or experts [King 2008, pp. 137-138; Luh 2013, p. 652]. Next to simply transferring the customer's interaction into a process chart, "mapping" also includes a comparison of the organization's service offers to the needs of the customers [King 2008, p. 138].

While journey maps can reflect a rather narrow or a broad part of the customer's total interaction with the company (Figure 3.3 exemplarily illustrates a customer journey of a generalized buying process), King [2008, pp. 136-138] defines three major advantages of the method, namely to identify relevant customer interactions, gaining insight on customer needs, and to keep customer focus. Journeys can visualize the interaction of a consumer with a company as flowcharts or other graphical formats, depicting either "the customer's actual or ideal journey" [Liedtka and Ogilvie 2011, p. 61].

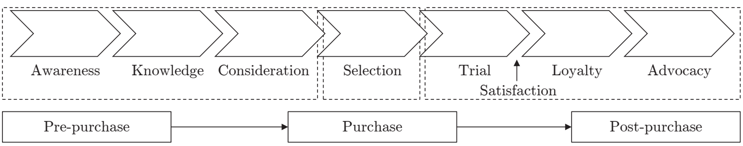

Figure 3.3 – Customer Journey Map
adapted from White et al. [2008, p. 123]

[2]In the context of a provider/customer relationship, user journey mapping is also referred to as customer journey mapping [White et al. 2008, pp. 122-123], "Moment Mapping ®" [Shaw 2005, pp. 135-136], or brand touch points mapping [Davis 2010, p. 374].

In his work, Davis [2010, pp. 379-380] outlines the following steps for a successful journey mapping:

- **Identification of customer's needs:** Observations and market research can help identify the needs of consumers at each and every touch point with the company.
- **Identification of the company's response:** Each need is mapped to a certain response of the company, is linked to a certain touch point, and involves the interaction with a stakeholder.
- **Response scoring:** The as-is state is rated by applying a comparison with competitors as well as by using consumer feedback. The main purpose is to identify a company's strengths and weaknesses within the customer interaction.
- **Identification of gaps, problems, and opportunities:** Based on the respective feedback, touch points with the largest expectation vs. experience gaps are selected.
- **Plan of action:** Disclosed gaps in customer perception need to be translated into an action plan that not only covers possibilities for improvement, but also captures success control mechanisms.
- **Review:** Iterative reviews and renewals help to constantly meet changing customer needs over an extended period of time. [Davis 2010, pp. 379-380]

"[S]uccess or failure of a service is determined by the expectations of the customer and the experience during the process or usefulness of its result" [Kronqvist and Korhonen 2009, p. 9]. Customer journey mapping thereby helps to select and improve customer touch points with highest potential to create experiences, and consequently to differentiate from competitors.

3.2.2.2 Technology Portfolio Analysis

As part of the strategic business planning, portfolio methods are used as a means for the selection of new business areas and strategic business activities [Hahn 2006, p. 215; Voigt 2008, p. 162]. Transferred from financial planning theories, portfolio analyses follow the goal of maximizing profit while minimizing potential risks for the enterprise [Simon and von der Gathen 2010, p. 34]. Amongst many other specializations, the technology portfolio analysis concentrates on the strategic assessment of existing and new technologies [Hahn 2006, pp. 226-228]. Its originators, Pfeiffer et al. [1991, pp. 13-21] name time as the critical strategic resource for company success and technological innovations driving a radical change, eliminating market barriers and opening up new possibilities to differentiate. The authors propose a four step approach: (1) identification of new technologies, (2) investigation of the as-is-state, (3) transformation of the technology portfolio, and (4) the derivation of recommendations for action [Pfeiffer et al. 1991, pp. 80-103]. In the course of this chapter, the originally suggested steps are adapted and transferred to the specific area of experiential SSTs [3].

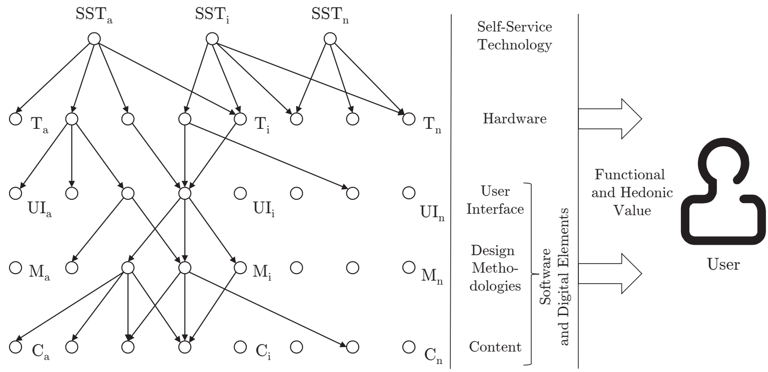

Figure 3.4 – SST-Technology Relation
adapted from Pfeiffer et al. [1991, p. 81] and Sandström et al. [2008, p. 121]

In their work, Pfeiffer et al. [1991, pp. 80-84] describe products as a collection of individual technologies. Figure 3.4 presents the modified contemplation, deeming SSTs as complex systems involving hardware and software technologies, respectively digital elements. The hardware part represents the physical elements of the human-computer interface, implemented in the form of input and output devices (e.g., keyboard, mouse, display). Software technologies and digital elements comprise all forms of content (e.g., images, text, user data) that is processed by using selected design methodologies (e.g., interaction concepts like gamification) and being presented through (e.g., graphical) UIs. As described by Sandström et al. [2008, p. 121] this technology-based service experience is perceived by the user in the form of functional as well as hedonic value in use (cf. Chapter 2.4.2.1.3).

After identifying relevant technologies of the observed business field, the as-is-state needs to be assessed. The identification can happen by using methods of technology foresight like "monitoring" and "scanning" [Voigt 2008, p. 170]. While in the original

[3] Further variations can also be found in Voigt [2008, pp. 162-169].

model technologies are rated using the criteria "technology attractiveness" and "resource strength" [Pfeiffer et al. 1991, pp. 85-92], a modified procedure is used within the context analysis and for the development of experiential SSTs. Instead of a single assessment, the rating is split up into two parts: the company's perspective and the customer's perspective (cf. Figure 3.5).

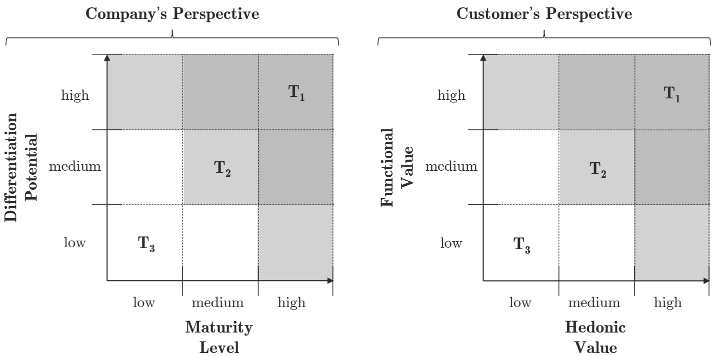

Figure 3.5 – Experiential Technology Portfolio
adapted from Pfeiffer et al. [1991, p. 99]

Within the company's perspective, technologies are rated in relation to their potential for differentiation (e.g., how many of the competitors already use this technology in the targeted application environment) as well as the technology's maturity level. This approach also covers a risk assessment, e.g., the likelihood of malfunction during use and potentially resulting support efforts. The customer's perspective, in contrast, puts the user's perceptions into focus. The goal of providing both functional as well as hedonic values (cf. Sandström et al. [2008, p. 121]) is transferred into target values of the technology portfolio's customer perspective. As SSTs in essence represent mashups of different hardware technologies, digital content, and design methodologies, the assessment has to be done for all of them.

Next to identifying the as-is-state of technologies available they need to be set in relation to each other using the applied rating criteria. The goal is to take the most advanced technology as a benchmark while considering the development abilities of the enterprise [Pfeiffer et al. 1991, pp. 92-98]. For the given use case it is important to consider that the basic technologies rated (especially the hardware parts) are usually not produced by the service supplier but externally acquired. In contrast to the traditional procedure by Pfeiffer et al. [1991, pp. 92-98], a transformation may be omitted. This approach, combining externally acquired with internally generated capabilities is also reflected in the model for technology generation by Phillips [2001, p. 30] depicted in Figure 3.6.

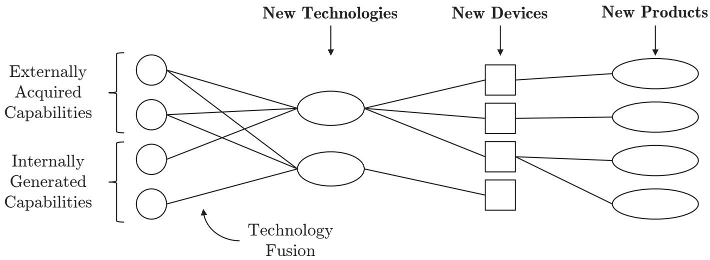

Figure 3.6 – Technology Generation, Acquisition, Fusion, and Evolution adapted from Phillips [2001, p. 30]

Pfeiffer et al. [1991, pp. 98-103] postulate three different recommendations for action based on the respective technology ratings (cf. Figure 3.5). The recommendations are adjusted according to the given context.

- **T1 - Investment recommendation:** Technologies with high differentiation potential and high maturity level need to be supported. The same applies for those technologies that provide a high functional as well as a high hedonic value to the user.

- **T2 - Selective recommendation:** These selection fields do not constitute a general recommendation for action. Instead, technologies in this position require a deeper analysis in regards to the given context and use case.

- **T3 - Disinvestment recommendation:** These technologies offer low attractiveness while having a low maturity level. On the other hand, they can show low functional and hedonic value. Companies should not invest in these technologies. [Pfeiffer et al. 1991, pp. 98-103]

Since all technologies are rated in regards to the company's as well as the customer's perspective, the results have to be analyzed in relation to each other. A final selection of technologies has to be done depending on the enterprise's overall strategy by implementing the service and the SST to be created. Just as the original technology portfolio method, the assessment exercise has to be conducted by experts [Pfeiffer et al. 1991, p. 90]. The same applies for methods used in technology foresight[4] [Popper 2008, p. 46].

3.2.3 Development

3.2.3.1 Ideation

This engineering approach focuses on the delivery of functional and especially emotional user values when designing and developing novel SSTs. The implementation of new self-service concepts involves technologies as the primary resource. A technique well suited for describing the components of these technology-based service innovations is the 4D model of service innovation by den Hertog [2000, p. 495] (cf. Chapter 2.2.3.2). Nevertheless, the original 4D model focuses on innovating traditional services, with technological options playing a prominent, but not the main role. Furthermore, the authors merely concentrate on the delivery of functional values through service innovation. Self-services and the respective SSTs use technology as the elementary means to either enhance or to substitute human service encounters (cf. Chapter 2.2.2.1). It is therefore important to consider and to include technology in all of the model's four dimensions. With the goal of delivering not only utilitarian, but also hedonic values to the consumer, a modified 4D model (cf. Figure 3.7) for the innovation of experiential SSTs is presented.

While the basic structure of the model remains unaltered, its innovation dimensions are defined as follows:

- **Service Concept:** Like in the original model, the service concept represents the intangible characteristic of the service. However, and next to the provision of a functional value, the redefined model considers the hedonic/emotional elements as a value per se, thus constituting an equal component of the service concept. This is achieved by focusing on the specific characteristics of SSTs as well as by strategically addressing the experiential dimensions by Schmitt [1999, pp. 63-69] and Schmitt and Mangold [2004, pp. 38-43] (cf. Chapter 2.4.2.2.3).

[4]Referring to Georghiou [1996, p. 359], technology foresight is defined as "a systematic means of assessing those scientific and technological development which could have strong impact on industrial competitiveness, wealth creation and quality of life".

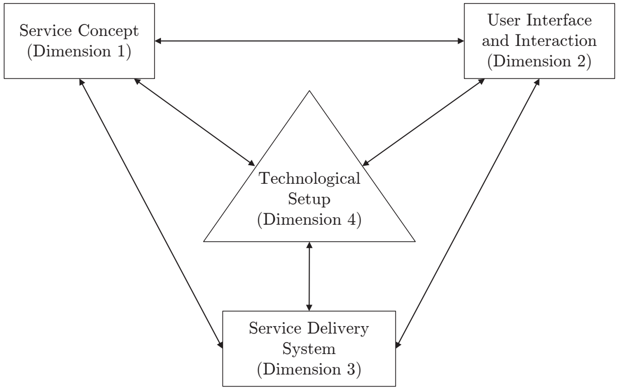

Figure 3.7 – 4D Model of Technology-Based Self-Service Service Innovation adapted from den Hertog [2000, p. 495]

- **User Interface and Interaction:** As stated in Chapter 2.4.3.1, the customer interface represents the primary point of reference for the consumer. Within SSTs, this customer interface is realized through the device's UI. During the development process of this UI, designers must concentrate on the needs of the targeted user groups. This includes an attractive design. Norman [2004, p. 60] for example states that "[a]ttractive things do work better - their attractiveness produces positive emotions, causing mental processes to be more creative, more tolerant of minor difficulties". A well designed UI, especially if it uses elements of VR, is also able to create a state of immersion and flow [Psotka 1995, p. 405; Hearst et al. 2002, pp 42-49]. As UIs of SSTs typically imply some form of interaction with the consumer it is important to also consider usability as a key element. In a self-service terminal the UI does not only include the software interface, but the combination of hardware and software elements. Therefore, the aesthetics and ergonomics of the "physical product" have to be considered as visual appeal triggers emotional responses that influence user acceptance [Rindova and Petkova 2007, pp. 225-226].

- **Service Delivery System:** This dimension includes all of the internal factors and backend tasks required to process data and to realize the desired functionality. These can be algorithms, APIs, drivers, or even embedded standalone applications that are used during implementation. These software components leverage various forms of digital content that for example includes all kinds of multimedia data like images, videos, animations, or 3D files. Hence, also information pulled from independent external systems (e.g., social media platforms) can serve as data that is processed for service delivery.

- **Technological Setup:** The goal is to apply state-of-the-art technology for service delivery. Instead of treating technology as a given, the concept explicitly features a combination of hardware and software technologies, which sets the foundation of a SST represented as a kiosk system (cf. Chapter 2.2.2.2). In an optimal case, already the novelty of the chosen technology combination is a reason for evoking positive emotions amongst the target group [Rindova and Petkova 2007, pp. 217-232].

3.2.3.2 Implementation

Self-service systems replace or enhance traditional service encounters (cf. Chapter 2.2.2.1). Referring to the concepts from Helander [2006, p. 4], Burmester [2006, p. 178], and Sandström et al. [2008, p. 121], a generic model for interactive system use is developed (cf. Figure 3.8). It includes elements that focus on the individual human perception as a result from the interaction with technology-based service encounters and serves as a basis for SST prototype development. The utilization context reflects the respective step within the customer journey identified and sets the situational and environmental frame conditions (application at a brick-and-mortar store, event, etc.). By considering the respective context of utilization, the SST setup needs to be adjusted accordingly. This for example includes vandalism proof hardware for public places or ergonomic adjustments for handicapped users. The SST's backend takes care of the actual service provision and applies digital content that is pulled either from internal resources or external platforms. As the primary touch point for the user, the SST's UI is composed of hardware and software components. Constituting a combined human-computer interface these elements and their combination represent a crucial factor for a smooth and pleasant interaction. Furthermore, the environmental conditions as well as the user's personality affect the individual and situational filters. This results in an individual utilitarian and hedonic value perception as a result from the user's mental processing of system use [Sandström et al. 2008, pp. 115-121].

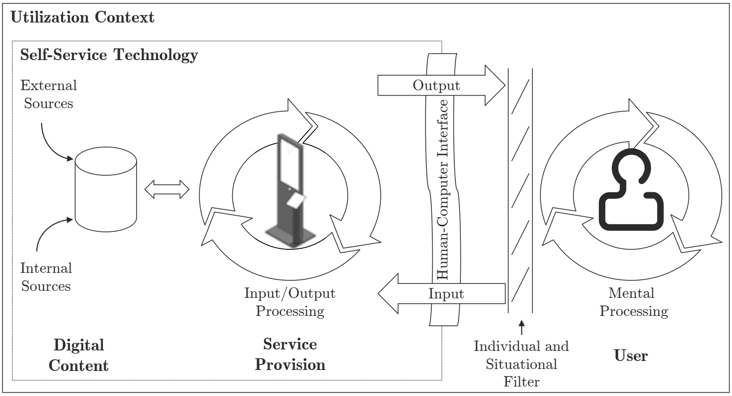

Figure 3.8 – Interactive Prototyping and Value Perception
adapted from Helander [2006, p. 4], Burmester [2006, p. 178], and Sandström et al. [2008, p. 121]

With the goal of visualizing and assessing functional and experiential aspects of innovative SSTs, it is required to decide for the right type of prototypical realization. This is especially important for being able to cover the holistic impact experienced, which is a result of the total SST design, being composed of physical and virtual components. According to the deliberations of Chapter 2.3.3.2 many prototyping methods can be used during the design and development process, but not all of them are suited to achieve the task of a deep perceptual quality assessment. Based on the categorization proposed by Beaudouin-Lafon and Mackay [2008, pp. 1018-1020], prototypes created as physical instantiations [Bertsche et al. 2007, p. 4], covering hardware and software components (representation), designed in detail to cover emotional aspects arising through visual design (precision), and providing feedback to user interaction (interactivity) meet the desired goal. Prototypes or proof of concept implementations assessed by a group of subjects can be used. While the concepts can either be implemented as a horizontal, vertical, or hybrid realizations [Nielsen 1994c, p. 95], the requirement of interactivity demands for an online prototype that involves the use of software [Beaudouin-Lafon and Mackay 2008, p. 1028].

3.2.4 Fascination Assessment and Transformation

3.2.4.1 Evaluation

Evaluations of existing services as well as novel concepts (e.g., in the form of prototypes) provide insights on the current state of user acceptance and excitement and disclose indicators for strengths and weaknesses of service design. Results disclose starting points for improving the as-is situation or for the development of new service concepts.

Comparable to the UX model of DIN EN ISO 9241 [DIN Deutsches Institut fuer Normung e.V. 2011a, p. 7] (cf. Chapter 2.3.2.2.3) the concept at hand differentiates three steps of user perception (cf. Figure 3.9). The overall experience is a result of the holistic interaction process, starting with the initial expectations right up to the mental reflection after having used the system. As a result, the measurement covers the individual perception occurring before use, during use, and after use. These are reflected in the evaluation process that consists of an objective and a subjective assessment.

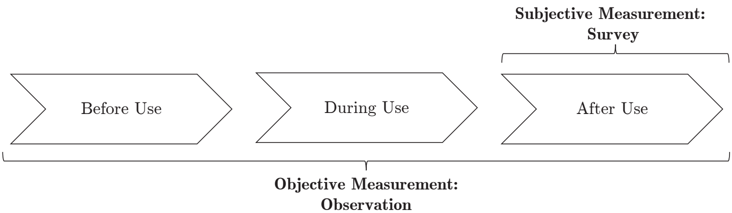

Figure 3.9 – Service Fascination Evaluation Process

In accordance to Mink and Georgi [2012, pp. 186-201] (cf. Chapter 2.4.3.3) and due to the explorative nature of the approach, qualitative and quantitative approaches are mixed. As recommended by Dumas and Fox [2008, p. 1141], Holzinger [2005, p. 74], Arndt [2006, p. 256], and Roto et al. [2009, p. 3], a combination of indirect with direct methods is chosen (cf. Chapter 2.3.3.3). This not only allows capturing additional and short-term reactions of the subjects, but also reduces the probability of undesired effects like social desirability. Aspects gathered through the evaluation need to focus on the fulfillment of the favored utilitarian and hedonic value propositions as well as the identification of acceptance barriers (e.g., emerging through the nature of technology). This can be done by observing the users in regards to their interaction with the system and their emotional reactions throughout the interaction process, constituting the objective, direct part of the evaluation. To furthermore get a deeper insight on the emotional aspects and the individual perception of the users, an additional subjective, indirect measurement is performed by providing the subjects with a survey after having interacted with the SST. Finally, and next to assuring general user acceptance (social feasibility), testing prototypes helps to verify the technical, operational, and economic feasibility of the service concept [Puntambekar 2007, pp. 2.17-2.18].

Due to the lack of methods for evaluating experiences within SST use (cf. Chapter 2.5), the subsequent chapter (cf. Chapter 3.3) presents the service fascination evaluation model that is used within the assessment process described above.

3.2.4.2 Improvement

Insights gained through the systematic evaluation of the designed SSTs can be used to refine the solutions depending on the strengths and weaknesses identified. Improving SSTs can happen in two phases (cf. Figure 3.10): either during design and development with the goal of a continuous optimization within the engineering process or as a consequence of ongoing monitoring after the roll-out.

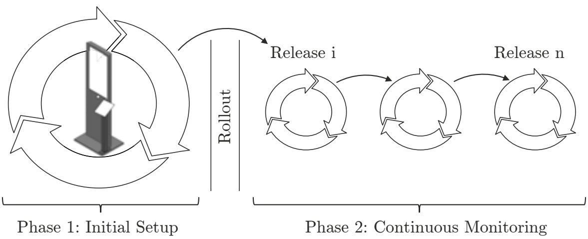

Figure 3.10 – Self-Service Technology Improvement

As part of the HCD process (cf. Chapter 2.3.3.1) several iterations of modifications can occur during system development (phase 1). The goal is to enhance the system in a way that it provides the user with a holistic experience. Observing the experiential dimensions as well as general aspects of technology use can lead to changes of the system design, involving the exchange or addition of complete components or even a reconsideration of the service concept.

Offering experiential SSTs follows the goal of attracting consumers and differentiating a company from its competitors. Nevertheless, experiential systems may lose attractiveness in the course of time as customers get used to them. Changes in user perception or substitutes occurring on the market can be the reason. As a consequence, hedonic or functional quality is lost and the service provided needs to be updated (phase 2). So far, little research is done in regards to these dynamic aspects of customer experiences [Verhoef et al. 2009, pp. 37-38]. If SSTs are understood as physical consumer touch points, traditional concepts for managing the lifecycle of software or products can be applied. Comparable to the management of a company's products within the Product Lifecycle Management (PLM)[5], SSTs follow "waves" of attractiveness (in the form of hedonic and functional quality) as visualized in Figure 3.11. Hence, new innovations need to be identified in order to ensure a constant appeal [Voigt 2008, pp. 388-391].

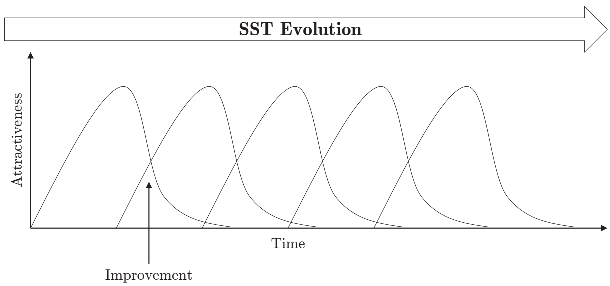

Figure 3.11 – Self-Service Technology Monitoring

As a result, the improvement needs to be scheduled in a way that declining system attractiveness is absorbed by new experiential aspects (functional or hedonic) rolled out to the system. In the worst case, and considering the economic consequences of modifications, the SST needs to be disposed of, and replaced by a completely new experience.

3.3 Evaluation Model

3.3.1 Overview

Current research lacks in methods for evaluating consumer experiences, especially within the area of technology-enabled service systems. This inevitably leads to limited knowledge about the distinct drivers of experiences and the effects of technology use (cf. Chapter 2.5).

[5] Stark [2011, p. 1] defines PLM as "the business activity of managing, in the most effective way, a company's products all the way across their lifecycles; from the very first idea for a product all the way through until it's retired and disposed of".

Building on widely accepted models of CX as well as technology acceptance and services research, this section introduces a measurement concept that enables researchers and practitioners to strategically assess the functional and emotional aspects of technology-based self-service systems [Zagel et al. 2014b, p. 179]. Theories for building customer experiences are combined and transferred to the specific use case of SSTs. As suggested before (cf. Chapter 3.2.4.1), the measurement procedure is split up into a subjective and an objective component. For the subjective part, a causal model applying elements of the traditional TAM is used. It allows measuring general acceptance, usage-barriers as well as experiential effects. Nevertheless, the sole application of interviews or surveys inevitably leads to a loss of information on a nonverbal level [Häder 2006, p. 189]. Therefore, observations conducted by researchers before, during, and after SST usage cover the objective part of the model and complement the findings from the evaluation.

3.3.2 Subjective Measurement

3.3.2.1 Objective

There is no gold standard for evaluating or measuring emotions [Scherer 2005, p. 709]. Directly addressing customers and asking them about their satisfaction with the company or service received is an inevitable task [Scharnbacher and Kiefer 2003, p. 2; Scherer 2005, p. 712]. Subjective measurements address the assessment of individual psychological circumstances and subsequent behavior [Scharnbacher and Kiefer 2003, p. 20]. In this context, conducting surveys is often mentioned as an appropriate instrument [Meyer and Schwager 2007, p. 4]. The goals of the subjective measurement construct are to

- reveal interdependencies between the observed variables, to
- evaluate the total manifestation of the observed variables, and to
- allow comparisons between different instantiations, user groups or utilization contexts.

Multiple methods are selected to reach these goals. While correlations between observed variables are assessed by using a specifically designed causal model, the total manifestations are assessed and group comparisons are carried out using significance analyses and effect size calculations (cf. Figure 3.12).

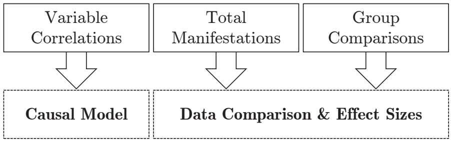

Figure 3.12 – Subjective Evaluation: Method Selection

3.3.2.2 Structural Equation Modeling using PLS

3.3.2.2.1 Methodological Foundation

Within business administration, social sciences, and psychology, researchers regularly design theoretical models in order to map complex interdependencies between researched variables. Usually, these variables defy a direct measurement. These circumstances lead to the development of complex models that try to explain the relationships between measurable indicators and their latent variables, as well as hypothesized correlations between these constructs. [Raithel 2009, p. 543]

As a consequence, these requirements bring about the development of structural equation modeling (SEM) approaches using latent variables [Fornell 1985, pp. 2-6]. These latent variables are assessed through measurable indicators and set into hypothesized relationships [Hildebrandt and Homburg 1998, p. 18]. The power of SEM in comparison to other methods lies in the possibility of analyzing the effects between multiple target variables by testing pre-defined hypotheses [Byrne 1998, pp. 3-4]. Basically, there are two different types of models that can be used: covariance based models[6] [Jöreskog 1967, pp. 443-482] and variance based models, also known as PLS (partial least squares) models [Wold 1975, pp. 307-357; Chin and Newsted 1999, pp. 307-342].

Both approaches hold their individual advantages and disadvantages. Table 3.1 provides a comparison of the most important criteria for both PLS and LISREL, based on selected literature.

[6] Also often referred to as "linear structural relations" or LISREL which is also the name of a statistical software package [Jöreskog and van Thillo 1972].

Table 3.1 – PLS vs. LISREL
adapted from Nitzl [2010, p. 20] and Fuchs [2011, p. 38], based on Chin and Newsted [1999, p. 314], Gefen et al. [2000, pp. 34-78], Bliemel et al. [2005, p. 11], Panten [2005, p. 226], Herrmann et al. [2006, p. 44]

Criterion	*PLS: Variance-oriented*	*LISREL: Covariance-oriented*
Estimation principle	Prognosis-oriented	Parameter-oriented
Consistency	Consistent, if sample size/number of indicators high	Consistent
Measurement models	Formative and reflective	Typically reflective (formative requires special procedures)
Distribution requirements	No requirements	Multivariate normal distribution
Sample size	Small samples often sufficient (30 and more)	At least 200
Model complexity	High	Small to medium (up to 100 indicators)
Quality criteria	Only partial quality criteria applicable	Partial and global quality criteria applicable
Theoretical requirements	Flexible	High
Scale requirements	No restrictions	At least interval-scaled

Amongst the SEM methods especially PLS is increasingly gaining attention due to its practical advantages in regards to exploratory research [Bontis 1998, pp. 63-76]. Furthermore, it is suited for assessing complex questions in research areas with limited prior knowledge [Fließ et al. 2012, p. 173]. PLS therefore experiences increasing popularity in psychology and psychology-related marketing research [Henseler et al. 2009, pp. 277-319; Wilson 2010, pp. 621-652; Albers 2010, pp. 409-425]. In comparison to the more restrictive covariance-based methods, also the manageable requirements regarding sample size and distribution make the method attractive for innovative research projects [Raithel 2009, p. 543]. Based on these advantages and the exploratory nature of the research at hand, PLS modeling is the method of choice for evaluations in the course of this work. This decision is also supported by the recommendations postulated by Chin and Newsted [1999, p. 336].

Causal models are based on two fundamental components: the structural model (also called the inner model [Magnus 2007, p. 136]) and the measurement model [Götz and Liehr-Gobbers 2004, pp. 714-736]. While the structural model reflects the correlations between the hypothetical constructs, measurement models allow the assessment of the latent variables using related manifested indicators [Albers and Götz 2006, pp. 669-677; Magnus 2007, p. 136; Nitzl 2010, p. 3]. Figure 3.13 depicts an example of a structural model including its measurement models. While ellipses define latent variables, rectangles represent their indicators. The example includes two exogenous variables and an endogenous one. Arrows between these constructs indicate the causal relationships and their hypothesized directions.

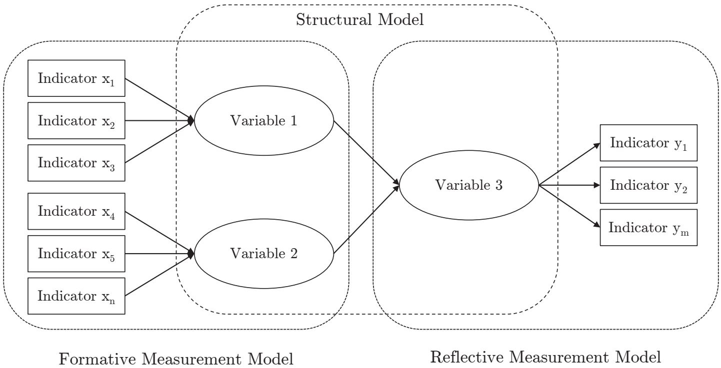

Figure 3.13 – Reflective vs. Formative Measurement Models adapted from Ringle et al. [2006, p. 83] and Nitzl [2010, pp. 3-4]

Every variable is operationalized through its indicators and therefore contains its own measurement model which also represents the causality between the variables and their indicators [Magnus 2007, p. 137]. A major aspect of PLS models is the explicit consideration of both formative and reflective models depending on the relation of the indicators towards the latent variable (cf. Table 3.1). Formative models are used in cases in which the indicators determine the latent variable. In formative relationships, a correlation between the indicators is not intended which leads to the fact, that the measurement of the latent variable requires a holistic coverage of the entirety of the causal indicators [Jarvis et al. 2003, pp. 199-218; Nitzl 2010, p. 6]. As the intention of formative constructs would change, an elimination of indicators is not possible [Bollen and Lennox 1991, p. 306;

Magnus 2007, p. 138]. Reflective measurement models[7] in contrast are used if the latent variable is the cause of the measured indicators [Magnus 2007, p. 137]. In this context, Diamantopoulos [1999, p. 446] describes the latent variables as the root cause of the indicators. This also means that a change in the latent variable will lead to a change in all indicators [Bollen and Lennox 1991, p. 306]. Consequently, the indicators of reflective measurements are highly correlated, which means that an elimination of single indicators should not affect the construct [Nitzl 2010, p. 7]. Table 3.2 provides an overview about the most significant differences between the formative and the reflective formulation of the measurement models[8].

Table 3.2 – Reflective vs. Formative Measurement Models
adapted from Jarvis et al. [2003, p. 201] and Nitzl [2010, p. 9]

Criterion	*Reflective*	*Formative*
Direction of causality	From construct to measure	From measure to construct
Exchangeability	Exchangeable	Not exchangeable
Correlation	Measures expected to be correlated	No correlation between measures expected
Classification	Indicators have identical causes	Indicators have identical effects

3.3.2.2.2 Model Evaluation

Just as with any SEM method, also the PLS approach requires a verification of the model quality[9]. While in principle identical criteria apply for both SEM types, parametric criteria cannot be applied to PLS models because of the lack of distribution assumptions [Fuchs 2011, p. 24]. In their work, Schloderer et al. [2009, p. 589] propose a multi-level approach, differentiating between formative and reflective measurement models, the assessment of the structural model, as well as of the overall model (cf. Figure 3.14).

[7]Reflective measurements represent by far "the most common approach in marketing" [Diamantopoulos 1999, p. 446].

[8]A very detailed decision matrix can also be found in Huber et al. [2007, p. 19].

[9]This section is limited to a basic explanation of the foundational elements and quality criteria. More detailed explanations and procedure descriptions are provided in Nitzl [2010, pp. 15-52], Schloderer et al. [2009, pp. 273-601], Vinzi et al. [2010a], Bliemel [2005], and Hair et al. [2011, pp. 139-152].

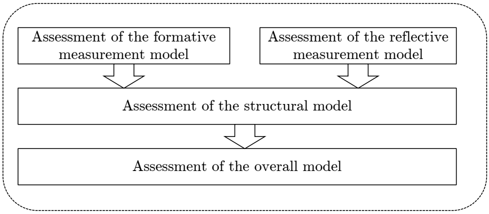

Figure 3.14 – Process for PLS Model Evaluations
adapted from Schloderer et al. [2009, p. 589]

For testing the reflective measurement model in regards to reliability and validity, Ringle and Spreen [2007, pp. 211-216] as well as Hair et al. [2011, p. 145] propose four quality criteria. While the first three are used to test the correlations between the indicators of a construct [Schloderer et al. 2009, pp. 580-581], the fourth is used to examine the model's validity [Nitzl 2010, p. 23]. Table 3.3 provides an overview about the evaluation criteria of the reflective constructs as well as their thresholds.

Table 3.3 – Reflective Measurement Model Estimation
adapted from Nitzl [2010, p. 27], Schloderer et al. [2009, p. 580], and Hair et al. [2011, pp. 139-152]

Quality Criterion	*Description*	*Recommended Value*
Indicator reliability	Explanatory power of the indicator variance through the construct	Factor loading $\lambda_i \geq 0.7$
Internal consistency reliability	Explanation of the correlation between the indicators of one construct	Construct reliability $\rho_c \geq 0.6$
Convergent validity	Explanatory power of the latent variables' variance in relation to the measurement error	$AVE \geq 0.5$
Discriminant validity	Diversity of the measurement of different constructs	1) $R^2 < AVE$ 2) indicator loadings higher than cross loadings

The indicator reliability allows making judgments of how good each of the indicators is explained by the latent variable. At least half of the variance should be explained by the construct. As the reliability on indicator level equals the squared factor loading, a threshold of at least 0.7 is recommended [Schloderer et al. 2009, p. 580]. Nevertheless, in newly developed scales, reflective indicators need to be eliminated if they reach a value of less than 0.4 [Krafft et al. 2005, p. 73].

Internal consistency reliability as the second step defines the local quality criterion on construct level [Henseler et al. 2009, p. 299]. It testifies how good a latent variable is measured through its indicators [Krafft et al. 2005, p. 74]. Construct reliability can reach values between 0 and 1 [Ringle and Spreen 2007, p. 212]. While also classical indexes like the Cronbach's alpha [Cronbach 1951, pp. 297-334] can be used to measure the unidimensionality of manifest variables [Vinzi et al. 2010b, p. 50], authors propose favoring ρ_c [Henseler et al. 2009, pp. 298-319].

Using the average variance extracted (AVE) allows an assessment of the latent variable's variance in relation to the measurement error [Schloderer et al. 2009, p. 581]. Based on the AVE it is possible to calculate the discriminant validity, which defines how far the indicators of one construct differ from the indicators of the other constructs [Schloderer et al. 2009, p. 581]. Traditionally, the Fornell-Larcker criterion is used to assess discriminant validity [Fornell and Larcker 1981, pp. 39-50]. In addition, authors propose assessing cross loadings. Each indicator should show the highest loadings in relation to its assigned construct [Huber et al. 2007, p. 37; Schloderer et al. 2009, p. 581; Nitzl 2010, p. 27; Hair et al. 2011, p. 145].

Also for the formative measurement model a quality assessment is required. Nevertheless, the procedure differs to the one of the reflective models. This is due to the fact, that the indicators do not measure the same situation [Schloderer et al. 2009, p. 582]. Literature proposes the use of the following quality criteria (c.f. Table 3.4).

Table 3.4 – Formative Measurement Model Estimation
adapted from Nitzl [2010, p. 31], Schloderer et al. [2009, p. 582], and Hair et al. [2011, p. 145]

Quality Criterion	*Description*	*Recommended Value*
Indicator weights	Validation of the weight's contribution to the construct	$t \geq 1.65$ sig. level=10% $t \geq 1.98$ sig. level=5% $t \geq 2.58$ sig. level=1%
Multicollinearity	Assessment of how far the calculated weights are influenced by linear correlations between the indicators	$VIF \leq 10$

The indicator weights disclose the extent to which the indicators contribute to the constructs. While values near 1 or -1 argue for a strong effect, values close to 0 indicate a weak effect [Krafft et al. 2005, p. 78]. Nevertheless, the values are of minor importance for the verification of the model. It is rather their significance that should be taken into account. The reason is that with the conceptual reflection of the formative indicators (and the holistic perspective) also variables with small weights may influence the overall construct [Jarvis et al. 2003, p. 202]. If the requirement is not fulfilled, also the significance of the loadings should be checked [Huber 2012, p. 23].

A further method to evaluate the relevance of indicators in formative measurement models is the so called multicollinearity. It describes the linear dependence between the indicators and is measured using the variance inflation factor (VIF). This factor describes the extent to which the variance of a parameter estimate is expanded through multicollinearity [Schloderer et al. 2009, p. 583]. A high multicollinearity (values above 10) leads to the need for eliminating the respective indicators. Some authors indicate a critical degree of multicollinearity already at values of 5 or less [Henseler et al. 2009, pp. 277-319]. Nevertheless, an elimination of formative indicators should not happen exclusively based on statistical methods. This means, that even non-significant formative elements should be retained if theoretical considerations persist [Nitzl 2010, p. 32].

On a structural model level, quality assessment comprises the evaluation of the relationships between the latent variables. Table 3.5 provides an overview about the corresponding quality criteria and their thresholds.

R^2, the coefficient of determination, is a substantial criterion for the assessment of the structural model [Chin and Newsted 1999, p. 316]. It describes the stake of explained variance of the endogenous variables. While values between 0 and 1 can be achieved, the interpretation depends on the underlying research question [Nitzl 2010, p. 32]. Especially in cases where potential influences are excluded on purpose, low R^2 values are quite usual [Schloderer et al. 2009, p. 594].

Analyzing the path coefficients allows getting a first impression of the strength of the hypothesized relationships between the latent variables, using their significances [Schloderer et al. 2009, p. 584]. "Paths that are nonsignificant or show signs contrary to the hypothesized direction do not support the proposed causal relationship" [Hair et al. 2011, p. 147].

The effect size f^2 furthermore provides insight on the exogenous latent variable's influence towards endogenous latent variables [Chin 1998, p. 316]. The effect is a result of changes in the coefficient of determination of the endogenous variable [Nitzl 2010, p. 34] and can be used to reveal non-hypothesized dependencies [Chin 1998, p. 317].

Table 3.5 – Structural Model Estimation
adapted from Nitzl [2010, p. 37], Schloderer et al. [2009, p. 585], and Hair et al. [2011, p. 145]

Quality Criterion	*Description*	*Recommended Value*
Coefficient of determination	Stake of explained variance of an endogenous variable	$R^2 \geq 0.67$ "strong" $R^2 \geq 0.33$ "medium" $R^2 \geq 0.19$ "weak"
Path coefficients	Extent and significance of relationships between constructs	$t \geq 1.65$ sig. level=10% $t \geq 1.96$ sig. level=5% $t \geq 2.58$ sig. level=1%
Effect size	Influence of the exogenous variables towards the endogenous variables	$f^2 \geq 0.35$ "strong" $f^2 \geq 0.15$ "medium" $f^2 \geq 0.02$ "weak"
Predictive relevance	Reconstruction of empiric data of reflectively measured variables using the model and the PLS-parameters	$Q^2 > 0$ predictive relevance existing $q^2 \geq 0.35$ "strong" $q^2 \geq 0.15$ "medium" $q^2 \geq 0.02$ "weak"

The predictive relevance criterion finally provides a statement towards the "model's capability to predict" [Hair et al. 2011, p. 147]. This assessment is done using Stone-Geisser's Q^2 [Geisser 1974, pp. 101-107], "which postulates that the model must be able to adequately predict each endogenous latent construct's indicators" [Hair et al. 2011, p. 147].

In contrast to covariance-oriented SEM, PLS "lacks a well identified global optimization criterion so that there is no *global fitting function* to assess the goodness of the model" [Vinzi et al. 2010b, p. 56].

As this chapter only provides a very general introduction of the method, an in depth description of the PLS algorithms is renounced. For this purpose, a referral to subsequent literature shall be given (cf. Chin [1998, pp. 395-336], Chin and Newsted [1999, pp. 307-342], Ringle et al. [2006, pp. 81-88], Vinzi et al. [2010a], Hair et al. [2011, pp. 139-152]).

3.3.2.3 Absolute Measures and Effect Sizes

Researchers are interested not only in general relationships of the observed constructs, but also in their absolute measurements. In order to get a deeper understanding of the underlying effects and their impact, a reasonable method is to compare different populations. In this context it is important to distinguish between dependent and independent samples. A sample is dependent if there is a natural matching between both samples, e.g., if it is possible to draw a meaningful connection of the value of one sample with exactly one value of another sample [Martens 2003, p. 125]. This case occurs, if the same subjects are measured before and after a certain treatment. If two independent groups are compared (e.g., males vs. females), an independent sample is given. Both types follow different procedures for testing. Which method can be selected furthermore depends on the respective scale of measurement applied (nominal, ordinal, interval)[10]. The goal of the measures is not only to identify if a difference between the groups exists, but also if the difference is significant. They can therefore be used to prove hypotheses. Table 3.6 provides an overview about the most commonly used test methods[11].

In this understanding significance reflects the probability of an effect happening by chance, which would lead to a false acceptance or refusal of an hypothesis [Clauss and Ebner 1975, pp 188-192]. Significance is defined at the levels "not significant" ($p > 0.05$), "significant" ($p \leq 0.05$), "very significant" ($p \leq 0.01$), and "highly significant" ($p \leq 0.001$)[12]. Especially in exploratory research, also weaker values (e.g., $p \leq 0.1$) are considered significant [Morien 2007, p. 115; Ayyub and McCuen 2011, p. 325].

Table 3.6 – Sample Test Methods
adapted from Bühl [2008, p. 120] and Martens [2003, p. 125]

Number of Samples	*Dependency*	*Test*
Interval Scale, Normally Distributed Variables		
2	independent	t-Test
2	dependent	t-Test for dependent samples
>2	independent	Analysis of variance (ANOVA)
>2	dependent	Repeated ANOVA measures
Ordinal Scale or Non-Normally Distributed Variables		
2	independent	Mann-Whitney U-Test
2	dependent	Wilcoxon-Test
>2	independent	Kruskal-Wallis H-Test
>2	dependent	Friedman-Test

[10]For additional information regarding scales, refer to Stier [1999, pp. 42-47].

[11]For additional information regarding nonparametric test methods refer to Reuschenbach [2009, pp. 501-520].

[12]A commonly accepted way of indicating significance is the use of symbols: *, **, and *** for "significant", "very significant", and "highly significant" respectively [Clauss and Ebner 1975, p. 189].

In practice, especially in psychology, emotion, and acceptance research, scientists treat ordinal data as continuous data. This is specifically the case if Likert-type scales are used and labeled only at the end points and if at least a 5-point scale is applied [Hripcsak and Heitjan 2002, p. 109; Brosius et al. 2012, p. 38; Rhemtulla et al. 2012, pp. 354-373; Tullis and Albert 2013, pp. 18-19]. This makes it possible to also use parametric tests.

But even fractional differences or correlations will be significant in tests, if the sample is large enough. However, these differences might not imperatively be of practical relevance. This means, that testing hypotheses allows providing statements on differences being of systematic nature. Nevertheless, it does not really evaluate the absolute sizes of the treatment effects. So called effect size calculations should be additionally carried out in order to identify the size of this effect. [Biemann 2009, p. 216]

Effect sizes therefore are intended "to provide a measurement of the absolute magnitude of a treatment effect, independent of the size of the sample(s) being used" [Gravetter and Wallnau 2014, p. 230]. One of these effect sizes is Cohen's d[13], which can be interpreted as "a specific numerical nonzero value used to represent the extent to which a null hypothesis is false. Cohen's d is typically used to represent the magnitude of differences between two (or more) groups on a given variable, with larger values representing a greater differentiation between the two groups on that variable" [Salkind 2010, p. 181]. The effect size is the difference in the two groups' means divided by the average of their standard deviations [Biemann 2009, p. 216] and usually reported as a positive number [Gravetter and Wallnau 2014, p. 230]. Rosenthal et al. [2000, p. 11] furthermore describe Cohen's d as a means "to measure the standardized difference between group means" (cf. Figure 3.15), which can also be calculated for groups of unequal sample sizes [Rosenthal et al. 2000, pp. 30-32].

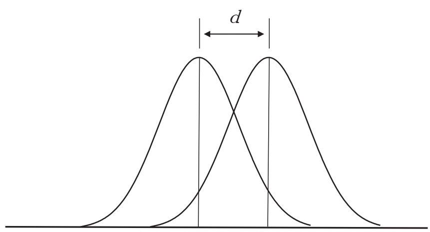

Figure 3.15 – Effect Sizes
adapted from Gravetter and Wallnau [2014, p. 231]

[13] A comprehensive introduction to Cohen's d is provided in Cohen [1988].

"Cohen's d is particularly popular in experimental and quasi-experimental research in which a difference in the effect of a treatment or manipulation of a group means is considered important" [McGrath and Meyer 2006, p. 387]. Cohen [1988, pp. 24-27] hesitantly defines a possible interpretation of the effect sizes as "small" (d=0.2), "medium" (d=0.5), and "large" (d=0.8). The author states that the terms "are relative, not only to each other, but to the area of behavioral science or even more particularly to the specific content and research method being employed in any given investigation" [Cohen 1988, p. 25].

3.3.2.4 Conceptual Elements

3.3.2.4.1 Overview

Schloderer et al. [2009, p. 575] as well as Huber et al. [2007, p. 3] state that the PLS modeling process requires detailed theoretical deliberations regarding the latent constructs included in the model, their formalization as reflective or formative constructs, as well as the formulated hypotheses. Based on the defined goal of providing the user with experiential SSTs, the most important service, HCI, and CX related characteristics are carved out and combined into a common package (cf. Figure 3.16).

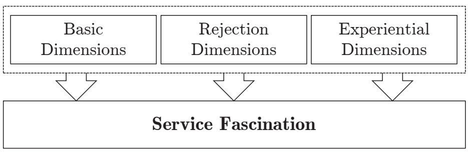

Figure 3.16 – Components of the Service Fascination Evaluation Model

Comparable to the model described by Kano et al. [1984, pp. 39-48], the concept integrates basic, rejection, and excitement attributes. In order to create successful self-service systems it is essential to first tackle the basic and the rejection elements, followed by a systematic integration of the experiential dimensions. A functioning system that provides value to the consumer, that is easy to use, and that does not involve any risk while using it can subsequently be made exciting by integrating of excitement elements.

3.3.2.4.2 Basic Dimensions

The traditional TAM "suggests that perceived ease of use (PEOU), and perceived usefulness (PU) are the two most important factors in explaining system use" [Legris et al. 2003, p. 192]. It consequently is not surprising that PU and PEOU are amongst the most adopted variables in acceptance research [Legris et al. 2003, pp. 191-204; Lee et al. 2003, pp. 752-780]. "The ultimate objective of TAM was to predict use" [Legris et al. 2003, p. 196], with PU and PEOU acting as the two primary predictors [King and He 2006, p. 740]. The two components are therefore adopted in their original meaning and used as basic criteria in the evaluation model created. The idea is that the fulfillment of both is a prerequisite to creating positive experiences. The following paragraphs provide an in depth description of the elements selected as latent variables for building the causal model thus, serving as evaluation criteria for service fascination.

- **Perceived Usefulness:** Identical to the TAM's proposition, PU describes "the customer's overall assessment of the utility of a product based on perceptions of what is received and what is given" [Zeithaml 1988, p. 14]. In this context, service value is regarded as equal to product value. In service management literature, authors describe service value as a trade-off between costs and benefits of using a service, performing a transaction or participating in a relationship [Heskett et al. 1990, p. 8; Blanchard and Galloway 1994, pp. 5-23; Hallowell 1996, p. 28]. In the following, the PU criterion equals the PU of previous applications of the TAM [Davis 1985, p. 26; Davis 1989, p. 320; Davis 1993, pp. 475-476] which is adopted in the major part of the predominant literature (cf. Venkatesh and Davis [1996, pp. 451-481] and Venkatesh and Davis [2000, pp. 186-204]). In this concept, PU is achieved through a meaningful service concept that provides functional value to the user.

- **Perceived Ease of Use:** As part of the HCI research, usability engineering (cf. Chapter 2.3.3) involves all tasks required to create interfaces that allow an efficient and effective accomplishment of desired tasks [Good et al. 1986, pp. 241-246; Mayhew 1999, p. 1]. Usability is one of the concepts that seek "to make products easier to use" [Garrett 2003, p. 50]. As a consequence, easy to use UIs have a positive effect on the efficiency of use [Nielsen 1994c, pp. 30-31] and need to be designed in a way to best support the users in completing their tasks. The PEOU criterion therefore equals the PEOU construct of the traditional TAM model defined by Davis [Davis 1985, p. 26; Davis 1989, p. 320]. Identical transfers are conducted in the greater part of literature dealing with technology acceptance [Venkatesh and Davis 1996, p. 480; Venkatesh and Davis 2000, p. 201; Childers et al. 2001, pp. 511-535; Zhang and Li 2004, pp. 283-296; Liu et al. 2010, pp. 600-610]. PEOU finally allows an easy achievement of the functional value provided through PU and is in accordance with the HCI perspective seen as a necessity for electronic systems [Jordan 1997, p. 251] (cf. Chapter 2.3).

3.3.2.4.3 Rejection Dimensions

Next to the basic dimensions it is important to also consider aspects that may lead to a general rejection of the service provided. These criteria reflect the user's (previous) experiences with comparable technologies, systems, or service providers and are formulated as the rejection dimensions "trust" and "technology readiness". The underlying hypothesis is that a SST won't be used if the perceived risk (as the antithesis to trust) exceeds a certain threshold or the consumer does not have confidence in the service provider. The same applies for technology readiness. If a user in general avoids using technology, the system might be rejected.

- **Trust:** Many different variables can be used to describe confidence towards a service received or a company dealt with. Next to security issues, this also covers a general perception of trust or potential risks involved during interaction with the provider. These aspects increasingly gain importance within acceptance research, especially in the area of technology-based services [Fukuyama 1995, pp. 3-6; Gefen 2000, pp. 725-737; King and He 2006, p. 741; Pantano and Di Pietro 2012, p. 4]. "Trust, in a broad sense, is the confidence a person has in his or her favorable expectations of what other people will do, based, in many cases, on previous interactions" [Gefen 2000, p. 726]. With SSTs replacing or enhancing the human service encounter, these criteria now exclusively apply for technology and all of its underlying concepts. Aspects of risk assessment and trust in electronic services, especially in online self-services, are part of scientific research since several years [Smith et al. 1996, pp. 167-196; Featherman and Pavlou 2003, pp. 451-474]. Many researchers focus on the evaluation of trust in regards to specific use cases. Examples include the investigation of trust aspects in relation to online shopping [Hoffman et al. 1999, pp. 80-85; Gefen 2000, pp. 725-737; Gefen and Straub 2004, pp. 407-427; Pires et al. 2004, pp. 118-131; Kim et al. 2008, pp. 544.564; Ling et al. 2010, pp. 63-76], in online banking applications or mobile payment [Suh and Han 2002, pp. 247-263; Nilsson et al. 2005, pp. 1701-1704; Chandra et al. 2010, pp. 561-588] or in relation to services and the respective service providers [Ghazizadeh et al. 2012, pp. 2286-2290; Coulter and Coulter 2002, pp. 35-50]. The factors implicating a potential risk in the use of electronic services are manifold. Especially concerns in the area of information privacy, particularly looking at extensive data collection [Mann and Prein 2008, p. 253], unauthorized use [Featherman and Pavlou 2003, p. 455], or unauthorized access [Chen et al. 2004, p. 30] are investigated. Pantano and Di Pietro [2012, pp. 6-7] furthermore provide an extensive overview about risk- and trust-related literature in regards to technology-based retail innovations. Nevertheless, the broad range of potential risk issues can be limited to the most critical ones that directly affect the acceptance of SSTs. For this purpose Chen et al. [2004, p. 30] developed an item set for risk assessment that is also adapted in subsequent literature. Focusing on general security and data privacy issues it is well suited for the assessment of SSTs. It is therefore also applied in this thesis (cf. Chapter 3.3.2.5.2).

- **Technology Readiness:** Because of their technological nature, the use of digital service encounters is inevitably dependent on the technology readiness of the users. Jia et al. [2012, p. 209] find that technology anxiety (as the antithesis to technology readiness) "negatively affects customer's trial intention". This decrease in usage motivation can lead to an avoidance of technological tools [Meuter et al. 2005, p. 65]. Research shows that people with higher technology anxiety are more likely to avoid using self-service technologies [Parasuraman 2000, pp. 307-320]. Technology readiness is furthermore found to influence overall satisfaction "and the likelihood of participating in positive word-of-mouth" [Meuter et al. 2003, p. 899]. Nevertheless, research proves that positive computing experiences might overcome a possibly existing anxiety [Hackbarth et al. 2003, p. 223]. Especially technology innovations are found being subject to these mental processes [Liljander et al. 2006, pp. 178-179].

3.3.2.4.4 Experiential Dimensions

Various criteria are listed in CX literature that are supposed to positively influence the experience perceived through interacting with products, technologies, or services (cf. Chapter 2.4.2.2.3). The understanding of Schmitt and Mangold [2004, pp. 38-43], respectively Schmitt [1999, pp. 63-69], is regarded as the prevailing opinion and also applied for the subsequent deliberations. While the basic definition of Schmitt's experiential dimensions remains widely unaltered, slight adaptions in regards to the application in the area of SSTs are done. As proposed by the authors, holistic experiences build on a stimulation of affective, cognitive, behavioral, sensory, and social aspects. Following this understanding, the experiential dimensions are transferred to the use case at hand. [Zagel and Bodendorf 2014, p. 539]

Taking this understanding as a basis, the experiential dimensions for this work are defined as follows:

- **Affective Dimension:** A customer's reactions in the form of emotions, moods, as well as the evaluation of specific situations resulting in a positive feeling towards the service and the service provider can be subsumed in the affective dimension. Schmitt and Mangold [2004, p. 40] describe the dimension as the value from feeling well. It includes aspects of fun and enjoyment and is independent of any performance consequences that may be expected. As important types of experiences within interactive systems use, the mental states of immersion and flow gain tremendous attention, especially in the area of game and human behavior research [Brown and Cairns 2004, pp. 1297-1300; Nacke and Lindley 2008, pp. 81-88; Jennett et al. 2008, pp. 641-661; Zhou and Deng 2009, pp. 319-325].

- **Cognitive Dimension:** Cognitive criteria focus on the consumer's intellect. They promote a person's creativity and target the mental confrontation with the service and its provider [Schmitt and Mangold 2004, p. 40]. Verhoef et al. [2009, p. 33] even describe cognitive evaluations as functional values. As a conscious component cognition involves a reflection of the functional components of a product or service received, including its quality, expectations, and mental assumptions [Gentile et al. 2007, p. 398].
- **Behavioral Dimension:** Alternative lifestyles, materialized experiences, a variety of possibilities to interact, as well as different types of using a product or service are covered by the behavioral dimension [Schmitt and Mangold 2004, pp. 41-42]. The perception of this component is the result of personal beliefs, interaction behaviors, and previous interactions [Gentile et al. 2007, p. 398]. Providing new options for habituated tasks can create positive experiences by including personalization or individualization tasks linked on the customer's personality [Schmitt and Mangold 2004, pp. 41-42; Verhoef et al. 2009, pp. 31-41].
- **Sensory Dimension:** The sensory dimension[14] reflects all impressions gathered through the sensory organs, may they be of visual, auditory, haptic, gustatory or olfactory nature. The importance of touching multiple senses at once is part of brand marketing strategies and especially multi-sensory store design [Hultén 2011, pp. 256-273]. This dimension also includes the user's perception of (e.g., visual) aesthetics, that in a second step also affects the other dimensions [Bloch et al. 2003, p. 553]. In respect to Schmitt and Mangold [2004, pp. 39-40] the sensory component draws on the very elementary stimulation of the senses (e.g., through colors and shapes, music and sounds, textures and materials) and also encompasses their style of implementation: dynamic vs. static, realistic vs. abstract.

[14] Sensory experiences are also called "physio-pleasure", touching any of the human senses [Hoonhout 2008, p. 14].

- **Social Dimension:** Social experiences concentrate on interpersonal relationships and interactions related to the customer's social network. Added value is generated through social identity, a sense of belonging, and interaction with others [Schmitt and Mangold 2004, pp. 42-43]. Especially in retail environments, social aspects contain the holistic social environment and all sub-components related. This not only includes the interaction between company representatives and the customer, but also the one of customers amongst each others and third parties [Verhoef et al. 2009, pp. 31-41]. In consideration of the technological development and interconnectedness using social media and means of mobile communication, this social network is nearly unlimited. Social aspects furthermore include a person's personal desire of individuality, self-improvement, and the "need to be perceived positively by individual others" [Schmitt 1999, p. 68].

It is hard to argue for a complete segregation of the dimensions due to their correlation and consequently the lack of a hard separation. Schmitt and Mangold [2004, p. 45] therefore emphasize that the mentioned dimensions are perceived in form of one holistic experience. This leads to the fact that customers discern the consequences of these stimuli as one integrated feeling, often not being able to consciously separate the elements [Gentile et al. 2007, pp. 395-410]. [Zagel and Bodendorf 2014, p. 540]

3.3.2.5 Item Set Development

3.3.2.5.1 Overview

In order to test SSTs in regards of the aspects described, a survey instrument is developed. Multi-item scales drawn from previously validated instruments as well as newly developed items[15] are used to measure the basic, rejection, and experiential dimensions. Evaluation results need to also allow an identification of coherences of different technological and methodical design elements and provide the basis for a fact-based comparison of the artifacts.

The items are composed into a survey instrument that is administered directly after the self-service system is tested by the participants. All items are measured using a seven-point scale of the Likert-type, labeled at the end points with "strongly disagree" and "strongly agree". The administered questionnaire is pretested on a small number of consumers and a factor analysis is conducted to ensure that the measures are distinct from each other. Their grouping reflects the assignment to the respective latent variable

[15] New items are only developed, if the respective construct is not already handled in literature. In this case, the new item is designed on basis of appropriate research of the respective field of application.

to be measured, which is revisited in the subsequent description of the causal model. In addition to the survey instruments described below, a supplementary part aims at the investigation of demographic data like gender and age.

3.3.2.5.2 Service Fascination Questionnaire

The first part of the survey is used to reflect the basic and rejection dimensions and furthermore enables a measurement of the eventually perceived service fascination. The "Service Fascination Questionnaire" reuses the PU and PEOU items of the original TAM by Davis [1989, pp. 319-340]. Trust is presented through reverse coded items traditionally employed for risk assessment. An identical reverse coding applies for the technology readiness criterion which is in its original state used to measure technology anxiety [Meuter et al. 2005, p. 66]. Within the evaluation process it is therefore required to invert the results. As literature recommends a cautious application of reverse coded items [Shultz et al. 2014, p. 221], the approach is only taken for the two rejection dimensions. The variable "Service Fascination" mirrors the practical effects of positive experiences, expressed through emotions, and the active willingness to positively promote and repeatedly use the device[16]. Table 3.7 lists the complete item set split up into the latent variables to be measured, naming their origin in literature[17].

Table 3.7 – Service Fascination Questionnaire
adapted from Zagel et al. [2014b, pp. 177-190] and Zagel and Bodendorf [2014, pp. 537-548]

	Item	*Adapted from*
Perceived Usefulness		
(PU1)	Using the system improves my performance.*	Davis [1989, p. 324], also used in Davis et al. [1989, p. 991], Venkatesh and Davis [1996, p. 480], and Venkatesh and Davis [2000, p. 201]
(PU2)	Using the system improves my productivity.*	Davis [1989, p. 324], also used in Davis et al. [1989, p. 991], Venkatesh and Davis [1996, p. 480], and Venkatesh and Davis [2000, p. 201]

The table is continued on the next page

[16] This assessment reflects the definition of service fascination presented in Chapter 2.1.
[17] For the German version of the questionnaire, refer to Appendix A.1.

(PU3)	Using the system enhances my effectiveness.*	Davis [1989, p. 324], also used in Davis et al. [1989, p. 991], Venkatesh and Davis [1996, p. 480], and Venkatesh and Davis [2000, p. 201]
(PU4)	I find the system to be useful.*	Davis [1989, p. 324], also used in Davis et al. [1989, p. 991], Venkatesh and Davis [1996, p. 480], and Venkatesh and Davis [2000, p. 201]
Perceived Ease of Use		
(PEOU1)	My interaction with the system is clear and understandable.	Davis [1989, p. 324], also used in Davis et al. [1989, p. 991], Venkatesh and Davis [1996, p. 480], and Venkatesh and Davis [2000, p. 201]
(PEOU2)	Interacting with the system does not require a lot of my mental effort.	Davis [1989, p. 324], also used in Davis et al. [1989, p. 991], Venkatesh and Davis 1996, p. 480, and Venkatesh and Davis [2000, p. 201]
(PEOU3)	I find the system to be easy to use.	Davis [1989, p. 324], also used in Davis et al. [1989, p. 991], Venkatesh and Davis [1996, p. 480], and Venkatesh and Davis [2000, p. 201]
(PEOU4)	I find it easy to get the system to do what I want it to do.	Davis [1989, p. 324], also used in Davis et al. [1989, p. 991], Venkatesh and Davis [1996, p. 480], and Venkatesh and Davis [2000, p. 201]
Trust		
(T1)	I am concerned that the system collects too much personal information from me.†	Chen et al. [2004, p. 30], based on Smith et al. [1996, pp. 167-196]
(T2)	I am concerned that the system will use my personal information for other purposes without my authorization.†	Chen et al. [2004, p. 30], also used in Koch et al. [2011]

The table is continued on the next page

(T3)	I am concerned that unauthorized people (i.e., hackers) have access to my personal information.†	Chen et al. [2004, p. 30], also used in Koch et al. [2011]
(T4)	I am concerned about the security of my personal information during transmission.†	Chen et al. [2004, p. 30], based on Smith et al. [1996, pp. 167-196]
Technology Readiness		
(TECH1)	I feel apprehensive about using technology.†	Raub [1981, pp. 132-139], also used in Meuter et al. [2005, p. 80]
(TECH2)	Technical terms sound like confusing jargon to me.†	Raub [1981, pp. 132-139], also used in Meuter et al. [2005, p. 80]
(TECH3)	I have avoided technology because it is unfamiliar to me.†	Raub [1981, pp. 132-139], also used in Meuter et al. [2005, p. 80]
(TECH4)	I hesitate to use most forms of technology for fear of making mistakes I cannot correct.†	Raub [1981, pp. 132-139], also used in Meuter et al. [2005, p. 80]
Service Fascination		
(SF1)	I would share my good experience about using the system.	Maxham [2001, p. 23], also used in Kim [2006, p. 34]
(SF2)	I would recommend using the system.	Maxham [2001, p. 23], also used in Kim [2006, p. 34] and Kim et al. [2008, p. 560]
(SF3)	Using the system is exciting.	Childers et al. [2001, p. 531], also used in Kim [2006, p. 34]
(SF4)	Given that I have access to the system, I predict that I would use it.	Venkatesh and Davis [2000, p. 201]
(SF5)	I will frequently use the system in the future.	Gu et al. [2010, pp. 287-297]

* Adaption of the item set to fit the respective field of application (e.g., shopping).

† negative wording / inverse coded item.

3.3.2.5.3 Experiential Design Questionnaire

A second survey instrument is used to identify the individual experiential characteristics of the self-service technologies evaluated. The questionnaire is assembled of items measuring the experiential effects of SST use based on the experiential dimensions postulated by Schmitt and Mangold [2004, pp. 38-43] (cf. Chapter 2.4.2.2.3). A literature analysis is performed in order to adapt appropriate items from previous research. Due to the novelty of the approach, several items need to be created from scratch and are justified on basis of predominant literature of the respective field [Zagel et al. 2014b, p. 180]. Table 3.8 lists the complete item set split up into the experiential dimensions and naming their origin in literature[18].

Table 3.8 – Experiential Design Questionnaire
adapted from Zagel et al. [2014b, pp. 177-190] and Zagel and Bodendorf [2014, pp. 537-548]

	Item	*Adapted from*
Affective Dimension		
(AFF1)	I find the system to be enjoyable.	Davis et al. [1992, p. 1116], also used in Venkatesh and Bala [2008, p. 313]
(AFF2)	The actual process of using the system is pleasant.	Davis et al. [1992, p. 1116], also used in Venkatesh and Bala [2008, p. 313]
(AFF3)	I have fun using the system.	Davis et al. [1992, p. 1116], also used in Venkatesh and Bala [2008, p. 313]
(AFF4)	Using the system is fun for its own sake.	Childers et al. [2001, p. 531], also used in Kim and Forsythe [2007, p. 507]
(AFF5)	Using the system makes me feel good.	Childers et al. [2001, p. 531], also used in Kim [2006, p. 34]
Cognitive Dimension		
(C1)	I am satisfied with the information the system provides.*	Chen et al. [2004, p. 30], based on Daft and Lengel [1986, pp. 554-571]
(C2)	The system provides information in a variety of ways (i.e., text, graphic, animation, audio, video).*	Chen et al. [2004, p. 30], based on Daft and Lengel [1986, pp. 554-571]
(C3)	Using the system is interesting.	Childers et al. [2001, p. 531], also used in Kim and Forsythe [2007, p. 507]
(C4)	Overall, the service quality of the system is high.	Chen et al. [2004, p. 30], based on Cronin and Taylor [1992, pp. 55-68]

The table is continued on the next page

[18]For the German version of the questionnaire, refer to Appendix A.2.

(C5)	The system allows me to make decisions in a reflected way.*	New item, based on Gentile et al. [2007, pp. 395-410] and Schmitt and Mangold [2004, pp. 38-43]
Behaviroal Dimension		
(B1)	Using the system would change my behavior.*	New item, based on Gentile et al. [2007, pp. 395-410], Schmitt and Mangold [2004, pp. 38-43], and Verhoef et al. [2009, pp. 31-41]
(B2)	Using the system would influence my behavior.*	New item, based on Gentile et al. [2007, pp. 395-410], Schmitt and Mangold [2004, pp. 38-43], and Verhoef et al. [2009, pp. 31-41]
(B3)	The system shows me alternative ways for performing my task.*	New item, based on Gentile et al. [2007, pp. 395-410], Schmitt [1999, pp. 64-72], Schmitt and Mangold [2004, pp. 38-43], and Verhoef et al. [2009, pp. 31-41]
(B4)	The system fits to my personal lifestyle.	New item, based on Gentile et al. [2007, pp. 395-410], Schmitt [1999, pp. 64-72], Schmitt and Mangold [2004, pp. 38-43], and Verhoef et al. [2009, pp. 31-41]
Sensory Dimension		
(S1)	Overall, I think the system looks attractive.	van der Heijden [2003, p. 548]
(S2)	The system stimulates my senses (visual, auditory, haptic, gustatory, or olfactory).	New item, based on Gentile et al. [2007, pp. 395-410], Schmitt and Mangold [2004, pp. 38-43], and Verhoef et al. [2009, pp. 31-41]
(S3)	The system stimulates multiple of my senses at once.	New item, based on Gentile et al. [2007, pp. 395-410], Schmitt and Mangold [2004, pp. 38-43], and Verhoef et al. [2009, pp. 31-41]
(S4)	The physical interaction feels appealing.	New item, based on Gentile et al. [2007, pp. 395-410], Schmitt and Mangold [2004, pp. 38-43], and Verhoef et al. [2009, pp. 31-41]

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Social Dimension		
(SO1)	In general, I think the system provides good opportunities for interaction with others.	Liu et al. [2010, p. 609]
(SO2)	The system motivates to use it together with others.	New item, based on Gentile et al. [2007, pp. 395-410] and Liu et al. [2010, pp. 600-610]
(SO3)	My friends would be envious of me having the chance to use the system.	New item, based on Schmitt and Mangold [2004, pp. 38-43] and Venkatesh and Bala [2008, pp. 273-315]
(SO4)	Having had the chance to use the system is like a status symbol.	New item, based on Schmitt and Mangold [2004, pp. 38-43] and Venkatesh and Bala [2008, pp. 273-315]

* Adaption of the item set to fit the respective field of application (e.g., shopping).

This part of the survey not only allows to rate a SST in regards to its experiential features, it also provides the basis for comparing the design elements of multiple systems. Strengths and weaknesses of the experiential service design provide starting points for improvement and the identification of promising technology combinations. [Zagel et al. 2014b, p. 181]

3.3.2.6 Causal Model

The traditional TAM (cf. Chapter 2.2.3.3.2) serves as a basis for an extended causal model to describe the effects of experiential system design characteristics on user emotions and the adoption of technology-based self-service systems. The basic dimensions PU and PEOU are directly transferred. Selected technologies and methods (for example based on the previously executed technology portfolio analysis) act as system design features to realize the desired functionalities for the specified use cases and to implement the experiential dimensions.

Integrating the understanding of experiences being perceived as one holistic construct, the experiential dimensions are operationalized in the form of one common target construct called "experiential design" [Verhoef et al. 2009, pp. 31-41]. This construct is formulated as a formative variable, as experiences are defined to arise from affective, cognitive, behavioral, sensory, and social dimensions. Theory demands for the formative construct's integrity. All other variables do not claim a complete reflection through their connected items and are therefore operationalized as reflective variables. [Zagel et al. 2014b, pp. 177-190]

Next to experiential elements, the model is augmented by the constructs trust and technology readiness as factors describing common human attitudes in regards to technology use. Positive experiences manifest in positive emotions and active willingness to share and recommend products or services [Mattila 2005, p. 106]. This aspect is operationalized through the service fascination target construct. Following the understanding of experiences as an individual source of value [Pine and Gilmore 1999, p. 2], the goal of the evaluation concept is to provide a systematic approach for measuring and improving immersive self-service systems for active user participation and interaction [Zagel and Bodendorf 2014, p. 539].

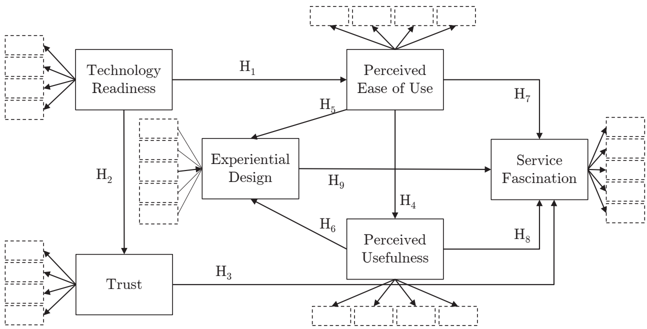


Figure 3.17 – Service Fascination Evaluation Model adapted from Zagel et al. [2014b, pp. 177-190] and Zagel and Bodendorf [2014, pp. 537-548], based on Davis [1985, p. 24], Davis [1989, pp. 319-340], Davis et al. [1989, p. 985], and Koch et al. [2011]

Based on these deliberations, the causal model (cf. Figure 3.17) can be used to identify interdependencies between the constructs. It includes hypotheses that build on previous research on technology adoption (cf. Table 3.9). The correlation between technology readiness and satisfaction with self-service systems is verified by Meuter et al. [2003, p. 904]. Technology anxiety, as the antithesis to technology readiness, is identified to be a significant mediator towards the PEOU when interacting with computers (H_1) [Hackbarth et al. 2003, pp. 225-228]. Furthermore, if persons are used to and enjoy working with new technologies they are likely able to assess potential security issues of a system(H_2).

Recent studies also identify this correlation between technology readiness and trust in regards to self-service systems [Liljander et al. 2006, pp. 177-191]. Based on the findings by Gefen [2000, pp. 725-737] and Gefen et al. [2003, pp. 51-90] the relation of trust towards the intention to use services is extensively substantiated (H_3). Missing trust will lead to customers avoiding to use a SST, consequently preventing the development of positive experiences [Chen et al. 2004, pp. 8-31]. It therefore plays a major role in the usage and adoption of SSTs, "either supporting or preventing the creation of positive experiences which finally lead to service fascination" [Zagel et al. 2014b, p. 182]. The direct influence of trust on the intention to use is also addressed in Kaasinen [2005, pp. 70-76] and Koch et al. [2011, pp. 1-14].

Table 3.9 – Hypothesized Relationships
adapted from Zagel et al. [2014b, pp. 182-183] and Zagel and Bodendorf [2014, p. 541]

Hypothesis	*Relationship*
H_1	Technology readiness affects the perceived ease of use of a SST.
H_2	Technology readiness affects trust towards a SST.
H_3	Trust affects service fascination when using a SST.
H_4	Perceived ease of use affects the perceived usefulness of a SST.
H_5	Perceived ease of use affects the perception of the experiential design of a SST.
H_6	Perceived usefulness affects the perception of the experiential design of a self-service system.
H_7	Perceived ease of use affects service fascination when using a SST.
H_8	The experiential design affects service fascination when using a SST.
H_9	Perceived usefulness affects service fascination when using a SST.

PEOU and PU as well as their causal relationship (H_4) are adopted from the original TAM by Davis [1989, pp. 319-340], supporting the understanding of usability having a positive influence towards usefulness. As both elements provide utilitarian value to the user, they also affect the experiential design of a SST via the cognitive construct (H_5 and H_6). Defined as basic dimensions, they also wield direct influence towards the overall service fascination (H_7 and H_8). Amongst others, Gentile et al. [2007, pp. 395-410] underline, "that customers strive for positive emotions. They show that a relevant part of the overall value perceived when using self-services consists of experiential factors that may even outweigh pure functional aspects. This leads to a direct relation between the experiential design of a solution and the level of satisfaction/fascination during use" [Zagel et al. 2014b, p. 182]. This perspective is also supported by Gentile et al. [2007, p. 401] who prove that "experiential features are perceived by customers almost as much relevant as the functional ones", which leads to hypothesis H_9.

In several situations humans behave in irrational ways, assessing a high value to their intrinsic and hedonistic goals despite of potential risks involved in completing a task. In psychology research authors reveal that especially in sports or adventure activities and also in regards to monetary investments people show a high willingness to take risks for the sake of exciting moments [Borsky and Raschky 2009, p. 210]. These behavior patterns can also be transferred to the use of electronic services. Due to intense use of personal data, research tackles particularly online shopping and social media [Gefen and Straub 2004, pp. 407-427; Sarkar 2011, pp. 58-65]. It is claimed that a positive experience makes a system more attractive to the users, potentially outweighing existing risks and security concerns.

3.3.3 Objective Measurement

3.3.3.1 Objective

Faullant [2007, p. 38] subsumes three aspects that characterize emotions. Next to the subjective experience of a feeling, she also mentions physiologic reactions (bodily changes like perspiration, changes in the heart rate) and behavioral aspects. While in this work the subjective component is already captured by the subjective measurement method described above and the physiological component requires complex invasive or noninvasive treatment, behavioral aspects can more easily be captured.

As the essence of behavioral aspects, human emotional expressions comprise the total body language. Especially facial expressions reflect emotional processes and can be used to analyze a person's psychological state [Kroeber-Riel and Gröppel-Klein 2013, p. 134]. This fact is especially important when considering that this natural body language arises from a biological instinct that leads to a reflexive occurrence as part of the emotional process [Izard 1999, p. 119]. Etcoff and Magee [1992, p. 227] even perceive facial expressions as "the most effective means of communicating emotion", as humans are able to "universally recognize" these expressions, "suggesting a perceptual mechanism tuned to the facial configuration displaying each emotion". Next to emotions expressed through body language and verbal explanations also general behavioral patterns of individual persons and groups are important for creating knowledge about given situations [Graumann

1966, pp. 86-88]. In regards to technology and HCI this includes aspects of usability and consequently the identification of user needs and usage or acceptance barriers [Kuniavsky 2003, pp. 259-302; Garrett 2003, pp. 46-59] (cf. Chapter 2.3.3.3).

Conducting observations and experiments (e.g., within laboratories or as field studies) is an appropriate research method that can be used to capture these expressions. The method arises from the field of qualitative research, being described as "the art and science of describing a human group - its institutions, interpersonal behaviors, material productions, and beliefs" [Angrosino 2007, p. 14]. Saunders et al. [2012, p. 335] furthermore state that "[s]ome participant observation affords the opportunity for the researcher to the experience 'for real' the emotions of those who are being researched".

This research method can also be used within the given context of CX and SST assessment. The goal is to cover the complete interaction process in order to capture all effects occurring as a result of SST use. This allows to also collect subconscious emotions and to avoid the effects of social desirability to support the findings of the subjective assessment. These observations should therefore cover all phases of the experience, from the first impression, to the actual use of the system, as well as the subject's reactions/reflection after use (cf. Chapter 3.2.4.1). Thus, the goals of the objective measurement are defined as follows:

- Complement the findings of the subjective measurement in order to capture subconscious elements and to counter the effect of social desirability.
- Include the pre-use and the actual utilization phase in the assessment.
- Reveal aspects, that are not yet covered by the subjective measurement.

3.3.3.2 Method Selection

There are many different ways of how to conduct observations. While observational research is in general considered the most "original" way for gathering data, scientific executions follow a controlled and systematic approach [Schnell et al. 2008, p. 390]. Jahoda et al. [1965, p. 77] regard an observation as scientific, if it serves a defined research purpose, if it follows a systematic planning process, if results are systematically recorded, and if multiple iterations are performed to validate the results.

Graumann [1966, p. 93] characterizes observations based on several aspects. Next to a differentiation between direct and indirect observations (studying the behavior as such vs. studying the effects of behavior), it is important to separate hidden from visible studies. With hidden observations, the identity of the researcher is not revealed and the behavior of participants is examined without their knowledge. While ethical concerns may occur, hidden observations facilitate the evaluation of complex situations and support the preservation of the result's validity [Schnell et al. 2008, p. 391; Saunders et al. 2012, p. 348; Przyborski and Wohlrab-Sahr 2014, pp. 42-43]. Also the researcher's distance towards the examined field is of substantial relevance. Graumann [1966, p. 93] discerns participating from non participating studies, with the researcher either being part of the group or studying it from the outside. Participating studies include the researcher's reflection of the situation and the events. Nevertheless, the distance towards the subject has to be chosen wisely in order to being able to understand the behavior while avoiding interferences [Przyborski and Wohlrab-Sahr 2014, p. 46]. Another important criteria for planning and conducting observational studies is the selection of the context in which the study takes place. Researchers differentiate between laboratory studies which provide a controlled, artificial environment and natural situations in field studies [Graumann 1966, p. 93; Schnell et al. 2008, p. 391]. Schnell et al. [2008, p. 392] finally identify four basic types of observations that can be further adapted to the specific case of investigation (cf. Table 3.10). The authors differentiate them on basis of the observer's distance towards the evaluated situation and based on their degree of structure.

Table 3.10 – Types of Observations
adapted from Schnell et al. [2008, p. 392]

	Distance towards Research Situation	
Structure	non-participating	participating
unstructured	"non-scientific" observations of daily life (Type 1)	anthropological/ethnological observations (Type 2)
structured	observation methods of empiric social research (Type 3)	(Type 4)

Documentation of the observed behavior can happen in many different ways. While taking field notes is popular amongst many researchers [Angrosino 2007, p. 40; Creswell 2007, pp. 134-138; Saunders et al. 2012, pp. 348-350], observational instruments can also include sign systems, category systems or rating scales, often being used in combination [19] [Schnell et al. 2008, p. 393]. Sign systems concentrate on the occurrence and duration of

[19] For a more detailed discourse on these methods, refer to Cranach and Frenz [1969, p. 272].

specific behavior patterns, not considering the rest of the interaction process. Category systems classify behavior using predefined categories including chronological sequences. Representing the most sophisticated method, rating scales not only include a documentation of behavior occurrence, but also of their extent of manifestation. This can happen either by assigning numerical values or verbal scales (e.g., weak, medium, strong) [Schnell et al. 2008, pp. 393-394]. In any case, these methods should always include a comment section, allowing the documentation of unexpected behavior [Szarkowicz 2006, p. 57].

The goal of the research at hand is to assess the undistorted effects of SST use. Therefore, the following strategy is pursued: All observations are carried out as scientific (structured and planned) and hidden assessments. The observer acts as a moderator, but does not actively participate in order to avoid a distortion of the results, especially in regards to usability. The applied method therefore represents a "Type 3" observation (cf. Table 3.10).

Table 3.11 – Observed Behavior

Observed Pattern / Usage Step	*before*	*during*	*after*
Pleasant anticipation / restraint	●	○	○
Ease of use and understandability	○	●	○
Software and hardware usability issues	○	●	○
Time spent	○	●	○
Exploration of application features	○	●	○
Pleasant surprises and focus points	●	●	○
Perceived functional and hedonic value	●	●	●
Attractiveness and appeal	●	●	●
Facial expressions	●	●	●
Verbalized emotions	●	●	●
Comments and feedback	●	●	●
Demography of users (gender, age groups, number of users)	●	●	●

● observed ○ not observed

According to the degree of the SST's development (prototype vs. productive system), the observations are carried out either in a laboratory setting or as a field study. As demanded in Chapter 3.2.4.1, they comprise the complete experience, including behavior that occurs before, during, and after usage of the system. The behavioral patterns observed focus on capturing the functional and emotional perceptions of the user throughout the interaction process (cf. Table 3.11). They reflect the dimensions of the subjective measurement model and include basic, rejection, and experiential aspects.

3.3.3.3 Observation Form

In order to ensure a structured scientific execution of the assessments, an observation form is developed that combines the rating scale method with field notes. An example for a rating scale used to capture emotions is the product emotion measurement instrument (PrEmo) provided by Desmet et al. [2000, pp. 111-117]. Designed as a non-verbal self-report tool, it is used to evaluate seven positive and seven negative distinct emotions emerging through product design [Desmet et al. 2000, p. 111]. The emotional impact is measured by visualizing feelings through cartoons, which allows a cross-cultural application [Desmet 2004, p. 116]. In a more recent evolution of the method (the tool is reduced to ten basic emotions) the author focuses on the assessment of positive experiences, referred to as "wow emotions". Desmet et al. [2007, pp. 143-144] describe them as an experiential construct which "represents a composite of several pleasant emotions: pleasant surprise, desire, and fascination". The author defines pleasant surprise as novelty (unexpectedness and suddenness), fascination as unfamiliarity (touching the need for curiosity), and desire as the willingness to use a product because it fulfills a need [Desmet et al. 2007, p. 144]. As the concept covers the relevant emotional aspects for the research at hand, it is adopted and transferred to the use case of SST assessment.

Building on these deliberations, the observation form (cf. Table 3.12) is used to assess the subject's behavior occurring before, during, and after using the system. It applies the emotions and their graphical representations proposed by Desmet et al. [2007, p. 145] to support an easy and quick identification and documentation. However, the assessment sheet is not used as a self-report instrument, but occupied by the observer. The observer therefore estimates the subject's emotions using the cartoons and documents them as part of the experiential assessment.

The form furthermore allows a documentation of field notes. Additional comments include general verbal statements and behavioral observations as well as findings related to the basic, rejection, and experiential dimensions which are also measured through the subjective instrument. General behavior that cannot be ascribed to the given dimensions (time used, usage of certain features, etc.) is covered in an extra field. It therefore represents a structured form of documentation, partly focusing on previously defined criteria [Creswell 2009, p. 181]. Next to the descriptive notes, the observational protocol allows documenting reflective notes, hence, the observer's interpretation [Creswell 2007, p. 138].

Table 3.12 – Observation: Measurement Instrument
adapted from Desmet et al. [2000, pp. 111-117], Desmet [2004, pp. 111-123], and Desmet et al. [2007, pp. 141-155]

Desire	Fascination	Pleasant Surprise	Satisfaction	Amusement
				

Unpleasant Emotions

Boredom	Contempt	Unpleasant Surprise	Dissatisfaction	Disgust
				

Field Notes

Basic Dimensions
Rejection Dimensions
Experiential Dimensions
General Behavior

3.4 Interim Conclusion

A differentiation from competitors requires the provision of extraordinary well designed products and services. Especially in the retailing industry, the use of experiential SSTs is increasingly gaining importance. Nevertheless, literature and practice lack knowledge in regards to their structured development and the impact of design methodologies towards emotions and finally the acceptance and experience perceived. Also, current research so far neglects considering SSTs as combinations of hardware and software components.

The service fascination research model is composed of the engineering as well as the evaluation model and represents a holistic framework for the design, assessment, and improvement of experiential SSTs. Starting with an analysis of the application context based on a customer journey map, service innovations are ideated, conceptualized, and designed considering the technological options available. High value is set on delivering positive experiences that not fulfill functional needs, but also touch the customer's hedonic ideals. The evaluation method developed includes a subjective as well as an objective component. Likewise, it takes utilitarian and experiential values into account and allows an assessment and comparison of existing systems, the derivation of best practices, and a systematic improvement of the services based on weaknesses identified. Both the engineering as well as the evaluation model will serve as a basis for the development and assessment of five experiential SSTs described in the subsequent chapter.

Chapter 4

Experiential Self-Service Systems

4.1 Objective and Methodology

The primary goal of this chapter[1] is to demonstrate the application of the presented engineering and evaluation models in a specific field of application. Following the proposal of the previous chapter, a customer journey map provides the foundation for identifying customer touch points that can be supported through innovative technologies. In order to focus on a specific shopping experience, the context of fashion and textile retailing serves as an exemplary field of application. For this purpose and to provide the customer with a holistic experience, five specific moments of truth within the customer journey are identified and enhanced through prototypes of innovative technology-based service systems. A technology portfolio analysis provides the basis for the selection of promising technology combinations. The systems are individually designed using the service fascination engineering model and assessed using the service fascination evaluation model (cf. Chapter 3). Next to an evaluation of their utilitarian and hedonic values, group comparisons are conducted to disclose differences in specific user group's perception. Strengths and weaknesses identified are furthermore used to develop refined systems that offer an increased experiential impact. Furthermore, knowledge generated allows drawing conclusions towards effective technology combinations.

Within this chapter, the following research questions will be addressed:

- **RQ 4:** Which technologies have the potential to create service fascination in physical retail stores?

[1] Parts of this research are published in Zagel and Bodendorf [2012, pp. 697-704], Zagel and Süßmuth [2013b, pp. 48-57], Zagel et al. [2014b, pp. 177-190], Zagel and Bodendorf [2014, pp. 537-548], Zagel [2014a, pp. 311-314], Zagel and Süßmuth [2014, pp. 7-10], Zagel [2014b, pp. 367-370], Zagel et al. [2014a], Zagel et al. [2014d], and Zagel et al. [2014c].

C. Zagel, *Service Fascination,* DOI 10.1007/978-3-658-11673-6_4,

- **RQ 5:** Which services have the potential for being enhanced through experiential self-service technologies?
- **RQ 6:** How does the technological design of self-service systems influence service fascination?
- **RQ 7:** How does the user's personality influence the perceived experience?
- **RQ 8:** How do technology failures influence service fascination?

4.2 Context Analysis

4.2.1 Retail Customer Journey Mapping

"Shopping and service experiences occur when a consumer interacts with a store's physical environment, its personnel, and its policies and practices" [Brakus et al. 2009, p. 53]. Technologies and especially self-service systems become increasingly important elements of this physical environment [Verhoef et al. 2009, pp. 31-41].

Moments of truth represent critical contact points between customer and company (e.g., store atmosphere, store or service employees), leaving a lasting impression that reflects in customer satisfaction and in perceived product or service quality [Goetz 2011, p. 381]. In order to identify relevant touch points for improvement through experiential SSTs, a retail customer journey map is created. The concept presented captures the yet neglected area of consumer goods retail stores with a special focus on the textile and fashion industry. For being able to strictly focus on the in-store shopping experience, the journey only represents touch points that can be directly ascribed to the process of shopping in a physical store. Upstream elements like first inspirations gained through websites or downstream processes like after sales services are not part of the focus.

Extensive customer observations performed in fashion stores of twelve textile retailers situated in three bigger cities throughout Germany provide a basis for the customer journey map. The findings are consolidated and categorized. In a second step the defined contact points are verified by six experts coming from the retail and marketing area on different hierarchical levels (store managers, store staff, customer experience managers, vice presidents of retail marketing). The results indicate, that a typical fashion store can be broken down into six core customer touch points (cf. Figure 4.1).

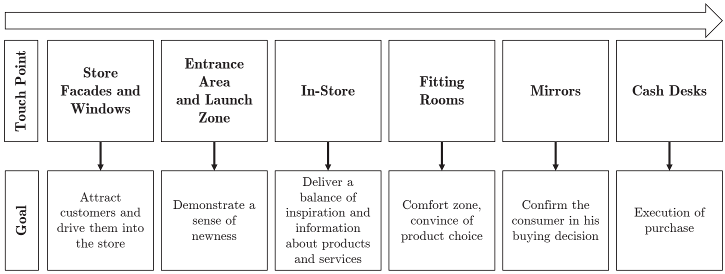


Figure 4.1 – Retail Customer Journey Fashion Stores

The analysis shows that throughout all observed stores the application of technology is so far limited to the support of internal processes (e.g., cash desks, RFID stock take). Consumer-oriented application of technology is restricted to simple information terminals. Use cases directed towards attracting new customers by providing them with innovative ways of advertising and service delivery merely exist.

Fashion shopping represents a habituated purchase type with high customer involvement [Weise 2008, p. 60]. While in total six touch points are identified, only the first five are relevant for inspiring, motivating, and convincing the customer of his/her purchase. Especially these moments of truth wield particular influence towards the buying decision of the customer. By offering a high level of consumer orientation at these contact points, it is possible to increase satisfaction and finally the company's success [Goetz 2011, p. 317]. In contrast, the purchase decision is already made when the customer approaches the sixth touch point, the cash desk. Instead of a place of purchase decision making it represents the place of the purchase deed and is therefore excluded from further investigation [Weise 2008, pp. 59-61].

4.2.2 Retail Technology Portfolio

To gain insight about the potential of various technologies, a technology portfolio analysis is conducted (cf. Chapter 3.2.2.2). As described before, SSTs always represent complex combinations of software and hardware technologies. In order to achieve a manageable level of complexity, the systems are split up into four basic components (cf. Figure 4.2). Input and output devices (I and II) represent the physical part of the human-machine interface. Design methodologies (III) portray the way of how the service concept is realized from a functional point of view and how it is showcased to the user. The system furthermore processes digital content (IV) of any kind (e.g., video, audio). The overall technological system design needs to lead to desired effects on the user side.

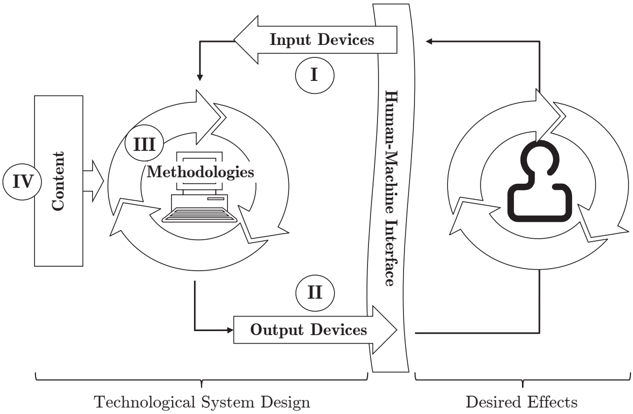


Figure 4.2 – Retail Technology Portfolio: System View

Eight experts participated in the technology portfolio analysis. Table 4.1 shows the profiles of the specialists interviewed. During selection of the participants attention is paid to covering expertise from each of the three underlying research fields.

Table 4.1 – Technology Rating: Expert Profiles

No.	*Sector*	*Profession*
# 1	Research institute	Senior Research Associate
# 2	Industrial company	Expert Virtualization Innovation
# 3	Industrial company	Head of User Experience and Interface Design
# 4	Industrial company	Manager Consumer Experience
# 5	Consultancy	Senior Manager Customer Experience, User Experience, and Research
# 6	Industrial company and research institute	Innovation Manager Customer Experience
# 7	Consultancy	UX Designer
# 8	Industrial company	Head of Product Management

Furthermore, the experts have different backgrounds ranging from research and industrial companies to consultancies. All of them are or have been working in the textile or retailing industry.

The workshop is conducted under specific consideration of the retail context. This not only takes the market situation (e.g., competitor's solutions) into account, but also aspects of general applicability in the selected environment. In phase one, the experts are asked to come up with technologies, design methodologies, and content types that can be applied within the given context. The feedback is consolidated and technology lists are created. In the second phase, the experts are asked to rate the technologies based on the technology portfolio method presented in Chapter 3.2.2.2, focusing on aspects relevant for either the company (maturity level and differentiation potential) or for the customer (potential to realize functional and hedonic value).

The input technologies mentioned range from typical mouse and keyboard controls to innovative methods like brain-computer interfaces and gesture-based interaction (cf. Figure 4.3). Touch and multi-touch input is commonly named by all experts.

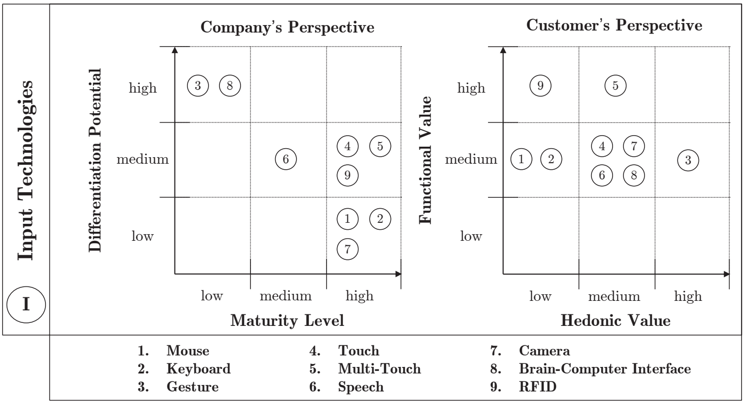


Figure 4.3 – Retail Technology Portfolio: Input Technologies

Many different visual output devices are named as potential output technologies. These include various forms of display types and projector technologies, but also innovative concepts like head-up displays and transparent LCDs (cf. Figure 4.4). Six out of the eight experts justify their nominations with the specific requirements of retail environments (e.g., brightness, robustness). Furthermore, the experts also agree that a specific differentiation potential arises not only from the technology applied but from how it is applied (e.g., quality of the realization and interplay of the selected technologies).

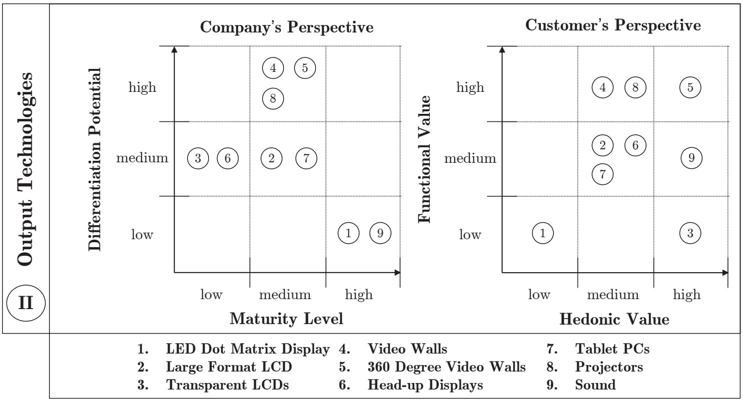


Figure 4.4 – Retail Technology Portfolio: Output Technologies

Design methodologies include the types of how a service is conceptually implemented (cf. Figure 4.5). The experts remark, that while the methodologies are usually considered as distinct procedures, it is often a combination of at least two of them that makes up the final service system.

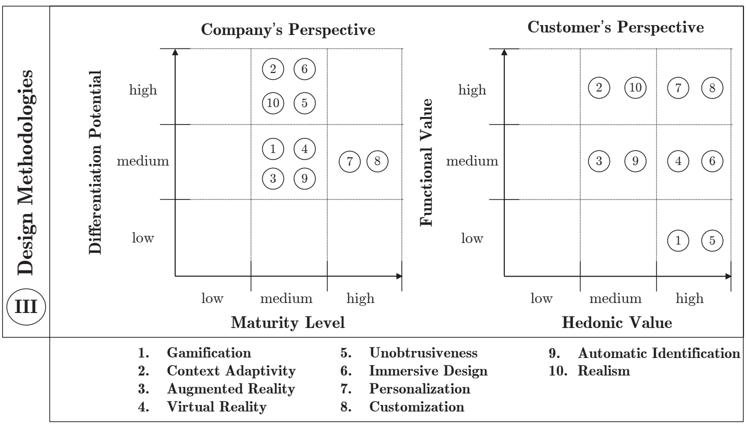


Figure 4.5 – Retail Technology Portfolio: Design Methodologies

Types of digital content are manifold and numerous combinations exist. Therefore, similar mentions (e.g., product videos and marketing videos) are consolidated if there is no concrete technological difference. Figure 4.6 visualizes the expert mentions and ratings.

Although all technologies are rated by the experts on an individual level, they indicate the importance of technology combinations and their interplay through well chosen design methodologies which in the end account for the desired effect. Nevertheless, innovative, unique, and rarely available technological components are considered desirable to the end user. This is also reflected in the individual ratings. The less mature a technology is, the higher is the potential for differentiation. This leads to desirability from the customer's perspective, particularly reflected in the perception of hedonic values.

Consequently, and in regards to the context of retail environments, experiential SSTs have to apply uncommon combinations of (innovative) technologies, while considering aspects of ergonomics, robustness, and serviceability. These findings will be applied during development of the SST prototypes presented in the subsequent sections.

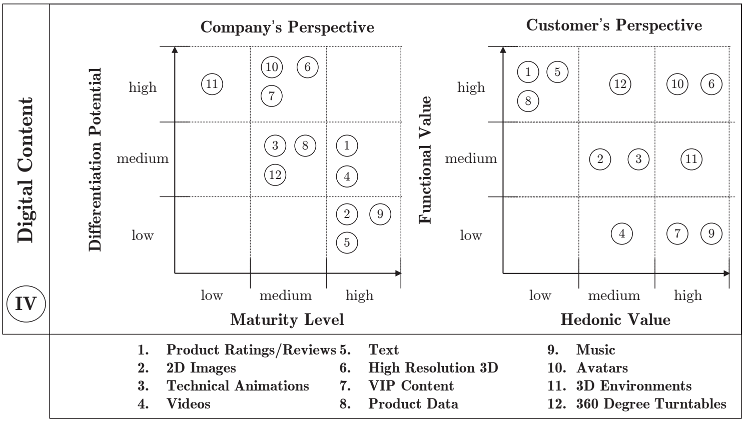


Figure 4.6 – Retail Technology Portfolio: Digital Content

4.2.3 Use Case Overview

Each of the identified moments of truth within the consumer journey is linked to a specific use case represented through a physical prototype to be created (cf. Figure 4.7).

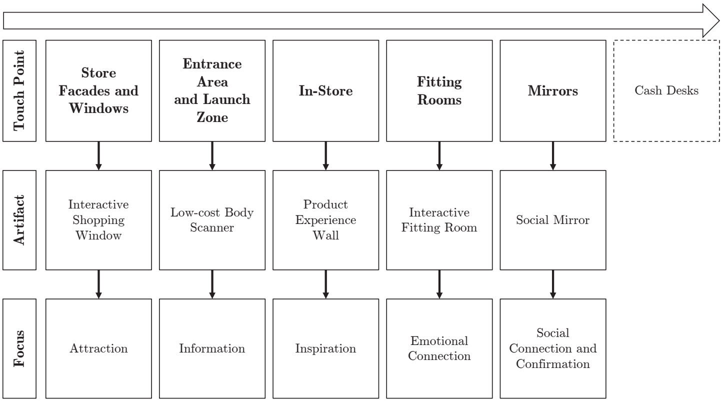


Figure 4.7 – Use Case Overview

While each of the artifacts introduced follows the goal of creating an exciting experience for the consumer, they all focus on slightly different aspects of their experiential realization in order to best support the respective touch points. This allows a comparison of their individual functional and hedonic features caused by the integration of innovative technologies.

Use case one realizes an interactive shopping window and represents the first consumer touch point within the customer journey. This interactive self-service system attracts consumers and allows them to experience the products in a digitally augmented way instead of just looking at a traditional static shopping window. Focusing on affective components the system invites them to enter the store. As the system is also accessible beyond shopping hours it facilitates a conspicuous differentiation from competitors and thus the creation of a brand image all around the clock.

A low-cost body scanner supports the consumer's desire of finding clothes that perfectly fit. Within seconds a digital avatar, representing the consumer's body, is created. This avatar can be automatically measured at any position on the digital body, hence allowing the presentation of size recommendations. The option to additionally simulate garments on the avatar and to visualize fit through a heatmap furthermore support the consumers in their buying decision.

After assessing body measurements, customers get assisted by the so called "Product Experience Wall". This self-service realizes an interactive, digital store assistant in real-life size, providing extensive information about a variety of products. Special focus lies on the presentation of complete outfits instead of single products, hence influencing the consumer's shopping behavior through inspiration. The use of sensor technology allows the creation of an innovative UI, enabling a system-initiated and personalized consumer approach based on context adaptivity.

Having selected the desired garments, the consumer is invited to enter an interactive fitting room. This touch point focuses on the stimulation of the consumer's senses. The prototype realizes an interactive system based on a combination of technologies such as RFID sensors and large touch-sensitive visualization surfaces. By automatically detecting products taken inside, an immersive virtual environment is created that represents the usage context of the respective garment (e.g., a mountain landscape is projected on the walls when entering with an outdoor jacket). Besides lending support to customers in the process of trying on and purchasing items by providing detailed product information, the system also connects customers to independent recommendation systems. Integrating haptic, visual, and auditory elements, this multi-modal approach creates a lasting impression.

The last use case takes the social aspects of shopping into account. A social mirror allows consumers to integrate their friends and families into the buying process. After trying on clothes, consumers can examine the outfit in the physical mirror and take a picture. This image can be commented and uploaded to favorite social networks. While the prototypes intend to encompass all of the experiential dimensions, each of them has a specific experiential focus (cf. Table 4.2).

Table 4.2 – Artifacts: Experiential Focus

Prototype / Dimension	*Affective*	*Cognitive*	*Behavioral*	*Sensory*	*Social*
Interactive Shopping Window	●	◕	◕	◑	◔
Low-Cost Body Scanner	◑	●	◕	◔	○
Product Experience Wall	◕	◑	●	◕	◔
Interactive Fitting Room	◕	◑	◔	●	◔
Social Mirror	◑	◔	◕	◔	●

● main focus ◕ strong focus ◑ medium focus ◔ minor focus ○ no focus

The implementation of the artifacts covers different levels of development, ranging from laboratory prototypes to fixed in-store installations in retail stores (cf. Table 4.3). The development stages later on also reflect on the system's evaluation conditions.

Table 4.3 – Use Case Overview

Artifact	*Status*	*Evaluation environment*
Interactive Shopping Window	productive	laboratory setup and 6 week proof of concept installation in a retail store
Low-cost Body Scanner	prototype	laboratory setup and multiple external presentations
Product Experience Wall	prototype	laboratory setup
Interactive Fitting Room	prototype	laboratory setup and multiple external presentations
Social Mirror	productive	laboratory setup and 11 fixed in-store installations placed in 10 retail stores

4.3 Interactive Shopping Window

4.3.1 Motivation and Goal

"As the digital and in-store experiences blur, it is opening up exciting new possibilities for forward-thinking retailers. [...] Consumers no longer see a distinction between online and offline shopping. Whether it's searching on a laptop, browsing in main street shops or hanging out at the mall - it's all shopping. To adapt to the competitive new reality, smart retailers are drawing classic retailing truths of the past and augmenting them for the now." [Ramaswamy 2013]

Shopping windows, constituting the first contact point of physical retail stores, offer a huge potential for differentiation. They represent the first store element through which the customer is confronted with the products and a specific advertising message [Maynert 2007, p. 10]. Their main goal is to gain the pedestrian's attention. According to Mayer [2000, p. 178], this activation can be achieved by addressing physical, cognitive, and emotional stimuli. "Although shopping windows represent one of the most important embodiments of retail stores, almost no innovation was introduced in that area within the last 200 years" [Zagel and Bodendorf 2012, p. 698]. Most retailers still trust in the design and furnishing of traditional retail store windows.

In many countries retail stores close in the evening and are shut down on Sundays. Nevertheless, the inner cities of large towns are still crowded in these times. People are going for a walk, having a drink, or go clubbing. If stores are closed, traditional shopping windows in many cases only offer limited product information due to a lack of space. This leads to the fact, that consumers who are interested in a product only have two choices: coming back when the store is open or trying to manually search for the product in the online store. But this will only work if the consumer knows either the article's name or its product number. With the large product ranges of retailers it is nearly impossible to find the correct product online just from a picture in the consumer's mind. On the other hand, online shops are always opened. They provide a 24/7 shopping experience with a potentially unlimited product range. The interactive shopping window bridges this gap between online and offline shopping. An innovative storefront makes it possible to buy products directly from the window, during or outside of shopping hours. Those shopping windows "can tell customers how to use certain products and provide additional information" [Ebster and Garaus 2011, pp. 57-59].

The presented concept intends to serve two goals. First, to attract consumers and to invite them to explore the brand and its products in an interactive and fancy way. During opening hours, it should lead users directly into the physical store. As a second goal, the system should also provide product experience and enable purchases beyond shopping hours.

4.3.2 Ideation

4.3.2.1 Service Concept

The prototype of the interactive shopping window follows two goals with a slightly different focus on delivering utilitarian and hedonic value (cf. Figure 4.8). During daytime, the system should attract potential customers through interactivity and by providing an exceptional experience. When the store is opened, the SST should lead customers directly into the store to buy the desired product. It therefore acts as a first contact point, gaining attention for the company's offerings and inspiring people to involve with the brand. Beyond shopping hours, the utilitarian value for the customers rises, as they don't have the chance to enter the store and directly shop for the desired products.

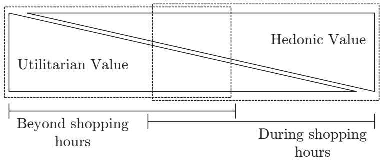


Figure 4.8 – Interactive Shopping Window: Utilitarian vs. Hedonic Value

Table 4.4 depicts the intended implementation of the basic and rejection dimensions for the interactive shopping window. Each of these dimensions forms a holistic entity in the final implementation. The focus of the experiential realization is justified by the primary goals of the interactive shopping window. Overall, the system intends to attract customers by touching their affective perception. By providing the users with extensive information about the articles displayed, the system in addition focuses on the consumer's cognitive senses. Finally, the device intends to change shopping behavior either by offering a digital starting point for the physical purchasing process or by offering a completely new physical entrance for shopping online.

Table 4.4 – Interactive Shopping Window: Basic Design Elements

Dimension	*Realization*
Perceived Usefulness	The system provides extensive product information and an enhanced way of product presentation. It allows the consumer to buy products during and beyond shopping hours.
Perceived Ease of Use	All interfaces follow the guidelines of DIN EN ISO 9241 (particularly DIN Deutsches Institut fuer Normung e.V. [1999], DIN Deutsches Institut fuer Normung e.V. [2008a], and DIN Deutsches Institut fuer Normung e.V. [2011a]) and are designed in an easy to use manner. The interaction happens using a virtual human model and is realized in a naturally and easy to use way. It is additionally supported by visual elements like buttons and arrows. Short user guides help the user to execute more complex functions (e.g., connecting the mobile phone).

The table is continued on the next page

Trust	Personal consumer data (e.g., name, address, payment information, or login data for social networks) is only asked for if the customer wants to order a product. Handling personal data is executed through the consumer's own smartphone and managed through secure gateways. By doing so, critical information is only displayed in a private space.
Technology Readiness	Through an innovative interaction design using a life-size virtual model, the system provides the subconscious perception of interacting with a human instead of a piece of technology. The goal is to also attract people with low technology readiness.

Table 4.5 reflects the realization of single experiential design elements based on the respective experiential focus. These apply design methodologies and digital content elements identified in Chapter 4.2.2. Strong focus lies on a sense of realism, unobtrusiveness, and immersive design by applying interactive human avatars, high resolution 3D content, and detailed product data.

Table 4.5 – Interactive Shopping Window: Experiential Design Elements

Dimension	*Realization*	*Focus*
Affective	The user interface is designed in a visually attractive way. A state of immersion is created through integration of interactive, moving, life-size virtual human models. Funny and unexpected motions and interaction possibilities enhance the emotional effects.	●
Cognitive	Extensive product information (e.g., materials, available sizes) allows a reflected purchase. Through interaction with the virtual human model, also functional aspects (e.g., zippers, hoods) of the products are conveyed. The virtual model presents the fit of the garment from all perspectives.	◕
Behavioral	Providing the possibility to buy products at any time changes the shopping behavior of the consumers. Additionally, the virtual representation of complete outfits instead of single items can lead to additional purchases. The system can therefore act as the first touch point for physical purchases or as a physical representation of an online shop.	◕

The table is continued on the next page

Sensory	The visual as well as the haptic sense are stimulated. A large, touch-enabled video-wall displays visually attractive content. An additional attachment of vibro speakers to the window glass allows the integration of sound.	◑
Social	By applying multi-touch technology, the system can be used by multiple persons in parallel. Furthermore, the mobile component allows sharing and commenting on products by connecting to social networks.	◔
	● main focus ◕ strong focus ◑ medium focus ◔ minor focus ○ no focus	

4.3.2.2 User Interface and Interaction

The interface consists of two separate visual elements: A virtual human model in real life size is displayed on the left, a virtual product shelf on the right side of the UI (cf. Figure 4.9).

Figure 4.9 – Interactive Shopping Window: User Interface

Both elements offer a scroll bar that logically extends the contents by switching through multiple layers. While the model can be changed from female to male, the product assortment can be modified by scrolling through different shelf designs. In idle mode, the interface is overlayed by a large button in form of a hand to indicate the interaction possibility.

To further visualize possible interactions, the system uses hotspots and information signs. These are either realized as buttons or integrated into the product images presented. All articles on the shelf can be clicked, moved around, or dragged into the virtual shopping bag. Interactive buttons are also placed on the mannequin. With these hotspots it is possible to control and to interact with the virtual model. The hotspots include specific meta data information like an individual identifier (ID) and their position on the mannequin or the product image, consisting of x and y coordinates. If required, they additionally contain product information. The spots on the mannequin intend to realize a natural interaction, comparable to the one with a real person. For example the user is able to instruct the virtual model to turn around, to take off the jacket or to present specific parts of the outfit in detail. The interactions are executed by gestures and illustrated through a button in combination with an arrow indicating the angle of the interaction gesture. Figure 4.10 exemplary visualizes a gesture that is used for revealing the t-shirt of the virtual model.

Figure 4.10 – Interactive Shopping Window: Model Interaction

As soon as the user touches an interaction spot an arrow appears indicating the drag direction for the desired action. In parallel, all other interaction spots fade out. By dragging the spot, the user controls the play-back of the mannequin video. Also a reversed play-back is possible. After releasing the hotspot the interaction is automatically finalized and the next interaction options appear.

A digital shopping bag is another important part of the UI. It can be moved anywhere on the interaction pane. In idle mode, it carries a QR code with an individual code to identify the window (cf. Figure 4.9, right and Figure 4.11, left). To connect to the shopping window, the user can either scan the QR code with an appropriate application or directly open up the mobile website using a short URL (cf. Figure 4.11). The target website displays a login screen in which the unique pin code has to be entered. As soon as the login sequence is completed, the user is automatically forwarded to his/her personal digital shopping list, displaying all articles that have been dragged to the window's digital shopping bag. This application also includes social network connectivity, that allows sharing products on favorite sites.

Figure 4.11 – Interactive Shopping Window: Mobile Component
adapted from adidas NEO Label [2012]

4.3.2.3 Service Delivery System

The service delivery system cares for handling the back-end tasks, including the provision of digital contents applied through databases and the connections to external networks. It therefore contains not only the content as such, but also the software technologies beyond the UI that remain invisible to to user. Content utilized in the prototype is selected based on the technology portfolio created before.

- **Front-End Application:** The UI uses HTML5 which has the advantage of being operated through standard web browsers, avoiding extensive local installations. In contrast to other technologies it is able to interpret multiple inputs at once and therefore can be controlled by multi-touch devices. Content of any kind can be integrated and interlinked.

- **Server Component:** A server is used to centrally manage the contents displayed on the interactive shopping window and to post online orders. Next to managing multiple distributed shopping windows, their product ranges and contents, it administers the link to the brand's online order system.

- **Mobile Website:** The mobile component is also realized in HTML5 and supports common mobile operating systems. A user client identification allows the automatic adjustment of the mobile wireframes to enable an optimal presentation on the specific customer device.

- **Digital Avatar:** The virtual models are realized through short and interlinked video clips embedded in HTML5. All sequences carry a timestamp and represent a certain mannequin movement carried out as a consequence of user interaction.

- **Product Database:** As part of the server component, the product database contains article images and 3D files, detailed product information, and metadata used for ordering the products through the online shop.

4.3.2.4 Technical Setup

The combination of hardware technologies to realize the prototype is constrained by the environment of the retail store. The system needs to follow certain regulations in regards to security, physical appearance, robustness, and reliability. Also constraints like room height or window size need to be considered. The customers need to have the possibility to interact with the device by touching the window's glass surface. While it is possible to realize this setup using projectors, current projector technologies require a certain distance to the projection surface and do not offer sufficient brightness for an operation during daytime. The setup of the self-service system needs an individual composition of all physical components. To ensure maximum flexibility a customized housing is created:

- **Housing Modules:** The casing consists of two separate modules built to mount the LCD displays and the computer. It is constructed in a way that gaps between the screens are minimized.

- **Cooling:** Fans built into the bottom and top of the construction ensure a constant air circulation for cooling the components. An air channel ensures a steady flow and a deflection of hot air.

Figure 4.12 illustrates the composition of the housing components excluding the computer and LCD panels. A smooth design is achieved by using side- and back-plates in the store's furniture design.

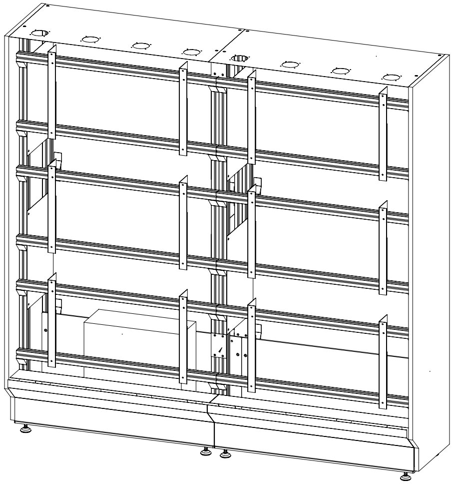


Figure 4.12 – Interactive Shopping Window: Base Construction

All hardware technology is selected to withstand the challenges of a productive use in a store environment. Therefore, main focus lies on robustness of the components while ensuring a maximum usability and user experience. The setup consists of the following devices:

- **Display Wall:** For presenting digital contents, Samsung LTI460HN01 Super Narrow Bezel (SNB) LED panels with FullHD resolution (1920x1080 pixels) at 46" size are used. An arrangement of six screens make up one video wall. With 700cd, the displays offer sufficient brightness for being installed inside a shopping window, considering standard daylight conditions. The display model offers a very slim bezel that allows an active-to-active distance of only 10mm when mounted next to each other. The video wall has a total size of 209,5cm width and 180cm height.
- **Capacitive Touch Foil:** As input device a capacitive touch foil with 100" size in 16x9 format is used. The foil is attached to the inside of the shopping window glass and supports multiple simultaneous inputs. This allows various users to interact with the system in parallel. Also gestures like zooming and rotating can be implemented.

- **DVI Splitter:** A DVI splitter allows the connection of all six displays through a single graphics output of the computer. The device resamples and distributes the video content to the individual displays.
- **Computer:** To control the setup and to connect to the back-end server, a computer with Intel Core i5-2320 CPU, 8GB RAM, 90GB SSD and NVidia GTX560Ti graphics card is used. It offers sufficient power for a smooth, jerk-free interaction.

4.3.3 Implementation

The final system is installed as a proof-of-concept project for a period of six weeks in a retail fashion store in Germany. For a smooth integration with the overall store front, the unused areas of the window are covered with a printed graphics foil (cf. Figure 4.13). The interactive window consumes the identical amount of store space as a traditional window. Evaluations and observations provide insight into public perception and serve as a base of decision making for future roll-outs.

Figure 4.13 – Interactive Shopping Window: Prototype

4.3.4 Evaluation

4.3.4.1 Overview

The prototype of the interactive shopping window is evaluated in a productive store environment. The observation takes place during shopping hours. Persons either approach the system independently or are recruited on the shopping street. They are observed before, during, and after interacting with the SST. After completing the process, they are asked to conduct the service fascination survey (cf. Chapter 3.3.2.5.2) on tablet computers. Out of a total of 540 persons approached, 213 participate in the evaluation process and complete the service fascination questionnaires. 135 are female, 78 are male, aged between 17 and 60 (Avg. 25.52, SD 6.64). Table 4.6 provides an overview about the study demographics. [Zagel 2014a, pp. 311-314]

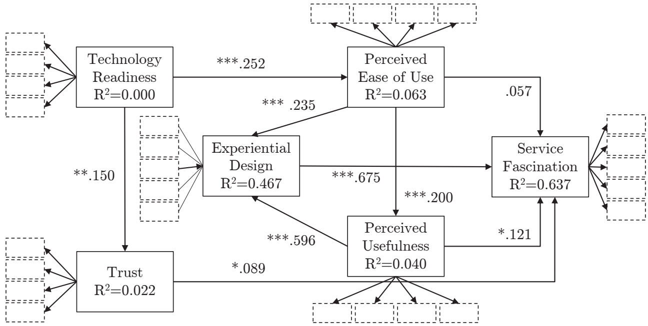
Table 4.6 – Interactive Shopping Window: Overview and Sample Demographics

System Status	Productive	
Location	Retail fashion store, Nuremberg, Germany	
Timeframe	10.09.2012 - 22.10.2012	
Samples	Female	135 (63.4%)
	Male	78 (36.6%)
	Total	213
Age	Minimum	17
	Maximum	60
	Median	24
	Average	25.52 (SD=6.64)
Participants	Customers and pedestrians, recruited on a shopping street	

4.3.4.2 Subjective Measurement

4.3.4.2.1 Overall Model

Basic, rejection, and experiential dimensions are analyzed using the proposed service fascination research model (cf. Chapter 3). Figure 4.14 outlines the results of the analysis. The causal model is evaluated in SmartPLS 2.0 [Ringle et al. 2005], applying 213 cases and 5000 samples. Both, the causal model as well as the measurement model are tested against the quality criteria introduced in Chapter 3.3.2.2.2. The factors for reflective and formative measurement models are within accepted thresholds.



*p<0.1; **p<0.05; ***p<0.001

Figure 4.14 – Interactive Shopping Window: Evaluation Results (Causal Model) adapted from Zagel [2014a, pp. 311-314]

The structural model is validated using the four quality criteria mentioned before. With one exception (H_6), all hypotheses are supported within the evaluation of the interactive shopping window. Table 4.7 provides a detailed overview on the path coefficients, their t-values, and the exogenous latent variable's influences towards the endogenous latent variables using effect sizes (f^2).

Table 4.7 – Interactive Shopping Window: Hypotheses adapted from Zagel [2014a, pp. 311-314]

	Hypothesis	*Path Coeff.*	*T-value*	f^2
H_1	Technology Readiness → PEOU	0.2519	3.4108	0.067
H_2	Technology Readiness → Trust	0.1496	2.0106	0.022
H_3	Trust → Service Fascination	0.0886	1.9457	0.019
H_4	PEOU → PU	0.2000	2.7826	0.042
H_5	PEOU → Experiential Design	0.2347	2.6396	0.067
H_6	PU → Experiential Design	0.5965	10.8980	0.541
H_7	PEOU → Service Fascination	0.0570	1.4177	0.006
H_8	PU → Service Fascination	0.1209	1.8355	0.019
H_9	Experiential Design → Service Fascination	0.6753	10.7841	0.650

PU = Perceived Usefulness; PEOU = Perceived Ease of Use

$t \geq 1.65$ sig. level = 10%; $t \geq 1.96$ sig. level = 5%; $t \geq 2.58$ sig. level = 1%

$f^2 \geq 0.02$ "weak"; $f^2 \geq 0.15$ "medium"; $f^2 \geq 0.35$ "strong"

The results indicate that a large share in producing the R^2 of the experiential design construct can be ascribed to PU. The same applies for experiential design in relation to service fascination. While weak effects can be identified for the other relationships, there is almost no effect of PEOU towards service fascination.

Both of the target constructs, experiential design ($R^2 = 0.467$) and service fascination ($R^2 = 0.637$), are well explained by the structural model. The predictive relevance is evaluated for the reflectively measured endogenous constructs using Stone Geisser's Q^2. All values exceed the critical level of 0. The values are depicted in Table 4.8 together with the overall results. The data show a lack of trust towards the SST, while also the PU is rated rather poor. These may be effects of the real case scenario and the experiment being executed at daytime, when the store is opened and the customers have the possibility to directly buy the product. On a subjective level the system is perceived as easy to use and three of the experiential criteria are rated slightly positive (affective, cognitive, and sensory dimension). Even though the behavioral and the social component are individually valued on a neutral level, the combination of all experiential dimensions leads to a slightly positive overall experiential design.

Table 4.8 – Interactive Shopping Window: Evaluation Results adapted from Zagel [2014a, pp. 311-314]

	Dimension	α	*Md*	$\overline{x}$	*SD*	R^2	Q^2
Service Fascination	Perceived Usefulness	0.925	4	3.46	1.54	0.063	0.0312
	Perceived Ease of Use	0.922	6	5.48	1.09	0.040	0.0536
	Trust	0.957	3	3.27	1.74	0.022	0.0171
	Technology Readiness	0.797	6	5.78	1.25	0.000	—
	Service Fascination	0.910	5	4.54	1.54	0.637	0.4655
	Experiential Design	—	5	4.73	1.01	0.467	—
Experiential Design	Affective	0.842	5	5.10	1.33	—	—
	Cognitive	0.794	5	4.92	1.08	—	—
	Behavioral	0.792	4	3.96	1.49	—	—
	Sensory	0.815	5	4.96	1.22	—	—
	Social	0.746	4	3.86	1.41	—	—

α = Cronbach's Alpha; Md = Median; $\overline{x}$ = Mean; SD = Standard Deviation; Q^2 = Stone Geisser's Q^2

$R^2 \geq 0.67$ "strong"; $R^2 \geq 0.33$ "medium"; $R^2 \geq 0.19$ "weak"

$Q^2 \geq 0.35$ "strong"; $Q^2 \geq 0.15$ "medium"; $Q^2 \geq 0.02$ "weak"

Figure 4.15 visualizes the overall ratings in a spider chart. The data is split up into results originating from the service fascination questionnaire and the experiential dimensions questionnaire.

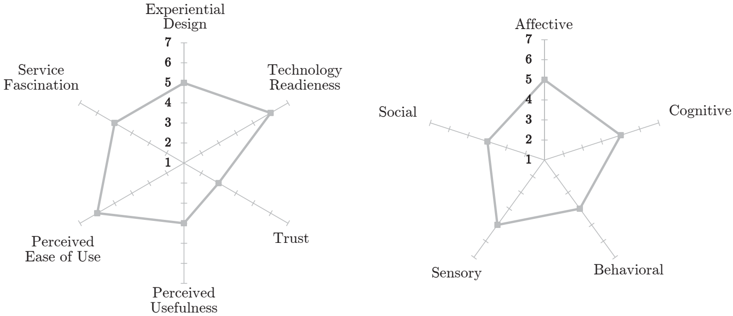


Figure 4.15 – Interactive Shopping Window: Evaluation Results Medians, adapted from Zagel [2014a, pp. 311-314]

4.3.4.2.2 Gender Splitup

A comparison of genders leads to further insights. Figure 4.16 depicts the differences of the medians in relation to the individual ratings. The experiential effects mainly differ in the appraisal of the behavioral dimension which is rated slightly better by men. While the overall PU is scored on an almost identical level, ease of use is perceived more positive by women. Nevertheless, a huge difference can be observed in regards to trust.

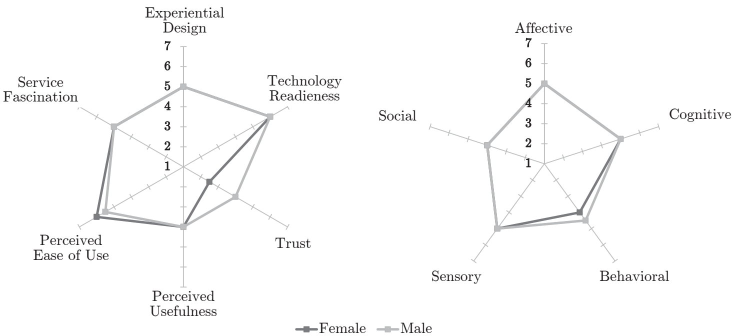


Figure 4.16 – Interactive Shopping Window: Evaluation Results (Gender Splitup) Medians, adapted from Zagel [2014a, pp. 311-314]

Taking a deeper look at the data (cf. Table 4.9) and also considering significances (t-test) and effect sizes (Cohen's d), the difference in trust perception can be identified as highly significant with a medium to large effect. The overall variance in regards to the cognitive, sensory, and social dimension, as well as the overall experiential design, and technology readiness are marginal. Nevertheless, all of them show small effect sizes.

Table 4.9 – Interactive Shopping Window: Evaluation Results (Gender Splitup) adapted from Zagel [2014a, pp. 311-314]

		Females (N=135)			*Males (N=78)*				
	Dimension	*Md*	$\overline{x}$	*SD*	*Md*	$\overline{x}$	*SD*	*p*	*d*
Service Fascination	Perceived Usefulness	4	3.40	1.52	4	3.56	1.57	0.471	0.104
	Perceived Ease of Use	6	5.50	1.12	5.5	5.44	1.03	0.680	0.055
	Trust	2.5	2.84	1.58	4	4.01	1.75	0.000	0.712
	Technology Readiness	6	5.68	1.26	6	5.95	1.20	0.132	0.218
	Service Fascination	5	4.53	1.61	5	4.56	1.42	0.862	0.019
	Experiential Design	5	4.83	0.96	5	4.56	1.07	0.064	0.270
Experiential Design	Affective	5	5.11	1.40	5	5.09	1.20	0.370	0.015
	Cognitive	5	5.01	1.08	5	4.76	1.06	0.091	0.233
	Behavioral	4	3.97	1.42	4.5	3.93	1.61	0.833	0.027
	Sensory	5	5.09	1.25	5	4.74	1.15	0.041	0.288
	Social	4	4.00	1.45	4	3.62	1.30	0.057	0.272

Md = Median; $\overline{x}$ = Mean; SD = Standard Deviation; p = Significance; d = Effect Size

$p \leq 0.05$ sign. level = 5% - $d \geq 0.2$ "small"; $d \geq 0.5$ "medium"; $d \geq 0.8$ "large"

4.3.4.3 Objective Measurement

According to the research process disclosed in Chapter 3.3.3, the subjects are observed before, during, and after usage of the system. As the study takes place in a public space, it is also possible to report general observations of spectators, who are not directly involved in the experiment with the 213 selected subjects. The observational report lists the notes taken during the assessment and also reflects the emotional reactions of the users based on the measurement instrument introduced in Chapter 3.3.3.3. Following behavioral patterns, problems, and usability issues can be observed:

Table 4.10 – Interactive Shopping Window: Observed Behavior

Basic Dimensions
Interaction usually starts by touching the idle button (hand) on the digital model.
Most persons stop interacting with the device, when they get stuck in the process and do not know how to continue.
Some people do not understand the purpose of the digital shopping bag. They drag the bag on the window without connecting their smartphone or filling it with products. If the purpose is not understood, the shopping bag is even considered disruptive. This especially applies, when it covers the digital model or products that people would like to explore.
People try to drag products from the shelves onto the digital model in order to dress it. Nevertheless, this option is not provided in the current implementation.
Users accidentally open the product information and do not understand why other features (e.g., scrolling) get disabled.
The scroll functionality for revealing further products is hardly used.
In bright sunlight, people do not recognize the interactive shopping window due to reflections of the glass surface and insufficient brightness of the displays.
Some users have problems in dragging products with one finger.
Subjects get creative in how they interact with the touch screen. While some use their finger, others use a fist, their forehead, or other body parts. If the device does not respond to the interaction, they try to put more pressure behind their actions.
Rejection Dimensions
Users are afraid of ordering a product just by connecting their smartphone to the shopping bag.
Older customers avoid using the system due to technology anxiety which leads to shame/fear of not being able to control the system correctly.
A few users avoid touching the window surface due to hygienic concerns.
Experiential Dimensions
The interactive shopping window is an eye-catcher. It is a clear focus point that pedestrians look at and talk about.
Interaction usually happens in groups of at least two people.
If multiple socially connected people (e.g., friends) approach the window, they usually interact together on one unit (mannequin or shelf).
The table is continued on the next page

If multiple independent subjects approach the window, each of them is positioning in front of one unit (mannequin vs. shelf), trying to interact independently.
Once a person starts to interact with the system other people stop by and start observing.
Observers point at the window to show it to others that did not take notice.
After leaving the window, some users return with friends to show them the SST.
The presentation of the digital model as a life-size avatar has a positive effect on the user's emotional reactions. Users sometimes behave like interacting with a human, not with a computer.
The majority of the subjects only interacts with the digital model, not with the products on the digital shelves (interaction relationship is around 85% for the digital model vs. 15% for the product shelf).
Especially children, teenagers, and young adults are attracted by the system. The younger people are, the more likely they stop and watch or interact.
Subjects and observers are in general amused by interacting with the system or observing the interaction. This also reflects the fact, that people start talking about the system, and take pictures and videos.
To some users, the glass surface does not feel appealing. This is particularly the case in warm weather conditions.
General Behavior
When crowded, the interaction only takes some seconds, up to a minute. If people are alone, they take more time to explore the system.
About 40% of the users enter the store after interacting with the device.
Several of the users search for the outfit combinations presented on the digital mannequins.
Some of the customers ask for specific products in the store, when they identified something interesting during interaction with the shopping window.
A crowded interactive shopping window hinders other customers from entering the store.

From an observational point of view, the overall acceptance of the interactive shopping window is very good. People have fun using it and invite others to participate in the experience. This becomes even more obvious during conversations with the users. The novelty of the system and especially the interactive human model are perceived as crucial elements. Negative feedback only occurs in regards to the systems usability and usefulness.

In general the system is perceived rather an entertaining interface with the option to inform oneself about products instead of a pure shopping device.

4.3.4.4 Summary

By combining the results of both assessments certain salient findings can be identified. The system is perceived as attractive and entertaining, attracting numerous spectators and users. The device preferably attracts young users to interact with it.

While the interactive shopping window is considered as being easy to use, its usefulness is, independent of gender aspects, perceived as poor. One reason might be that the study is performed at daytime, when the primary purpose of the SST is to attract and inform customers. If they are interested in a product, they directly enter the store and buy the article instead of ordering it through the system. Also the fact that the device is located within the traditional shop environment leads to the same effect. Further studies have to be conducted at nighttime as well as with a standalone system, e.g., placed in the subway, at the train station, or at the airport in order to identify the environment's influence towards PU. Moreover, the shopping functionality, especially the digital shopping bag, is not well understood. This requires a reconsideration of the buying process and to ease up the steps for connecting the mobile device. The lack of trust towards the SST might be another reason why customers only use the system for amusement instead of exploiting its utilitarian value. Especially females have less confidence in the technology. Usability shortages arising from hardware issues (decent touch functionality, deficits in display brightness) can be solved with advances in technological developments.

Another interesting finding is the obvious contradiction of the subjectively reported social impact of the interactive shopping window and the actual social behavior. While the subjective assessment attested a neutral perception in regards to the social dimension, the system is in practice almost exclusively used in groups [Zagel 2014a, pp. 311-314]. Nevertheless, there is also huge potential for improvement regarding the other experiential dimensions and the overall service fascination.

4.3.5 Improvement

The findings of the system evaluation provide the starting points for the development of an enhanced version of the interactive shopping window. This improvement concentrates on a clear provision of a utilitarian value as well as an improved implementation of the experiential dimensions. Another goal is to rectify the lack of trust by providing a modified and easy to use connection to the mobile device. A combination of physical products and digital contents using virtual environments intends to increase the level of immersion while keeping the reference to the real product.

The new concept converts the interactive shopping window into a solution that is intended for use exclusively at night. By reducing environmental influences (e.g., sunlight) to a minimum, it is possible to avoid potential usability issues. At daytime, the window needs to have the same purpose and functionality as a traditional one. The idea is to deploy a standard, plain white window interior and multiple projectors in combination with wrapping and edge blending technologies[2]. This allows using the three-dimensional window furniture as a projection surface. Physical products that are placed on the furniture can be integrated into the digital scene. Using depth cameras (e.g., the Microsoft Kinect®) allows customers to interact with the digital content and to actively influence the scenery. Figure 4.17 shows the physical prototype of the improved storefront setup. Three short-throw projectors mounted on the top, left, and right hand side and directed towards the furniture provide the possibility of covering the complete interior with digital content. Standard products are placed on cubes (or mannequins) in the scene.

Figure 4.17 – Refined Interactive Storefront: Prototype Configuration adapted from Fick [2013, p. 22]

In idle mode (when no user is interacting with the device) the system plays an eye catching multimedia loop in order to attract customers. As soon as a person approaches the window, the system detects the user and switches to active mode. Now the customer

[2]Edge blending describes the realization of extended display areas by using multiple projectors with overlapping images [Ashdown et al. 2010, pp. 83-85]. It "is a [...] technique for reducing seams. The idea is to overlap the edges of projected images by certain number of pixels and blend the overlapped pixels to smooth the luminance and chromaticity transition from one tiled image to another" [Li and Chen 1999, p. 281]. Wrapping (also called texture mapping) stands for applying a two-dimensional, projected image to a three-dimensional, rigid object [Parekh 2006, p. 170].

has the possibility to interact with the products and the interactive content via gestures (cf. Figure 4.18).

Figure 4.18 – Refined Interactive Storefront: Gesture Interaction adapted from Fick [2013, p. 26]

By pointing on a physical product, a countdown appears and the system activates the product-specific content as well as an appropriate virtual environment. This can be a soccer stadium for a football shoe, or an interactive panorama of a city for a lifestyle product. The usage of high-resolution 3D content allows displaying a detailed digital version of the product that can be rotated via gestures. The wrapping and edge-blending technology allows creating completely different environments using identical interior. Examples are depicted in Figure 4.19.

Figure 4.19 – Refined Interactive Storefront: Projection Mapping adapted from Fick [2013, pp. 44-53]

Integrating additional information (e.g., price, applied materials) lets the consumer learn more about the product. For dealing with the lack of trust, a new shopping process is developed. When the customer selects a product and opens the respective information section, a QR code is displayed. This code leads the user to a mobile online shop, where the product can be ordered. Today's broad distribution of QR codes guarantees broad knowledge about their usage, especially in the field of mobile marketing applications [Kato et al. 2010, pp. 114-116; Kan et al. 2011, pp. 340-341].

4.4 Low-Cost Body Scanner

4.4.1 Motivation and Goal

Trying on garments to identify the best matching size is an essential part of a fashion shopping process. While standardized codes for communicating garment sizes exist since almost two hundred years, "[a]lmost every apparel company employs a different fit model and develops its own size charts" [Workman 1991, p. 31]. Not only do sizes and fit of garments vary between brands, they also differ between different product lines of the same manufacturer. This often leads to frustration of the customers [Kinley 2003, p. 19]. Furthermore, a garment's fit does not only depend on the garment's size, but also on the customer's individual preferences and the personal perception of fit [Workman and Lentz 2000, p. 251]. Fit is therefore more than a simple function of body sizes. To overcome this issue, some companies offer made-to-measure garments.

Nevertheless, buying decisions are not only influenced by functional, but also by hedonic motives [Kim and Forsythe 2008, p. 46]. Soft factors like opinion leadership and fashion innovativeness become increasingly important [Kang and Park-Poaps 2010, pp. 312-328]. Especially in fashion shopping, positive emotions and a hedonic consumption tendency play a decisive role. Next to the product's fit and aesthetic appeal clothes are subject to an emotional type of consumption that is strongly influenced by the shopping process and environmental aspects. Especially in this context, a positive shopping experience can lead to impulse purchases [Park et al. 2006, pp. 433-446].

Body scanning is a service that is able to close both gaps, supporting the consumers in their buying decision while providing an innovative way of shopping. Especially when applied in traditional retail environments, body scanners are considered a possibility to create an innovative virtual shopping experience [Kartsounis et al. 2003, p. 137]. To date, high investment costs, the need for specialized knowledge, and a lack of flexibility prevent fashion companies from a broad integration of professional body scanners in their retail stores [Zagel and Süßmuth 2013a, p. 552]. Nevertheless, the rapid evolution of technology allows the development of cheap scanning solutions, that cannot only be used to accurately measure a customer's body, but also to enhance the customer experience and differentiate from competitors [Kim and Forsythe 2007, pp. 502-514]. This section presents the concept, development, and evaluation of a low-cost body scanner for application in physical retail environments[3].

4.4.2 Ideation

4.4.2.1 Service Concept

The self-service system presented primarily serves the functional need of getting insight in the customer's body measurements in order to recommend garment sizes based on a captured avatar. It furthermore allows a digital visualization of complete outfits including garment fit. This happens via simulating the physical drape of the garment on the digitized body. The innovativeness of the SST as well as its realization furthermore provide emotional value to the user (cf. Figure 4.20).

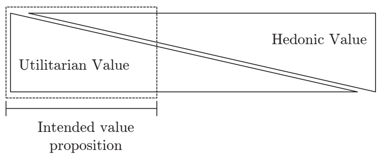


Figure 4.20 – Low-Cost Body Scanner: Utilitarian vs. Hedonic Value

Table 4.11 provides an overview about how the basic and rejection dimensions are realized in the implementation of the low-cost body scanner. These predominantly represent the implementation of the utilitarian values gained through application of the SST.

[3]Parts of this research are published in Zagel and Süßmuth [2013b, pp. 48-57], Zagel and Süßmuth [2013a, pp. 551-564], Zagel and Süßmuth [2014, pp. 7-10], Zagel et al. [2014d], and Zagel et al. [2014c].

Table 4.11 – Low-Cost Body Scanner: Basic Design Elements

Dimension	*Realization*
Perceived Usefulness	The system is able to automatically and accurately measure the consumer's body size and proportions based on the acquired virtual avatar. It is furthermore possible to simulate outfit combinations on the virtual body and visualize their fit.
Perceived Ease of Use	All interfaces follow the guidelines of DIN EN ISO 9241 (particularly DIN Deutsches Institut fuer Normung e.V. [1999], DIN Deutsches Institut fuer Normung e.V. [2008a], and DIN Deutsches Institut fuer Normung e.V. [2011a]) and are designed in an easy to use way. The scanning process takes less than five seconds and can be conducted either alone or with the help of store staff. Nevertheless, the user has to take a specific pose to perform the scanning process.
Trust	The user has full control over his/her personal body information. Customer data is only stored in the central consumer database if desired. The technology used is nonhazardous and contactless. Nevertheless, scanning should be performed naked or in tight underwear to achieve the most accurate measurement results.
Technology Readiness	The system can be used either individually or with the support of store staff. Previous knowledge is not required.

The system can also provide emotional value to the customers. This emotional value can reflect on the satisfaction with the products and finally lead to a higher buying probability. An important stake of this positive influence is also achieved through actively supporting the customers in their purchasing process thus, affecting their cognition. Previous behavioral patterns need to be broken in order to create a more desirable and less frustrating shopping experience. Affective stimulation is achieved by emotionally connecting the customer to the product, leading to a personal identification with the brand and its products. The implementation of the respective experiential criteria is reflected in Table 4.12, including the intended focus. Promising design methodologies and content identified before are applied to the new service offering.

Table 4.12 – Low-Cost Body Scanner: Experiential Design Elements

Dimension	*Realization*	*Focus*
Affective	Apparel shopping by using a personal avatar that digitally represents the consumer's body can create a state of immersion. Researchers state that the more realistic a digital avatar is, the stronger is the psychological connection of the user towards the service provided [Suh et al. 2011, pp. 725-726].	◑
Cognitive	Strong emphasis is put on supporting the consumers in their purchase by providing additional criteria for decision making. Reflected purchases are fostered through a fast visualization of the clothes without the need for a physical try-on. A heatmap visualization provides feedback about the predicted garment fit.	●
Behavioral	The system intends to change the way how consumers shop by visualizing garment style and fit on a personal avatar. This leads to cross- and up-selling potentials.	◕
Sensory	The sensory design elements focus on physical interaction during the scanning process and the visualization of the garments on the user's avatar.	◔
Social	A game-like interaction type for dressing the digital avatar is realized. This encourages the users to not only use the dressing feature individually, but together with their friends and fellows.	○

● main focus ◕ strong focus ◑ medium focus ◔ minor focus ○ no focus

4.4.2.2 User Interface and Interaction

The system's UI is divided into five basic screens that guide the user through the scanning process. A starting screen (cf. Figure 4.21, left) provides the customer with a preview of the camera data. It allows the operator to choose between scanning a male or a female person. This selection is particularly important for optimizing the scanning results and thus for creating a more realistic avatar.

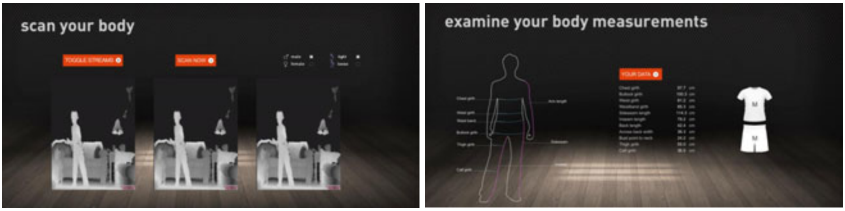


Figure 4.21 – Low-Cost Body Scanner: Scanning and Size Table

The scan button starts the process that triggers the cameras and automatically creates and measures the digital avatar. Thereafter, the customer is lead to his/her personal sizing table that provides information about eleven important measures required for size recommendations (cf. Figure 4.21, right). A schematic visualization of the garments shows the size codes computed and adjusted to the brand's size run and in relation to the garment's pattern.

Another screen (cf. Figure 4.22) allows the customer to dress his/her avatar. It corresponds to the user's body shape and can be turned 360 degrees. In order to avoid potential disappointments due to a bad recognition of skin color and hair (e.g., caused by the current technical setup), an abstract and normalized visualization in form of a blue mannequin body is chosen. This also avoids potential shame that may be caused through a naked representation of the customer's body. It is possible to toggle between male and female garments and to select combinations to dress the avatar. The visualization allows an assessment of the fit based on the garment's physical drape on the body. Next to the correct garment size which is calculated by the software, also other sizes can be used to dress the digital body. This allows to visually compare the fit of different sizes.

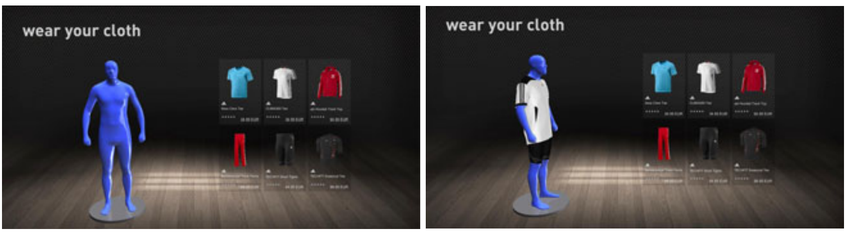


Figure 4.22 – Low-Cost Body Scanner: Avatar Dressing

The final option allows exporting and saving the captured avatar for future use (cf. Figure 4.23). Also files from previous sessions can be imported and used for visualizing measurement tables and outfit combinations.

Figure 4.23 – Low-Cost Body Scanner: Avatar Export

4.4.2.3 Service Delivery System

The service delivery system and its algorithms are the core of the SST to be created. The concept proposed uses cheap depth sensors (e.g., the Microsoft Kinect® game controller) that are able to measure the distance of each captured pixel towards the device. For that purpose the device projects a known pattern of infrared dots into the scene which is then recorded by a built-in depth camera. Based on the deformation of that pattern, the sensor calculates the depth of each of the points (approximately 10.000 to 20.000, extrapolated to all 640x480 pixels). This structured light method makes it possible to create a point cloud and to extract the geometry of the scene [Valkenburg and McIvor 1998, pp. 99-110; Silberman and Fergus 2011, pp. 601-608]. As the sensor only offers a limited resolution it cannot easily generate a high quality 3D model. Figure 4.24 illustrates the depth information extracted by a single sensor (left: including color information, right: raw point cloud). [Zagel and Süßmuth 2013a, pp. 554-555]

Figure 4.24 – Low-Cost Body Scanner: Depth Information
adapted from [Zagel and Süßmuth 2013a, p. 555]

New algorithms are required to consolidate and to process the data acquired through the depth cameras. In the given setup, they are used to match a predefined statistical model of the human body to the body shape of the scanned person. In another step, this approach allows the automatic transfer of semantic information to the digital avatar generated and consequently also its measurement [Zagel and Süßmuth 2013a, p. 552]. Therefore, an advanced version of the algorithm presented by Zollhöfer et al. [2011, pp. 195-202] is applied to generate a high quality body model. Initially used for the reconstruction of face scans based on Kinect sensor data, the algorithm is extended to handle entire human bodies [Zagel and Süßmuth 2013a, pp. 551-564]. The basic idea of the process is to match a generic human body to the depth data acquired (cf. Figure 4.25). As the statistical model only allows plausible body shapes, potential artifacts like noise or quantisation effects [Süßmuth 2012, pp. 12-15] of the depth data can be compensated.

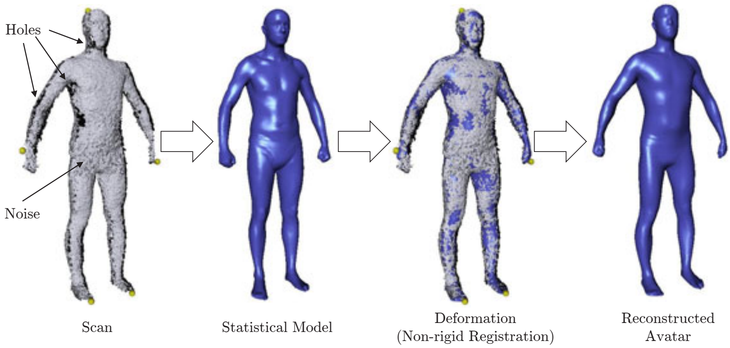


Figure 4.25 – Low-Cost Body Scanner: Avatar Reconstruction

Reconstructing a digital avatar follows three steps (cf. Figure 4.26). Multiple images from different points of view of the still standing person are captured and merged into a common point cloud. Elements in the background and the environment surrounding the person are removed. Non-rigid registration[4] is used to deform the statistical model in order to match the pose and the shape of the scanned person. The goal is an optimal approximation of the given point cloud. This step also allows closing gaps (e.g., under the arms) and eliminating noise and artifacts. Predefined landmarks on the statistical model are transferred to the registered avatar and allow the automatic measurement of the model created. [Zagel and Süßmuth 2014, p. 8]

[4]Süßmuth [2012, pp. 119-136] provides an essay about non-rigid registration of polygonal models.

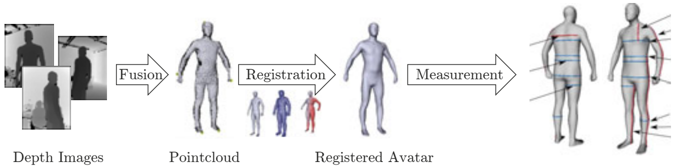


Figure 4.26 – Low-Cost Body Scanner: Avatar Creation and Measurement adapted from Zagel and Süßmuth [2014, pp. 7-10]

Based on these measurements, the system is able to derive garment size recommendations. A physics engine allows the simulation of digital garments on the virtual body and is able to visualize garment fit in respect to the given body shape. Ultimately, the service delivery system consists of the following core components:

- **Calibration Engine:** The system presented uses multiple depth sensors to capture a single object and to create a point cloud. In order to arrange the captured segments accordingly, a calibration needs to be done. As a result, the individual parts of the scene are merged into a common point cloud under consideration of the cameras positions towards the captured object.

- **Statistical Model:** For reducing artifacts and to transfer semantic information to the avatar created, a statistical model of the human body is applied. It represents the variations of plausible human body shapes as well as the full range of possible linear combinations. The solution uses an extended algorithm of the system presented by Zollhöfer et al. [2011, pp. 195-202].

- **Scanning Application:** All features are combined in one common application. The software provides an attractive UI through which the complete process is handled. It is used to compare the body measurements with garment sizing tables in order to provide the consumer with recommendations. An integrated feature allows printing the results.

- **Simulation Engine:** Besides measuring the avatar on predefined positions, the system also allows to virtually dress the digital body with garments of different sizes. For this purpose, a physical simulation based on the NVIDIA PhysX[5] engine is used. It calculates the drape of the garment based on the material characteristics and the body's proportions (cf. Figure 4.27, left). A heatmap functionality allows

[5] cf. https://developer.nvidia.com/physx-sdk

to indicate garment fit: tight areas are displayed in red, lose areas in green color (cf. Figure 4.27, right). [Zagel and Süßmuth 2013b, p. 556; Zagel and Süßmuth 2014, p. 8]

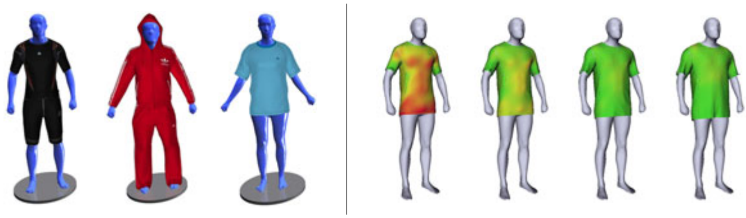


Figure 4.27 – Low-Cost Body Scanner: Garment Simulation and Fit Visualization adapted from Zagel and Süßmuth [2014, pp. 7-10]

4.4.2.4 Technical Setup

One of the core advantages of the presented body scanner is its simple hardware setup. It uses a standard computer as well as an array of low-cost depth cameras built into a custom-made housing (cf. Figure 4.28). The pillars are arranged around the person to be scanned (in approximately one meter distance) and allow capturing humans of up to two meters height [Zagel and Süßmuth 2014, p. 8]. Any display can be used to visualize the scanning results.

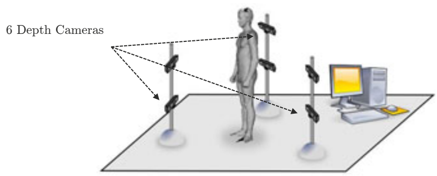


Figure 4.28 – Low-Cost Body Scanner: Prototype Setup adapted from [Zagel and Süßmuth 2014, p. 8]

- **Calibration Device:** As described before it is required to calibrate the cameras to the given setup. The calibration engine uses a reference object with known proportions and dimensions. For this purpose, a detachable, three-sided body, carrying a checkered pattern is used (cf. Figure 4.29). In total, six checkerboards provide the visual reference for the six cameras.

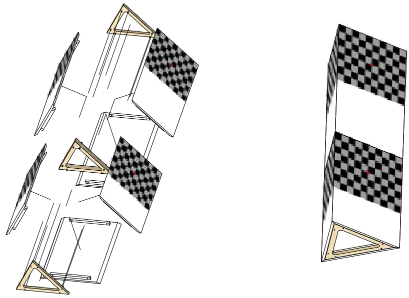


Figure 4.29 – Low-Cost Body Scanner: Calibration Object

- **Cameras:** An array of ASUS Xtion Pro motion sensing depth cameras is employed to capture the human body. The cameras support a depth image resolution of 640x480 pixels (extrapolated) at 30 frames per second and are constructed for use on x86 platforms. Next to a depth sensor, the device also contains a color camera. As an alternative, any other depth camera (e.g., the Microsoft Kinect® game controller) can be used.

- **Pillars:** A custom housing is built to carry the cameras and to ensure a consistent height and alignment of the devices. In total, the system consists of three pillars, each carrying two of the cameras. Mounting the sensors in a horizontal orientation rotates the aspect ratio which facilitates a better utilization of the limited resolution (cf. Figure 4.30). A baseplate allows to fix the pillars on the floor.

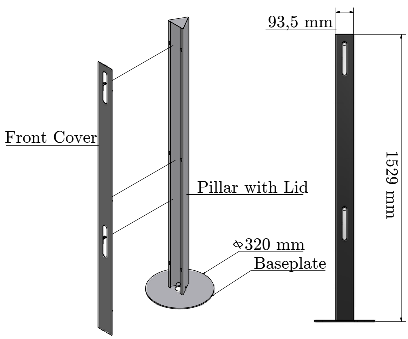


Figure 4.30 – Low-Cost Body Scanner: Pillar

- **Computer:** For calculating the avatars a standard personal computer with Intel Core i7 3.4Ghz, 16GB RAM, 128GB Solid State Disk and NVidia GeForce 560 GTX with 2GB memory is used. Each of the cameras requires its own USB controller. In the presented setup, a 22" LCD display is used to visualize the results.

4.4.3 Implementation

The SST is realized as a fully functional prototype. With total costs of approximately 2.000 Euros, the system represents a cheap solution compared to commercial scanners [Zagel and Süßmuth 2014, p. 8]. All components are fully portable, which allows a mobile operation in addition to fixed installations. Installing the device at a new location only takes twenty minutes. Because of its minimized distance towards the scanned person, the SST requires approximately four square meters of space. The complete scanning process, from capturing the customer to creating and measuring the digital avatar, takes less than ten seconds. In order to achieve the best results, scanning needs to happen in underwear or tight scanning clothes (cf. Figure 4.31). For being able to efficiently match the statistical model to the customers pose, a defined posture needs to be taken.

Figure 4.31 – Low-Cost Body Scanner: Prototype

Figure 4.32 illustrates four examples of captured bodies and their reconstructed avatars. As the SST's intention is to deliver utilitarian value to the consumer by providing an automatic measurement functionality, the accuracy of the system is an essential criterion. In order to get insight into the accuracy of the system and consequently its objective utilitarian value, a scan result comparison is conducted using objects of known size. This comparison is done engaging the criteria "precision" and "accuracy".

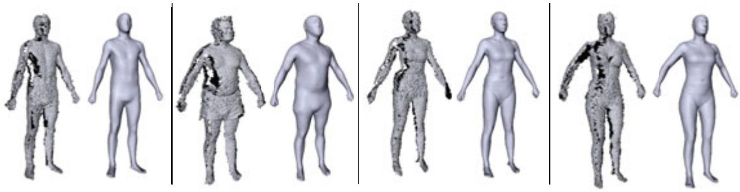


Figure 4.32 – Low-Cost Body Scanner: Examples of Scanning Results

While precision defines how well the results can be reproduced across multiple scanning iterations under identical conditions, accuracy determines the correctness of the measurements (e.g., true physical measurements vs. scanned and calculated measurements). Within a standard measurement assessment of humans, the given setup is subject of variances: scanned people for example vary in their posture or breast circumference through breathing. [Zagel and Süßmuth 2014, p. 9]

For achieving trustworthy measurements along a series of iterations, different dummies with distinct known proportions (manufacturer's production data) and sizes are used for the experiment. These dummies represent men (sizes 42, 50, 54, 58, and 66), women (sizes 36 and 38), as well as kids (sizes 170 and 176). Multiple scans are conducted with each dummy. The results are then gauged on five prominent measuring points (breast, waist, hip, tigh, calf). In total, 99 scans are used to evaluate the system's precision and accuracy. With circumference variations (standard deviations) of $\pm 3.5mm$ (breast), $\pm 1.7mm$ (tigh), $\pm 7.2mm$ (hip), $\pm 3.3mm$ (tigh), and $\pm 5.5mm$ (calf), the results indicate a high precision with variances between 0.3% and 2.0% of the true circumference measurements. [Zagel and Süßmuth 2014, pp. 9-10]

The accuracy of the proposed technology heavily depends on how well the scanned body shape can be reproduced using the statistical model. This is also reflected in the outcome of the results comparison depicted in Table 4.13.

Table 4.13 – Low-Cost Bodyscanner: Accuracy adapted from Zagel and Süßmuth [2014, p. 10]

	Breast	*Waist*	*Hip*	*Tigh*	*Calf*
M42	6.85	11.18	19.16	0.05	14.74
M50	6.08	3.09	11,71	6.58	8.35
M54	1.14	10.80	7.32	15.78	21.66
M58	1.67	13.82	8.32	25.22	17.69
M66	10.26	55.16	3.45	16.98	24.24
F36	2.82	4.24	21.83	5.60	9.90
F38	1.49	26.17	8.71	28.74	16.49
K170	12.03	15.11	22.18	12.40	13.10
K176	0.83	16.89	12.29	4.99	0.00

Average deviations in millimeters

The results show that most variables (especially breast and hip circumference) are captured quite accurately with an average error of less than 10mm. Nevertheless, especially the results for overweight subjects lack in accuracy above average. This circumstance can be attributed to the dynamically defined measurement positions on the statistical model, that do not conclusively correspond to the measurement positions used by the dummy manufacturer. A comparison with a professional body scanner (using the example of a system offered by the Human Solutions GmbH[6]) reveals an aberration of 0.6% at the most. If compared with historical results (variation coefficients) of manually taken body measurements [Davenport et al. 1934, pp. 265-284], the system shows a comparable accuracy. [Zagel and Süßmuth 2014, p. 10]

4.4.4 Evaluation

4.4.4.1 Overview

Next to the precision and accuracy assessment, the SST is evaluated using the service fascination research model (cf. Chapter 3.3). The study takes place in a laboratory environment and is performed amongst students recruited at the university campus. For reproducing a realistic scanning process, the subjects are scanned either in underwear, swimwear or in tight fitting sportswear. Out of a total of 244 students approached, 104 (50 female, 54 male, aged between 18 and 36) agree to take part in the study. The

[6] cf. http://www.human-solutions.com/

most frequently mentioned reason for declining a participation is the need for undressing. 70.2% of the participants refer to the potential utilitarian value as the main reason for participating in the study, only 2.1% name fun. All of the other subjects report curiosity as the main argument. All participants are provided with a printout of their personal measurements after the assessment. Table 4.14 depicts the sample demographics.

Table 4.14 – Low-Cost Bodyscanner: Overview and Sample Demographics

System Status	Prototype, laboratory experiment	
Location	University, Nuremberg, Germany	
Timeframe	16.01.2014 - 30.05.2014	
Samples	Female	50 (48.1%)
	Male	54 (51.9%)
	Total	104
Age	Minimum	18
	Maximum	36
	Median	23
	Average	23.47 (SD=3.63)
Participants	Students, recruited at the university	

4.4.4.2 Subjective Measurement

4.4.4.2.1 Overall Model

As part of the subjective measurement, the structural model is evaluated using Smart-PLS 2.0 [Ringle et al. 2005], applying 104 cases at 5000 samples (cf. Figure 4.33). All measures determining the reflective measurement model's goodness are found to meet the requirements of the proposed thresholds (cf. Chapter 3.3.2.2.2). Also the Cronbach's α values of all constructs exceed the value of 0.7 [Nunnally 1978, pp. 245-246].

As part of the assessment of the formative measurement model, the indicator weights of the sensory (0.2332) and the social (0.8369) dimension do not reach the threshold of 1.65. Nevertheless, both dimensions show high significance in their loadings towards the formative construct. All experiential dimensions feature a VIF of less than 1.5.

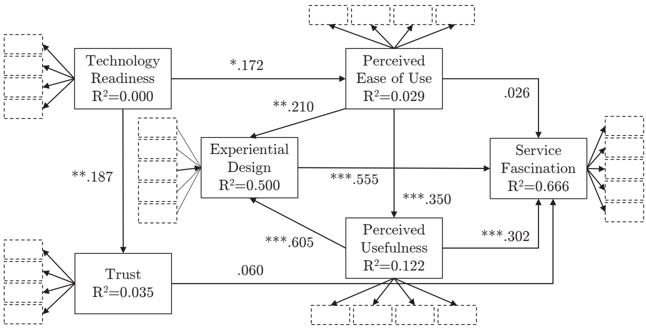


Figure 4.33 – Low-Cost Body Scanner: Evaluation Results (Causal Model)

The assessment on a structural model level is conducted using the criteria derived before (cf. Chapter 3.3.2.2.2). Despite H_3 and H_7, all hypothesized relationships can be confirmed (cf. Table 4.15). The high significance of H_4 corresponds to the findings within research of the traditional TAM [Davis 1989, pp. 319-340].

Table 4.15 – Low-Cost Body Scanner: Hypotheses

	Hypothesis	*Path Coeff.*	*T-value*	f^2
H_1	Technology Readiness → PEOU	0.1717	1.7605	0.030
H_2	Technology Readiness → Trust	0.1873	2.0528	0.037
H_3	Trust → Service Fascination	0.0596	1.3023	0.012
H_4	PEOU → PU	0.3496	4.2435	0.139
H_5	PEOU → Experiential Design	0.2105	2.1730	0.074
H_6	PU → Experiential Design	0.6052	8.0110	0.628
H_7	PEOU → Service Fascination	0.0257	0.5956	0.003
H_8	PU → Service Fascination	0.3025	3.2643	0.141
H_9	Experiential Design → Service Fascination	0.5550	5.9059	0.437

PU = Perceived Usefulness; PEOU = Perceived Ease of Use

$t \geq 1.65$ sig. level = 10%; $t \geq 1.96$ sig. level = 5%; $t \geq 2.58$ sig. level = 1%

$f^2 \geq 0.02$ "weak"; $f^2 \geq 0.15$ "medium"; $f^2 \geq 0.35$ "strong"

The f^2 effect sizes reflect the influence of the exogenous variables. Both PU and experiential design have a strong effect towards the target construct service fascination.

R^2 values of 0.500 (experiential design) and 0.666 (service fascination) argue for a medium to strong ability of the model to explain the two major endogenous target constructs. All other constructs feature rather small coefficients of determination, which indicates that these variables are also influenced by further effects.

The subjective data show that the system in general is perceived as attractive, useful, and easy to use (cf. Figure 4.34). While on an experiential level the affective, cognitive, and behavioral dimensions are rated equally and slightly positive, the social and especially the sensory component are not that well perceived. Particularly the social dimension shows a high variation. All subjects consider themselves as technology savvy. The system is perceived as being very easy to use. Interestingly, and even though the SST evaluated uses and stores personal user information and health-related data (body size and a three dimensional picture of the subject in underwear), trust is rated on an indifferent, slightly positive ($\overline{x} = 4.50$) level, but with a high variation of 1.86 points.

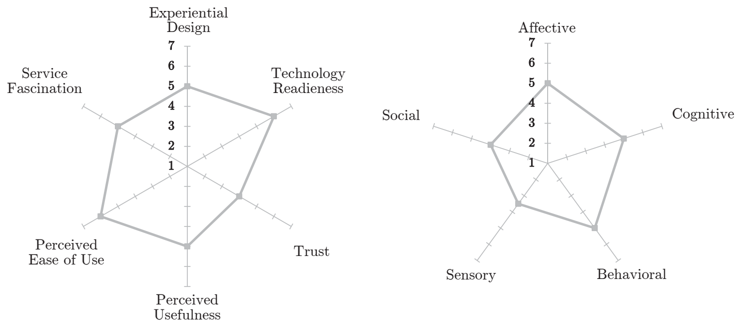


Figure 4.34 – Low-Cost Body Scanner: Evaluation Results

Even though the system's intention is to serve a utilitarian need, the perceived usefulness is only slightly rated positive. As a final quality criterion for the structural model, Stone Geisser's Q^2 exceeds the critical value of 0. It furthermore confirms a strong predictive relevance for the service fascination construct. Table 4.16 provides a detailed overview of the data gathered.

Table 4.16 – Low-Cost Body Scanner: Evaluation Results

	Dimension	α	*Md*	$\overline{x}$	*SD*	R^2	Q^2
Service Fascination	Perceived Usefulness	0.935	5	5.00	1.13	0.122	0.1004
	Perceived Ease of Use	0.855	6	6.13	0.96	0.029	0.0200
	Trust	0.940	4	4.50	1.86	0.035	0.0256
	Technology Readiness	0.853	6	5.54	1.40	0.000	—
	Service Fascination	0.903	5	5.44	1.48	0.666	0.4652
	Experiential Design	—	5	4.56	1.10	0.500	—
Experiential Design	Affective	0.764	5	4.95	1.18	—	—
	Cognitive	0.767	5	5.39	0.92	—	—
	Behavioral	0.839	5	5.11	1.25	—	—
	Sensory	0.756	3.5	3.27	1.32	—	—
	Social	0.807	4	3.50	1.40	—	—

α = Cronbach's Alpha; Md = Median; $\overline{x}$ = Mean; SD = Standard Deviation; Q^2 = Stone Geisser's Q^2

$R^2 \geq 0.67$ "strong"; $R^2 \geq 0.33$ "medium"; $R^2 \geq 0.19$ "weak"

$Q^2 \geq 0.35$ "strong"; $Q^2 \geq 0.15$ "medium"; $Q^2 \geq 0.02$ "weak"

4.4.4.2.2 Gender Splitup

Differentiating the subjective perception of the low-cost body scanner between male and female subjects provides insight on possible interdependencies (cf. Figure 4.35). Compared to men, women perceive themselves as significantly less technology ready, while expressing a slightly higher level of trust.

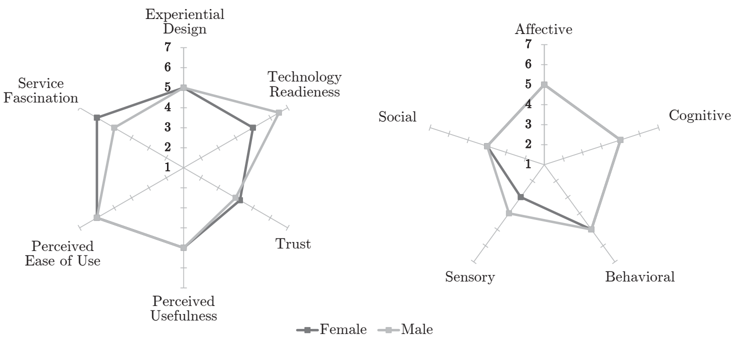


Figure 4.35 – Low-Cost Body Scanner: Evaluation Results (Gender Splitup)

Even though the experiential results only differ in the perception of the sensory dimension (rated better by men), the overall service fascination criterion receives a slightly more positive rating by women (cf. Table 4.17). Overall, and despite of the technology readiness dimension, all differences are non significant. Small effect sizes occur only in the cognitive as well as the sensory perception of the system, pleading for an almost heterogeneous perception by both genders.

Table 4.17 – Low-Cost Body Scanner: Evaluation Results (Gender Splitup)

		Females (N=50)			*Males (N=54)*				
	Dimension	*Md*	$\overline{x}$	*SD*	*Md*	$\overline{x}$	*SD*	*p*	*d*
Service Fascination	Perceived Usefulness	5	4.99	1.08	5	5.00	1.19	0.964	0.009
	Perceived Ease of Use	6	6.09	0.99	6	6.18	0.95	0.652	0.093
	Trust	4.25	4.54	1.97	4	4.46	1.77	0.834	0.043
	Technology Readiness	5	4.86	1.49	6.5	6.17	0.95	0.000	1.057
	Service Fascination	6	5.54	1.03	5	5.35	1.25	0.406	0.165
	Experiential Design	5	4.49	1.21	5	4.62	1.00	0.549	0.118
Experiential Design	Affective	5	5.00	1.26	5	4.91	1.10	0.691	0.076
	Cognitive	5	5.28	1.01	5	5.50	0.82	0.224	0.240
	Behavioral	5	5.04	1.29	5	5.18	1.22	0.582	0.112
	Sensory	3	3.02	1.25	4	3.50	1.34	0.063	0.370
	Social	4	3.60	1.42	4	3.42	1.39	0.507	0.139

Md = Median; $\overline{x}$ = Mean; SD = Standard Deviation; p = Significance; d = Effect Size

$p \leq 0.05$ sign. level = 5% - $d \geq 0.2$ "small"; $d \geq 0.5$ "medium"; $d \geq 0.8$ "large"

4.4.4.3 Objective Measurement

The objective measurement is conducted as part of the experiment. After a short introduction, the subjects are observed while interacting with the system. Table 4.18 provides insight on the observed behavior and feedback provided before, during, and after the assessment.

Table 4.18 – Low-Cost Body Scanner: Observed Behavior

Basic Dimensions
The system's usefulness is confirmed by almost all persons and perceived as very positive. This especially applies if the value of the data and the resulting possibilities are fully understood.
Overall, the functionality of the system is perceived as highly desirable and practicable.
Age does not seem to influence the value perception.
The heatmap functionality is perceived as valuable, especially for doing quick preselections of garments.
Many participants want to have the possibility of using this kind of service in a retail store.
All persons are surprised by the easy and quick scanning process.
Parents see value in using the system for buying garments for their children. Using a kid's 3D avatar for trying on garments would avoid impatience during shopping.
In some cases the scanning process results in a distorted avatar, e.g., because the person moves or is not correctly positioned. The result is then regarded as "disgusting".
Both usage types are well perceived: being able to individually use the system, or getting assisted by store staff.
Especially the visualization of complete garment outfits instead of single products is perceived as a benefit.
Persons miss auditory feedback on the completion of the scanning process. Most of them keep standing still even when the scan is already completed.
Rejection Dimensions
Some of the subjects fear health damage caused through the scanning process. They believe for example that the system works with radiation technologies.
A minor part of the subjects fears that the system is able to see them naked, comparable to the scanners operated at airports.
Customers that are not satisfied with their body avoid a further/repeated application the system.
Almost no participant is afraid of storing personal avatars or measurement data, especially due to the potential for additional use cases.
The majority of the subjects believes in the results of the scanning process.
The observation does not disclose usage barriers of non technology ready users.

The table is continued on the next page

Experiential Dimensions
The persons have fun using the system and enjoy exploring its features.
Users are fascinated by the functionality of the system.
Participants would rather like to be scanned in underwear instead of naked. Here, they would accept worse measurements. Nevertheless, some customers prefer getting scanned wearing tight clothes.
Users are amazed of the system's accuracy and functionality.
Especially women tend to use the system in groups. Men prefer to use it alone.
The visualization of the avatar in form of an abstract (blue) body does not negatively influence the overall perception of the system.
Nevertheless, users ask for a more natural and realistic representation of their body, e.g., skin color and hair.
Subjects would like to see their dressed body in real-life size.
The majority of customers think that having their body scanned will make them purchase more. Hence, the service influences their shopping behavior.
General Behavior
Especially with lifestyle garments some customers buy apparel in wrong sizes in order to express their own style.
Women are highly interested in their body measurements.
Customers would also like to use the system or at least the measurement results at home, e.g., for online shopping.
Repeated and regular use of the system is considered especially for extended time intervals (e.g., in case the body shape changed).
Many customers would like to use their avatar for different purposes, e.g., for integrating them into video games or fitness applications.
Made to measure is seen as a highly attractive use case next to general size recommendation.
Many participants state that the service would differentiate the company from others and that this fact could even change their brand preferences if the service is offered exclusively.

The results obtained reveal insights that are not captured by the subjective assessment. Especially the utilitarian value of the SST is perceived more positive than reported through the survey. All of the persons are surprised by the easy, quick, and accurate scanning process. The possibility to combine outfits on the avatar and to illustrate garment fit is perceived a valuable feature. While almost no negative comments are given regarding the visual representation of the avatar, users express the wish to have a more realistic representation of their bodies. The observation shows that for women the process of using the system is more social if compared to men as they tend to interact in groups. Interestingly, no user mentions an issue with storing the personal body and measurement information.

4.4.4.4 Summary

Combining the results of the service fascination assessment allows deriving potentials for improvements. Differences in perception amongst genders are insignificant. In contrast to the results gathered through subjective assessment showing no difference between male and female users, observations reveal that females tend to use the SST in groups. This argues for a certain social effect of the interaction process. Independent of gender, the perceived functional value of the service is higher than subjectively reported. All subjects are satisfied with their measurement data and impressed by the functionality provided. This also reflects in suggestions for a home version and further use cases besides garment shopping.

Nevertheless, the system misses hedonic value. This may be attributed to the visual representation of the captured avatar. Due to the small display, users have the impression of interacting within an online shopping environment. Even though the abstract avatar barely receives negative comments, customers wish to have a more realistic representation of themselves, including hair and skin color.

4.4.5 Improvement

While providing a better in-store experience by showing the scan results on a larger visual output is a rather easy task, the creation of more realistic avatars requires certain software adjustments. Many depth cameras also include a standard RGB camera that allows merging color information with the captured point cloud data [Zollhöfer et al. 2011, pp. 195-202]. This texture assignment can be used to enhance the avatar e.g., with skin color. Figure 4.36 shows a recorded color image and its depth scan, as well as a reconstructed face with and without texture information.

Figure 4.36 – Low-Cost Body Scanner: Avatar Enhancement adapted from Zollhöfer et al. [2011, p. 198]

The positive effects of avatar realism are also mentioned by Suh et al. [2011, p. 711], who state "that the more closely an avatar resembles its user, the more the user is likely to have positive attitudes (e.g., affection, connection, and passion) toward the avatar, and the better [he is] able to evaluate the quality and performance of apparel products". A possible extension of the system is to use it in an online shopping context at home. This option would allow users to do a size assessment before ordering a product and therefore to avoid returns. Next to an enhancement of the online shopping experience this process could lead to a decrease in customer frustration and to cost reductions for the company [Zagel and Süßmuth 2013a, p. 552].

Nevertheless, an application at home is subject to certain restrictions: a hardware setup as described above is not feasible. However, depth cameras (e.g., in form of game controllers like the Microsoft Kinect®) make their way into the customers home. As usually only single devices are present, the system needs to be adapted to the new conditions. Figure 4.37 illustrates a possible home setup and the respective application using the customer's home television. Instead of using a dedicated personal computer, the software application may also be implemented as an application on the gaming console or integrated into the vendor's online store.

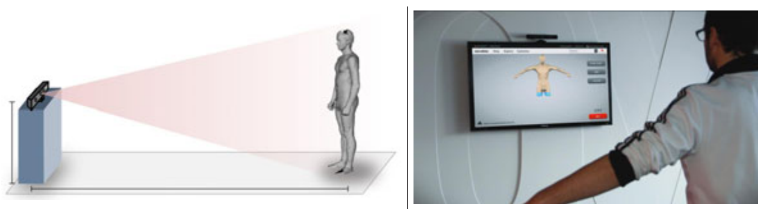


Figure 4.37 – Low-Cost Body Scanner: Home Use Setup adapted from Zagel and Süßmuth [2013a, p. 557]

As a single camera is used, the system is only able to capture the front of the customer's body with a single shot. While it would also be possible to use multiple shots of a rotating person a single shot setup allows the reduction of user interaction to a minimum which leads to an improvement of usability. Comparable to the retail version of the low-cost body scanner, a statistical model is applied. It is not only used to eliminate noise and artifacts, but also to reconstruct the back of the body (cf. Figure 4.38). Following the process proposed by Zollhöfer et al. [2011, pp. 195-202], three steps are required to assemble the human's body. The posture of the customer detected through skeleton recognition is used to adjust the pose of the generic avatar. Non-rigid registration is then applied to fit the statistic model to the geometric depth card captured, minimizing the distance between both elements. Missing information on the rear side of the user does not allow a correct reconstruction, leading to an overestimation of the back. Therefore, the final step projects the registered avatar into a space of plausible body shapes. The result is a reconstruction of the likeliest backside for the given front. [Zagel and Süßmuth 2013a, pp. 558-559]

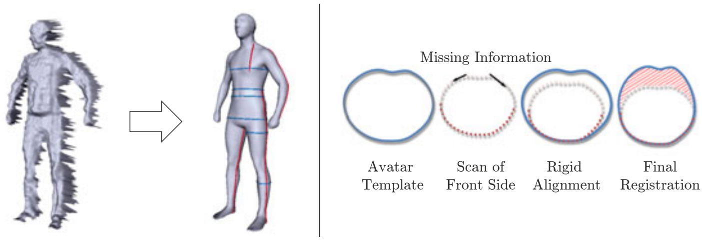


Figure 4.38 – Low-Cost Body Scanner: Home Use, Backside Reconstruction adapted from Zagel and Süßmuth [2013a, p. 558]

A similar method can be used to realize a functionality that allows the reconstruction of naked avatars from users scanned in loose clothes (cf. Figure 4.39). However, missing information on the real body will result in a lack of measurement accuracy.

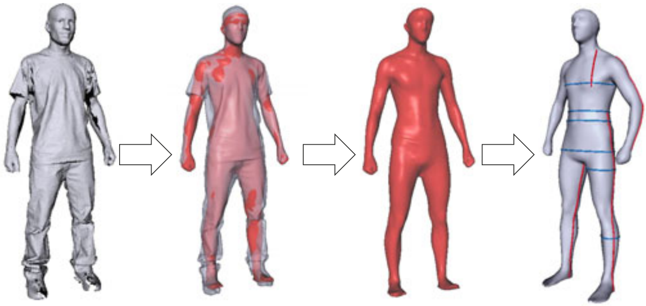


Figure 4.39 – Low-Cost Body Scanner: Garment Removal
adapted from Zagel and Süßmuth [2014, pp. 7-10]

Zagel and Süßmuth [2013b, pp. 48-57] provide a detailed overview about further use cases for digital avatars created from low-cost body scanners. Next to supporting the consumer in shopping for garments, fitness and healthcare represent promising fields of application.

4.5 Product Experience Wall

4.5.1 Motivation and Goal

The in-store experience is mainly characterized by a strong focus on delivering a balance of inspiration and information about products and services. It is therefore not only a result of a generally appealing store design and atmosphere, but particularly of how well products and services are presented and marketed.

"The shopping context is an area where a wide range of persuasive approaches traditionally plays an important role in order to influence customers' shopping behavior" [Reitberger et al. 2009, p. 1]. Especially in relation to fashion stores the authors ascribe mannequins situated in the store a special role and specific importance. They are used to present the latest outfits, to draw attention, and finally to guide the customer into the store and to the presented items. In their research, Anitha and Selvaraj [2010, pp. 641-647] identify that the presentation of garments on mannequins positively influences the customer's purchase decision making. Not only are mannequins well suited for illustrating how garments can be worn, they are furthermore identified to provide customers a better overall visualization of the garment and to save time while shopping. Interestingly, as customers "can envision themselves in outfits worn by mannequins" [Anitha and Selvaraj

2010, p. 646], this way of presenting products is perceived a well suited option to gain fashion ideas, sometimes even better suited than a personal trial of the product. By including mannequins as the "ultimate malleable vehicle of display" in garment store design, retailers "blur the line between fantasy and reality", hence, invoking desire, curiosity, and positive emotions through touching the senses [Klug 2009, p. 201]. Nevertheless, and as store space is a limiting factor, not all garments can be displayed on mannequins.

On the other hand, customers desire to be supported in their shopping process by friendly store employees. Nevertheless, store assistants should "not interfere in the customer's shopping experience, unless asked" [Brengman and Willems 2009, p. 349]. The importance of friendly and knowledgeable staff is also proved in further studies [Birtwistle et al. 1999, pp. 1-16; Britwistle and Shearer 2001, pp. 9-18; Terblanche and Boshoff 2006, pp. 33-43]. But especially in the fast fashion retail industry it can be observed that store staff often lacks knowledge about the garments and their specific location in the store [Barnes and Lea-Greenwood 2010, pp. 760-772].

In order to validate these needs and issues reported through predominant literature, two qualitative studies are conducted between August 2013 and February 2014 with specific focus on the inspirational and informational aspects of the in-store experience. In the first study [Lu 2013, pp. 24-29], 12 semi-structured, qualitative interviews are conducted amongst potential customers aged between 23 and 32 (7 female, 5 male). The second study [Rösler 2014, pp. 57-68] leverages findings of the first evaluation and is executed in form of three focus group discussions, each with 10 subjects (aged between 15 and 17). The studies confirm the needs of the focus group addressed in literature. With a specific focus on the digital generation the following aspects are derived: Store staff should not annoy the customers and interact with them like they were their friends. Especially for young customers, inspiration is essential. For this purpose, mannequins are considered a very important element. They should be pretty and realistic (e.g., with hair and faces). As customers want to identify with the mannequins, they should also represent the respective focus group. Customers moreover are interested in shopping for outfit combinations due to personal product matching issues and for being inspired through new styles. They express a strong desire to receive product information in order to make better purchase decisions. Nevertheless, all of the subjects currently miss innovative elements in their in-store garment shopping experience. The goal of this concept is to support the aspects mentioned by introducing an innovative SST that serves both purposes: to inspire and to inform the customers during their shopping process.

4.5.2 Ideation

4.5.2.1 Service Concept

This chapter presents the concept and prototype of an interactive and context-adaptive outfit recommendation system, the product experience wall[7]. The intention of the SST is not only to implement a new way of inspiring consumers by transferring the idea of traditional store mannequins to a digital level, it also needs to support purchase decision making by offering detailed product information. An attractive system design and the application of innovative HCI methods furthermore allow to address the hedonic aspects (cf. Figure 4.40).

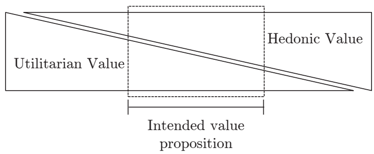


Figure 4.40 – Product Experience Wall: Utilitarian vs. Hedonic Value

Already in 1991 Weisner [1991, p. 104] states that technologies should "fit the human environment instead of forcing humans to enter theirs". One engineering methodology to realize this human-oriented behavior of systems is context-adaptivity, which forms the core of the concept presented [Zagel 2014b, pp. 367-370]. As part of HCI research in the area of pervasive computing, the methodology is described as a system's ability to autonomously adapt to given situations it is used in [Soylu et al. 2009, pp. 992-993]. The system therefore requires knowledge about its environment (context) in order to react in the desired way. Dey [2001, p. 5] defines context as "any information that can be used to characterise the situation of an entity. An entity is a person, place, or object that is considered relevant to the interaction between a user and an application, including the user and applications themselves". This knowledge is derived through a number of sensor technologies applied in the prototype presented (cf. Figure 4.41). The context is then used "to provide relevant information and/or services to the user, where relevancy depends on the user's task" [Dey 2001, p. 5].

[7]Parts of this are published in Zagel [2014b, pp. 367-370] and Zagel et al. [2014a].

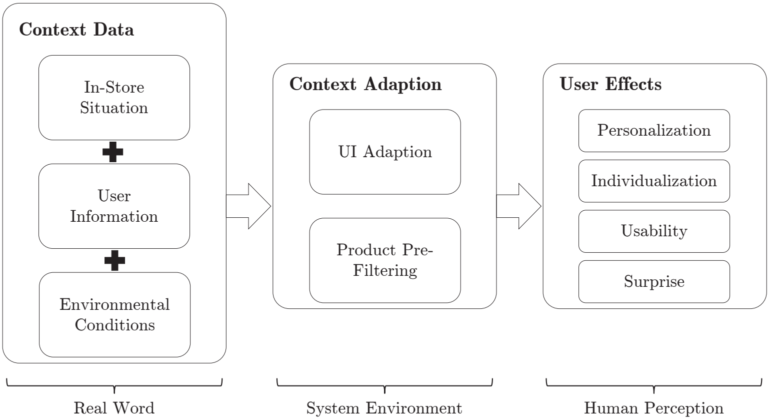


Figure 4.41 – Product Experience Wall: Service Concept adapted from Zagel [2014b, pp. 367-370]

In the concept presented context-adaptivity is realized by applying knowledge from three different data sources. The in-store situation and the user's context are analyzed by automatically detecting products taken in front of the system. Information about the user himself is gathered through a face detection technology that is able to derive gender and age of the users. As a third component, current environmental conditions (e.g., weather data) are deployed. This real world information serves as a basis for the respective adaption of the system's UI and features. As a result, the service system automatically pre-filters the products presented (based on gender, age, or weather), adapts the UI (e.g., showing rain as a background image), or adjusts the way of how the customer is approached. The system needs to then serve as a SST that allows browsing through articles and creating outfits on digital life-size avatars. A social share functionality enables the customers to push the outfits to favorite social networks.

Table 4.19 presents how the basic and rejection criteria (cf. Chapter 3.3.2.4) are fulfilled within the concept presented. Special value is set on the provision of extensive product information and the ability to inspire consumers by visualizing complete outfits on digital mannequins.

Table 4.19 – Product Experience Wall: Basic Design Elements

Dimension	*Realization*
Perceived Usefulness	A solution is created that provides the consumers a better impression of the design and fit of not only single garments but complete outfits. The system also acts as a digital shop assistant, supporting the user with product and technology information as well as personalized offers. It furthermore provides information about where in the store the products can be found. A news ticker announces new products and provides the customer with information related to lifestyle and further topics.
Perceived Ease of Use	All interfaces follow the guidelines of DIN EN ISO 9241 (particularly DIN Deutsches Institut fuer Normung e.V. [1999], DIN Deutsches Institut fuer Normung e.V. [2008a], and DIN Deutsches Institut fuer Normung e.V. [2011a]) and are designed in an easy to use way. Large buttons are used to visualize interaction possibilities. The system uses a face detection technology to pre-filter the contents presented based on gender and age detected.
Trust	Personal consumer information is only used if the user wants to receive personalized offers. Nevertheless, the face detection technology may be seen as a risk.
Technology Readiness	The system can be used without prior knowledge. Applying a life-size virtual avatar provides the impression of interacting with a human instead of a computer. This is furthermore supported by the system-initiated interaction process.

The functionality of the product experience wall is oriented on the customer's in-store shopping behavior. It needs to serve as a persuasive tool that increases the amount of garments and outfits presented by transferring the concept of traditional mannequins to a digital version. Through new ways of showcasing the contents and by applying an innovative interaction component the system also focuses on the hedonic elements, appealing to the affective dimension. Table 4.20 provides an overview about how the intended experiential focus is transferred into the respective dimensions. It is expected that in the given use case the dimensions will predominantly have subconscious effects, e.g., resulting from context adaptivity and by using digital life-size avatars.

Table 4.20 – Product Experience Wall: Experiential Design Elements

Dimension	*Realization*	*Focus*
Affective	A large video wall offers the possibility to display virtual human avatars in real-life size. A natural way of interaction creates a state of immersion and a positive feeling towards the service. Various virtual backgrounds emotionally connect the consumer with the selected product.	◕
Cognitive	The concept focuses on the visualization of complete outfits instead of single products. Innovative filter mechanisms and extensive product information support the consumer in shopping and in making a reflected purchase decision.	◑
Behavioral	The focus on outfits instead of single products supports cross- and up-selling. Filter mechanisms and the possibility to promote selected products can drive additional sales. The system furthermore provides an easy to use way for receiving new inspirations.	●
Sensory	Next to the visuals, music, speech, and sound effects are used to stimulate the senses. For controlling the system a large touchscreen is installed, tackling the haptic aspects. Physical products are integrated into the interaction process through automatic product recognition.	◕
Social	Applying multi-touch technology, the system can be used by multiple customers in parallel. Furthermore, it is possible to share outfits and experiences on favorite social networks.	◔

● main focus ◕ strong focus ◑ medium focus ◔ minor focus ○ no focus

4.5.2.2 User Interface and Interaction

The system's UI is kept simple and clear. At the top, a news ticker is embedded that shows the most current messages and advertisements of the vendor. A realistic, life-size virtual avatar represents the core component of the experience. It is possible to rotate the body around its own axis. Information buttons allow the derivation of detailed product information, product price, and location of the article within the store. While complete outfits are shown on the digital body it is possible to exchange single garment components or switch between colorways. The social share functionality makes it possible to post product combinations including the digital avatar on favorite social networks. For this purpose, a QR is used as a link between the product experience wall and the customer's own smartphone. Figure 4.42 provides an overview about the different interaction possibilities.

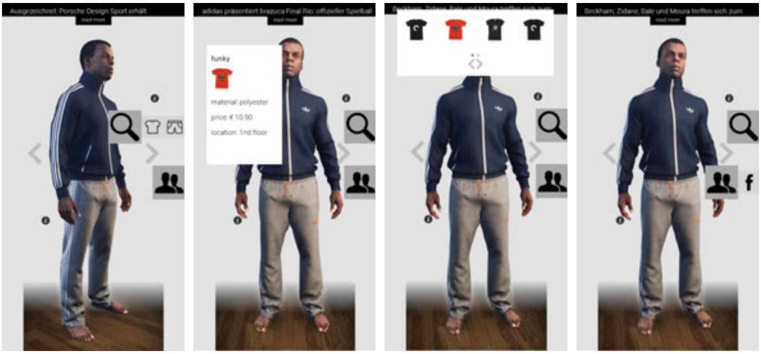


Figure 4.42 – Product Experience Wall: User Interface

4.5.2.3 Service Delivery System

In order to implement the desired context adaption the service delivery system has to be set up in the respective manner. A flexible real-time personalization system represents the core component of the concept. The goal is to realize a modular system that is able to handle arbitrary sensor data while offering a standardized data output to feed any client application. For the concept presented three different kinds of sensor data are used: product specifications derived through RFID tags, information about the user gathered through a camera and face detection software, as well as environmental data in the form of weather information. Figure 4.43 illustrates the association of the sensors, their respective software components, and 3rd party services used to derive data as well as the data processing steps required to realize the context adaption of the system.

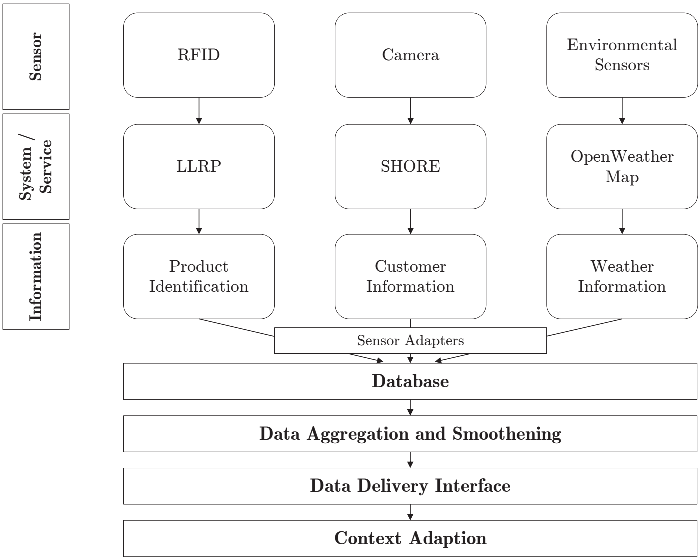


Figure 4.43 – Product Experience Wall: Context Adaption

The different sensors and their software packages use distinct standards for providing their data. In order to standardize these data and to create a modular system, sensor adapters are implemented. They are used to transfer the data into a common database. Table 4.21 provides an overview about the information gathered through the different sensor components. All together, the service delivery system consists of the following elements that are used to realize the sensor-enabled interaction as well as the UI:

- **RFID Interface:** Gathering RFID sensor data is accomplished by using the low level reader protocol (LLRP)[8]. Next to the EPC-96 value which represents the individual ID of the RFID tag, the protocol allows the extraction of signal strength, timestamps, and further elementary information. Data gathering is handled via sllurp[9], a Phython based software package. [Groeger 2014, p. 23]

[8] cf. http://www.gs1.org/gsmp/kc/epcglobal/llrp
[9] cf. http://github.com/ransford/sllurp

Table 4.21 – Product Experience Wall: Sensor Data Overview adapted from Groeger [2014, p. 31]

RFID	*Face Detection*	*Weather*
_id	_id	_id
timestamp	timestamp	timestamp
signal_strength	data (age, uptime, gender, mood)	clouds
epc	data_size (number of persons detected)	windspeed
antenna_id		sunrise
		sunset
		location
		temperature

- **Face Detection Engine:** The Fraunhofer SHORE SDK [Küblbeck and Ernst 2006, pp. 564-572][10] is integrated for detecting users approaching the system. This tool is able to detect faces in a video stream and uses them to register gender, age, and mood of the persons in front of the camera. Based on this information the goal is to individualize content and pre-filter the product selection. As in the current state of the SDK mood detection is not sophisticated enough, only gender and age are further processed.

- **3rd Party Services:** External data sources are used to enhance the functionality and to better individualize the customer-centered approach by providing additional knowledge to the logic component. Real-time weather data of the respective location is pulled from Open Weather Map[11]. This information is applied in the UI, e.g., by pre-sorting products based on current weather conditions. This information always represents the current weather of the geographic location, the SST is operated in.

- **Sensor Adapters:** In order to bring the different sensor data types into a consistent format and to ensure a loose coupling of the interfaces, sensor adapters are implemented. This step ensures compatibility of the interfaces, hence realizing a maximum level of flexibility [Goll and Dausmann 2013, p. 79]. JSON (Java Script Object Notation) is used as the protocol to transfer data between the different modules and the sensor database. [Groeger 2014, p. 26]

[10] cf. http://www.iis.fraunhofer.de/de/bf/bsy/fue/isyst.html
[11] cf. http://openweathermap.org/

- **Sensor Database:** The open source database MongoDB[12] is applied to collect the data from the sensor adapters and to store them in a structured document type.

- **Aggregation and Smoothening:** All sensor data gathered require an optimization for the purpose of maximizing the system's reliability. This for example includes the elimination of irrelevant data, bypassing potential detection lacks (e.g., if a RFID tag is shielded or a customer turns away for a short period of time), and finally the derivation of meaningful data sets. Consequently, the data is aggregated over a defined timespan (e.g., 5 seconds) and then handed over to the data delivery interface. For every sensor data type, smoothening needs to be adjusted individually.

- **Data Delivery Interface:** Delivering the sensor data to the respective service system happens through web sockets. They can be used in real-time systems due to their low latency and bi-directionality. The software package Autobahn[13] is applied to provide the cleansed data packages to the respective clients. [Groeger 2014, pp. 34-35]

- **Front End:** A logic component manages the visualization of different contents based on the output of the face detection engine, the 3rd party data, and the RIFD information. The UI itself is designed and animated using HTML5. Google Chrome is used to display the contents.

- **Content Database:** This database contains all product-individual information (product details, available colors, etc.) and digital content like videos or animations of digital shop assistants. Popular outfit combinations are furthermore defined in a style database.

- **News Ticker:** All information displayed in the news ticker are pulled from an RSS (Rich Site Summary) feed.

4.5.2.4 Technical Setup

The physical setup is constructed to meet the requirements of a flexible prototype (cf. Figure 4.44). The basic structure is portable and carries all hardware technology. It comprises the elements stated below.

[12] cf. http://www.mongodb.com/
[13] cf. http://autobahn.ws/python/

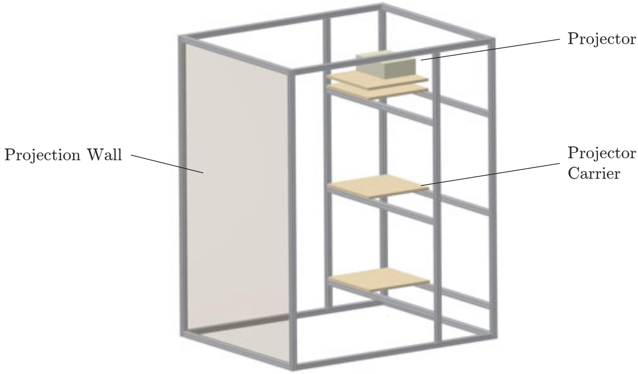


Figure 4.44 – Product Experience Wall: Construction

- **Frame Construction:** A stable rack is built using 40mm aluminum profiles, providing the flexibility to infinitely adjust distances and fittings.
- **Projector Carriers:** It is necessary to mount the projector in a fixed position. Vernier adjustments allow an optimal alignment of the image on the projection wall.
- **Projection Wall:** Scratch resistant acrylic glass of 2050mm to 1250mm size is used to mount the touch foil and in parallel serves as a back-projection screen. With 8mm thickness, the glass is stable enough to withstand touch interaction without bending.

Although it is possible to build the self-service using large-format LCD screens which would allow the creation of a device with reduced depth, the system is implemented using a back-projection setup. This makes it possible to realize a bezel-less surface in order to improve the state of immersion. In detail, the setup consists of the following hardware components which are chosen to realize the desired functionality and to ensure smooth interaction:

- **Short Distance Projector:** A Benq W1080ST projector in rear projection mode is used to display the user interface. It offers FullHD resolution (1920x1080 pixels) and a brightness of 2700 ANSI lumens. In order to best take advantage of the resolution, the projector is mounted in vertical orientation.
- **Capacitive Touch Foil:** To enhance the plexiglass wall with touch functionality, a capacitive touch foil is applied. The foil offers 1868mm to 800mm (21:9 form

format) of active area at a total size of 2000mm to 1250mm. It furthermore serves as the back projection canvas.

- **Camera:** A "Creative Live! Cam Socialize HD" web camera is utilized in order to integrate the face detection technology into the system. With FullHD video capability, auto focus, and wide angle lens it is well suited for the use case.
- **RFID Reader and Antennas:** An Impinj Speedway Revolution R420 RFID reader (UHF 869MhZ) in combination with three Kathrein mid-range antennas (100 degrees radiation angle) serves as the technology to automatically identify RFID-enabled products. Two antennas are mounted behind the acrylic glass and one above the system. This arrangement allows an almost entire coverage of the interaction area in front of the device.
- **Computer:** A Fujitsu Siemens Celsius W520 workstation controls all components. The system has the following configuration: Intel Xeon E3-1245v2 CPU with 3.40 GHz and four cores, 32GB RAM, 128GB SSD, and ATI FirePro W7000 graphics card with 4GB memory and four display outputs.
- **Sound System:** For integrating the auditory element into the self-service system, a BOSE Companion 2 speaker set is used.

4.5.3 Implementation

A functional prototype is built based on the concept described above. It is used for the concept evaluation and to derive knowledge on behavioral patterns of the users. The physical setup is designed for being used in a laboratory environment. Application in a store requires further refinement of the components, especially in regards to stability, space requirements, and visual attractiveness. Therefore, strict focus lies on communicating the service concept and the features of the SST and not to promote the prototype as a final system (cf. Figure 4.45).

Figure 4.45 – Product Experience Wall: Prototype

The prototypical realization of the social share functionality and its mobile website are shown in Figure 4.46. Connected to a Facebook application, the website allows pushing the personal avatar including the outfit to the user's personal social media profile. Comments can be added. The system automatically attaches web shop links to the respective products.

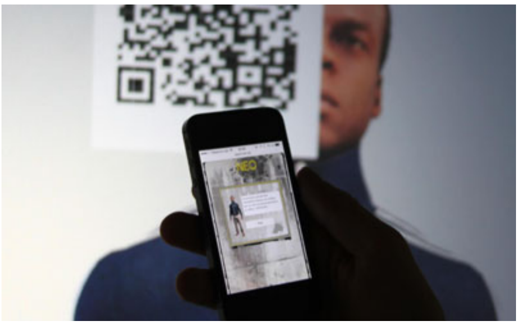


Figure 4.46 – Product Experience Wall: Social Share Prototype

4.5.4 Evaluation

4.5.4.1 Overview

The prototype of the product experience wall is evaluated in a laboratory setup over the period of three weeks. All participants taking part in the evaluation are recruited at the university. After a short introduction to the project, they are asked to interact with the system and to provide feedback using the service fascination questionnaires. As proposed before (cf. Chapter 3.3.3), observations are conducted in order to identify further insight on the user's emotions, possible issues, and behavioral effects not covered by the subjective reports. As the evaluation takes place amongst students, the average age is between 19 and 34 years (SD=2.46), representing an early population of the digital generation (cf. Table 4.22). Out of a total of 366 invited students, 240 agree to participate in the study and complete the assessment process.

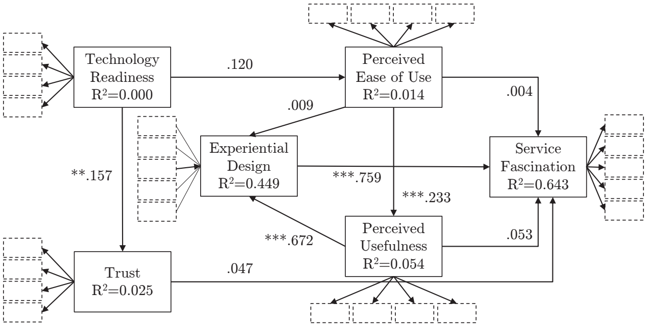
Table 4.22 – Product Experience Wall: Overview and Sample Demographics

System Status	Prototype, laboratory experiment	
Location	University, Nuremberg, Germany	
Timeframe	02.06.2014 - 27.06.2014	
Samples	Female	120 (50.0%)
	Male	120 (50.0%)
	Total	240
Age	Minimum	19
	Maximum	34
	Median	24
	Average	24.39 (SD=2.46)
Participants	Students, recruited at the university	

4.5.4.2 Subjective Measurement

4.5.4.2.1 Overall Model

SmartPLS 2.0 [Ringle et al. 2005] is used to evaluate the causal model which is tested against the criteria depicted in Chapter 3.3.2.2.2 (cf. Figure 4.47). As the number of cases should be equal to the number of data sets of the sample provided, 240 cases at 5000 samples are computed.



*p<0.1; **p<0.05; ***p<0.001

Figure 4.47 – Product Experience Wall: Evaluation Results (Causal Model)

All Cronbach's α values are within the accepted thresholds. The measurement models are validated using the quality criteria depicted before. All of them meet the requirements for reflective and formative constructs. Also the structural model is tested against the previously stated criteria and proved valid. Table 4.23 provides an overview about the investigated data, listing path coefficients, significances, and effect sizes.

Table 4.23 – Product Experience Wall: Hypotheses

	Hypothesis	*Path Coeff.*	*T-value*	f^2
H_1	Technology Readiness → PEOU	0.1201	1.6423	0.014
H_2	Technology Readiness → Trust	0.1571	2.1268	0.026
H_3	Trust → Service Fascination	0.0468	1.3861	0.006
H_4	PEOU → PU	0.2331	4.0178	0.057
H_5	PEOU → Experiential Design	-0.0095	0.1591	0.000
H_6	PU → Experiential Design	0.6724	14.2184	0.753
H_7	PEOU → Service Fascination	0.0040	0.1483	0.000
H_8	PU → Service Fascination	0.0531	1.2233	0.006
H_9	Experiential Design → Service Fascination	0.7593	16.2632	0.818

PU = Perceived Usefulness; PEOU = Perceived Ease of Use

$t \geq 1.65$ sig. level = 10%; $t \geq 1.96$ sig. level = 5%; $t \geq 2..58$ sig. level = 1%

$f^2 \geq 0.02$ "weak"; $f^2 \geq 0.15$ "medium"; $f^2 \geq 0.35$ "strong"

While for the given SST H_1 does not constitute a significant relationship, technology readiness is found to significantly influence perceived trust. Nevertheless, the hypothesized relationship between trust and PEOU cannot be confirmed. The positive and significant connection hypothesized in H_4 is able to approve the interplay proposed in the traditional TAM [Davis 1989, pp. 319-340]. While ease of use does not significantly influence the experiential design (H_5), PU does. Both, PU and PEOU are not able to predict service fascination on a significant level. Finally, experiential design is again found to act as a strong predictor of service fascination. Weak f^2 effects can be derived for technology readiness towards trust and PEOU towards PU. Moreover, very strong influence is calculated for PU towards the endogenous variable experiential design and for experiential design towards its endogenous variable service fascination. The overall results of the evaluation are visualized in Figure 4.48.

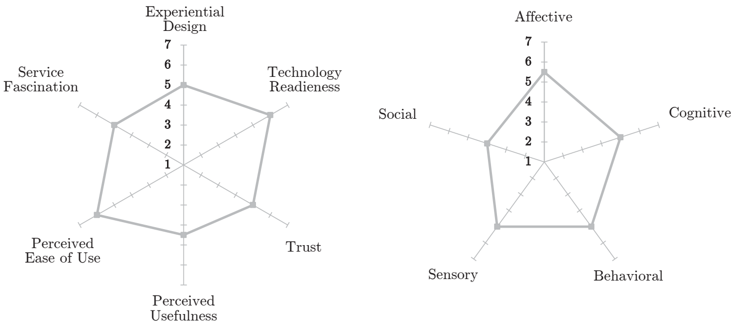


Figure 4.48 – Product Experience Wall: Evaluation Results

R^2 values of 0.449 (experiential design) and 0.643 (service fascination) account for a high capability of the structural model being able to explain the two target variables. As expected, the R^2 values of all other constructs only show weak manifestations, indicating that further influences may exist. With a Q^2 value of 0.4447, the structural model is furthermore able to adequately predict service fascination.

While the majority of the experiential elements is rated on an almost equal, slightly positive level, the subjective evaluation of the social dimension lags behind. Both the general experiential design as well as the overall service fascination are rated positive. The subjects consider themselves as technology ready and the SST as easy to use. Nevertheless, in its current state, the SST lacks in functional value (cf. Table 4.24).

Table 4.24 – Product Experience Wall: Evaluation Results

	Dimension	α	Md	$\overline{x}$	SD	R^2	Q^2
Service Fascination	Perceived Usefulness	0.902	4.5	4.33	1.44	0.054	0.0398
	Perceived Ease of Use	0.856	6	6.03	1.00	0.014	0.0087
	Trust	0.950	5	4.68	1.78	0.025	0.0201
	Technology Readiness	0.734	6	5.88	1.02	0.000	—
	Service Fascination	0.896	5	5.10	1.22	0.643	0.4447
	Experiential Design	—	5	4.73	1.17	0.449	—
Experiential Design	Affective	0.836	5.5	5.51	1.04	—	—
	Cognitive	0.802	5	4.70	1.28	—	—
	Behavioral	0.824	5	4.46	1.29	—	—
	Sensory	0.810	5	4.70	1.42	—	—
	Social	0.758	4	3.77	1.34	—	—

α = Cronbach's Alpha; Md = Median; $\overline{x}$ = Mean; SD = Standard Deviation; Q^2 = Stone Geisser's Q^2

$R^2 \geq 0.67$ "strong"; $R^2 \geq 0.33$ "medium"; $R^2 \geq 0.19$ "weak"

$Q^2 \geq 0.35$ "strong"; $Q^2 \geq 0.15$ "medium"; $Q^2 \geq 0.02$ "weak"

4.5.4.2.2 Gender Splitup

Interesting insights can be derived by splitting up the evaluation results into genders. It is possible to identify significant differences in regards to the perception of the experiential design elements as well as the basic and rejection criteria influencing the overall service fascination (cf. Figure 4.49).

In the study female subjects express a slightly higher trust towards the SST evaluated. Nevertheless, the difference in means between male and female subjects is of non-significant nature. While the same applies for the PEOU, male subjects are accredited a significantly higher technology readiness. This variation is additionally supported by a strong Cohen's d effect of 0.989. Highly significant distinctions can be found in regards to the functional value (PU), the overall experiential design (medium effect), as well as the ultimate service fascination (strong effect).

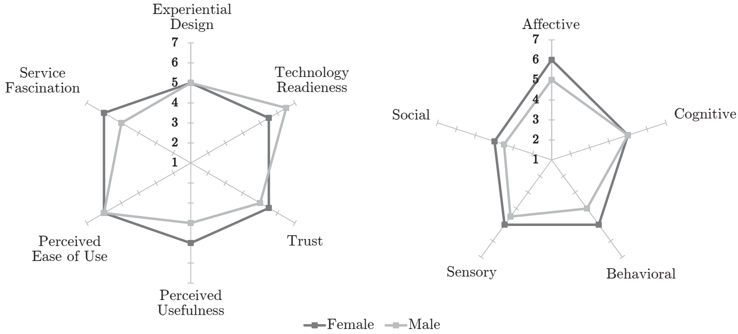


Figure 4.49 – Product Experience Wall: Evaluation Results (Gender Splitup)

This situation is also reflected in the assessment of the individual experiential dimensions (cf. Table 4.25). All criteria evaluated show highly significant differences in their mean values.

Table 4.25 – Product Experience Wall: Evaluation Results (Gender Splitup)

		Females (N=120)			*Males (N=120)*				
	Dimension	*Md*	$\overline{x}$	*SD*	*Md*	$\overline{x}$	*SD*	*p*	*d*
Service Fascination	Perceived Usefulness	5	4.63	1.40	4	4.03	1.42	0.001	0.426
	Perceived Ease of Use	6	6.05	1.14	6	6.00	0.84	0.700	0.050
	Trust	5.5	4.79	1.81	5	4.58	1.76	0.357	0.118
	Technology Readiness	5.5	5.43	1.11	6.5	6.33	0.65	0.000	0.989
	Service Fascination	6	5.55	0.98	5	4.65	1.28	0.000	0.790
	Experiential Design	5	5.04	1.12	5	4.41	1.13	0.000	0.560
Experiential Design	Affective	6	5.78	0.96	5	5.25	1.05	0.000	0.527
	Cognitive	5	4.90	1.36	5	4.50	1.17	0.015	0.315
	Behavioral	5	4.85	1.12	4	4.06	1.33	0.000	0.643
	Sensory	5	4.95	1.46	4.5	4.44	1.33	0.005	0.365
	Social	4	4.05	1.36	3.5	3.49	1.27	0.001	0.426

Md = Median; $\overline{x}$ = Mean; SD = Standard Deviation; p = Significance; d = Effect Size

$p \leq 0.05$ sign. level = 5% - $d \geq 0.2$ "small"; $d \geq 0.5$ "medium"; $d \geq 0.8$ "large"

Women ascribe the product experience wall a higher experiential value then men. This applies to all of the dimensions assessed. Cohen's d effects of small to medium amplitude additionally support the results.

4.5.4.3 Objective Measurement

Observations conducted before, during and after using the system complement the findings of the subjective evaluation (cf. Chapter 3.3.3). Since the study takes place in a laboratory environment it is possible to reduce potential interferences to a minimum. The notes taken during the observation are listed in Table 4.26.

Table 4.26 – Product Experience Wall: Observed Behavior

Basic Dimensions
The SST is in general considered to be a useful tool.
Subjects like using the tool for browsing through product combinations presented on the mannequins. In addition, they create individual outfits based on their personal preferences.
The touch functionality does not work well with every user. Some of them lose an object during drag and drop commands and get frustrated after several tries. This leads to a dropout of some participants.
The face detection algorithm is not stable enough. As the camera is mounted at the side of the system, the face of the user is not always correctly captured. This leads to restrictions in context adaptivity.
Rejection Dimensions
Every subject is able to interact with the system. A low level of technology readiness does not negatively influence the experience.
Some of the users approach the system with skepticism. Nevertheless, this negative attitude calms down quickly.
Subjects do not express fear in regards to the face detection technology as it is not obvious to them.
Experiential Dimensions
Users are impressed by the large, bright, and seamless display.
The users laugh while interacting with the SST.
Subjects tend to interact with the system in groups, mainly consisting of two people.
The table is continued on the next page

Users proactively integrate their friends into the interaction process.
The subjects are surprised when the system pre-filters the content based on their gender. Nevertheless, most of them do not immediately take notice.
The life-size avatar is perceived very well.
Some of the subjects interact with the avatar as if it was alive.
Eight of the users start talking to the SST during use.
After the experiment, several of the users return to the laboratory in order to use the system again.
Even though some users experience issues with the touch technology, most of them keep interacting with the system because of hedonic motives (fun and amusement).
The experience is perceived as boring only by a small number of participants (less than 5%).
Subjects are not only excited by the system itself but also by the product combinations they create.
Sound and music do not obviously influence the behavior of the user.
Positive comments are made regarding the sound. It is described as "cool".
General Behavior
Subjects would like to see the dressed avatar moving. While some of them would like to see the garments in pre-defined motion sequences (e.g., a running avatar), others would like to define the motions themselves.
Men prefer interacting with a male, women with a female avatar.
Users that enjoy working with the system use it for a longer time span and try to discover all of its features.
The subjects would like to have the option of sorting outfits based on special occasions (e.g., going to a club, doing sports).
Presenting complete outfits instead of single products leads to increased awareness of the product range, which can result in additional sales.
Users would like to receive recommendations for garments matching clothes they already have.

The observational study reveals that the SST in general is perceived very well. Subjects predominantly interact with the system in groups. This finding stands in contrast to the ratings of the social dimension reported through the subjective measurement. A similar discrepancy appears in regards to the system's usability. While in the subjective assessment this criterion is rated very positive, several subjects face issues in controlling the device using the touch screen. Especially during drag and drop interactions, the system looses track of the user's hand and returns the object to its original position. The visual representation of the contents on a large screen is perceived as very positive, especially in combination with the life-size avatar. Shopping for outfits instead of shopping for single products is favored. With the exception of the face recognition feature, context-adaptivity works well, but mainly at an subconscious level. This means, that some of the subjects consider the selection of the presented garments as a given, not obviously taking notice of the individualization.

4.5.4.4 Summary

Summarizing the results of the subjective and the objective evaluations it is possible to identify interdependencies of system design towards human perception. Weaknesses of the current prototype are pointed out in order to derive recommendations for action.

Remarkable differences in the perception of male and female users can be highlighted. While both genders show an almost equal level of trust towards the SST, the effect of the experiential design features is permanently higher for females. This also results in a more positive rating of the overall experiential design and finally service fascination. The large-scale visualization of the avatar is a vital element. Nevertheless, the system lacks in usefulness. Subjects ask for additional features to enhance their shopping experience and to provide additional value in comparison to traditional mannequins. These functions mainly follow the idea of an advanced product presentation. While the current context adaption works well for most of the subjects, the integration of additional sensors may further improve the functional value of the service. Regarding the hardware especially the touch recognition requires additional work in order to ensure a smooth usability and functionality.

4.5.5 Improvement

As the prototype presented lacks in functional value, further features need to be integrated to best support the customers in their shopping process.

During the assessment, the subjects express the wish of getting outfit recommendations that also take products into account that they already own. Leveraging the sensor technology that is already part of the system (a standard RGB camera) and integrating image recognition methodologies it is possible to automatically analyze the user's current clothing. For realizing this feature, Zhang et al. [2008, pp. 1-10] present a novel approach: based on the image of a standard webcam, their algorithms allow detecting the user's pose and orientation. In a second step, an element segmentation is applied in order to identify specific regions containing body parts and clothes. Based on color and texture captured, the software recognizes the worn clothes and compares them to images in a database. Methods for identifying similar garments based on photos taken are also presented by Liu et al. [2012, pp. 3330-3337] and Yamaguchi et al. [2013, pp. 3519-3526]. An identical approach can also be applied to gain knowledge about hair and skin color of the customer using the recorded body parts. This provides the potential for further recommendation options. Figure 4.50 shows the parsing steps for image based garment recognition utilizing the process described by Yamaguchi et al. [2013, pp. 3519-3526].

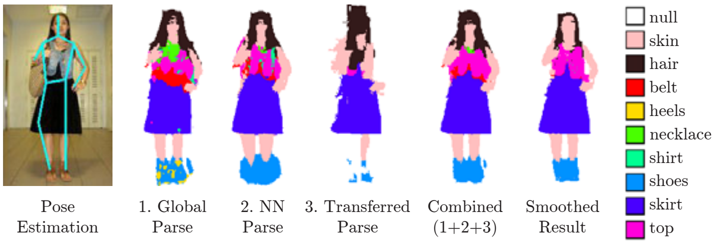


Figure 4.50 – Product Experience Wall: Garment Recognition Process adapted from Yamaguchi et al. [2013, p. 22]

For providing the users with a more realistic representation and further functionality of the digital avatar it is possible to integrate an animation feature. To do so, the motions of the customer standing in front of the SST are captured using a standard depth camera in combination with a skeleton tracking functionality. In a second step the avatar is overlaid with the movement patterns of the user's skeleton model (cf. Figure 4.51). This allows animating the avatar in real time which realizes a simple version of a virtual mirror. Fit and drape of the garments can be simulated accordingly. [Zagel and Süßmuth 2013b, p. 54; Zagel and Süßmuth 2013a, p. 556]

A detailed customer identification may be realized using RFID based loyalty cards. Comparable to the detection of products, the system would be able to identify customers and derive personal information from a central database. This would make it possible to individually address the user. But also without knowing the person in detail, the customer centric interaction can be further improved. Analyzing the users in front of the system can happen in many different ways.

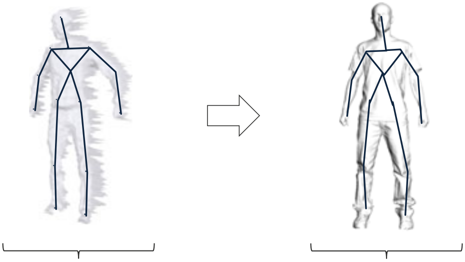


Figure 4.51 – Product Experience Wall: Avatar Animation

Next to their gender and age, also their mood may be captured. New algorithms furthermore allow the contact-less measurement of a human's pulse using standard web cameras [Poh et al. 2010, pp. 10762-10774; Poh et al. 2011, pp. 7-11; Lewandowska et al. 2011, pp. 405-410]. An integration of this feature into the product experience wall permits drawing inferences on emotions arising during interaction with the device. This, as well as the collection of knowledge about the attractiveness of products presented makes it possible to further optimize the interaction process and to improve the effects of product recommendations. [Zagel 2014b, p. 370]

A final improvement step can be made by integrating the customers themselves as a digital avatar into the experience. This can happen by applying their personal body scans instead of using a generic and anonymous avatar (cf. Chapter 4.4). As described by Suh et al. [2011, pp. 711-729] this approach would emotionally connect the customer with the service provided, leading to increased satisfaction. [Zagel and Süßmuth 2013a, p. 556]

4.6 Interactive Fitting Room

4.6.1 Motivation and Goal

Fitting rooms are one of the most important elements of apparel stores. Despite their relevance for consumers and the companies, their physical appearance and the core service provided hardly changed throughout the last century [Zagel et al. 2014b, p. 178]. This fact is also underlined by Jason Kemp (Managing Director Envision Retail), who states that "fitting rooms are usually the most uncared for areas. In high-street stores the fitting rooms are generally poorly sign-posted and messy, and staff are more concerned with security issues and how many items customers are taking inside than making it a service area and trying to assist shoppers. [...] Retailers need to realise that the fitting rooms have great potential and are an important commercial area" [Kaluschka 2006, p. 23]. While studies are conducted in regards to how atmospheric and environmental conditions affect dressing room experiences [Baumstarck and Park 2010, pp. 37-49], the effects of technology are hardly researched. Although first concepts of technology-enhanced dressing rooms already exist (e.g., by retailers like Metro and Kaufhof [Al-Kassab et al. 2010, pp. 281-308] or companies like Brooks Automation GmbH [Quiede 2008]), current solutions merely concentrate on delivering functional value by providing additional product information. Experiential aspects are not part of the concepts.

4.6.2 Ideation

4.6.2.1 Service Concept

This chapter[14] introduces the concept of an interactive fitting room. A combination of innovative technologies allows the creation of an immersive virtual environment that emotionally connects the consumer with the product. Besides supporting the consumer in his/her fitting- and buying-process through additional product information, the system embeds a connection to social networks, giving users the chance to invite friends into the shopping experience. Also product ratings and recommendations can be examined.

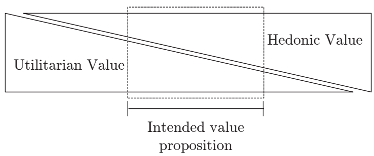


Figure 4.52 – Interactive Fitting Room: Utilitarian vs. Hedonic Value

The SST is designed with the goal of creating a completely new shopping experience by focusing on emotional aspects, especially by touching multiple senses in parallel. The goal therefore is to provide a combination of both, utilitarian and hedonic value on a balanced level (cf. Figure 4.52). Table 4.27 provides an overview about how the basic and rejection dimensions will be implemented.

[14]Parts of this research are published in Zagel et al. [2014b, pp. 177-190], Zagel and Bodendorf [2014, pp. 537-548], Zagel et al. [2014d], and Zagel et al. [2014c].

Table 4.27 – Interactive Fitting Room: Basic Design Elements

Dimension	*Realization*
Perceived Usefulness	The goal is to provide extensive consumer support throughout the shopping process. The SST supports fact based purchase decision making by providing detailed product information (e.g., available sizes, colors, material characteristics) as well as product recommendations derived from the Internet. Users should furthermore get inspired through product combinations displayed. Real-time stock data is provided by connecting the system to the back-end databases of the store.
Perceived Ease of Use	All interfaces follow the guidelines of DIN EN ISO 9241 (particularly DIN Deutsches Institut fuer Normung e.V. [1999], DIN Deutsches Institut fuer Normung e.V. [2008a], and DIN Deutsches Institut fuer Normung e.V. [2011a]) and are designed in an easy to use way. All buttons are integrated into the immersive UI animations. Interaction happens via touch surfaces integrated into one of the interactive walls.
Trust	The implementation follows a design that limits any potential risk exposure to a minimum. Entering login information in order to use external services (e.g., social networks) is handled through the consumer's own smartphone and by using a QR code in combination with a mobile website. The users always have full control over their personal data.
Technology Readiness	The system interacts semi-autonomously. Products are detected without interaction required from the user. This allows any user to participate at least partly in the experience, even if no further customer-initiated interaction takes place.

The concept involves software- and hardware-technologies in order to best implement the experiential criteria and stands out due to its specific focus on stimulating multiple senses and by creating an immersive virtual environment. All interaction elements and product information are integrated into product-specific animations. Automatic product recognition using RFID technology allows the creation of a consistent interaction concept, conveying a sense of stepping into another world when entering the fitting room. A virtual world is created that represents the usage context and lifestyle connected to the respective product taken inside, for example a mountain environment when trying on an outdoor jacket or a soccer stadium when entering with a football jersey. Adding appropriate sound elements creates an even more immersive scenery. All information displayed and the corresponding functionality provided is adjusted to the needs of the respective customer group. This means, that for the young buyer of a lifestyle product a social share functionality might be of more relevance than for the buyer of an expensive outdoor jacket, being more interested in textile technologies. An interface to social networks and the retailer's online shop allows the consumer to share, comment and recommend products to the outside world or to browse through recommendation pulled from the Internet. The elements aimed at providing emotional value are stated in Table 4.28.

Table 4.28 – Interactive Fitting Room: Experiential Design Elements

Dimension	*Realization*	*Focus*
Affective	The creation of an immersive virtual environment needs to emotionally connect the consumers to the brand and the products. An automatic product recognition intends to surprise them and make them feel like stepping into another world. Appealing interfaces, animations, colors, and sound effects support the positive state and aim at realizing a pleasant stay.	◕
Cognitive	Extensive product information, technology descriptions, as well as cross- and upselling information allow the consumer to make a reflected purchase.	◑
Behavioral	Information about product combinations, product feedback as well as recommendations given by the system (e.g., based on the consumer's buying history) can change the way how consumers shop. By emotionally connecting the user to the product, return rates are reduced and the overall satisfaction is increased.	◔
Sensory	Multiple senses are stimulated in parallel: the visual sense by showing large-scale, surrounding animations, the haptic sense through interaction with the garment and by using a touch interface as well as the auditory sense by integrating music and sound effects.	●
Social	The system allows to connect to social networks and to share products, reviews, and comments. There is also the possibility to display third party product reviews and recommendations (e.g., from the online store, rating websites or social media).	◔

● main focus ◕ strong focus ◑ medium focus ◔ minor focus ○ no focus

4.6.2.2 User Interface and Interaction

The success of the interactive fitting room concept requires the implementation of an interaction concept that best addresses the consumer's needs. When designing the client interface special emphasis has to be put on usability and visual attractiveness. As stated before, the goal is to emotionally connect the consumer with the product at hand by showing the article in its intended context. As soon as the consumer enters the fitting room with an RFID tagged product, it automatically triggers the specified animation, displayed on the walls of the fitting room. As there is no consumer identification implemented, the content is individualized by tracking down the article's category and type (e.g., lifestyle, sports). In case multiple articles are identified, the logic component decides which of the animations to show first and allows the consumer to switch between the experiences. By taking the product assortment of a sporting goods and lifestyle manufacturer as an example, the following experiences are realized and visualized in Figure 4.53:

- **Sport Performance - Outdoor:** The animation consists of a three-dimensional virtual environment of a mountain and is augmented by the sound of wind blowing and birds singing. The functionality and content focuses on the needs of consumers buying expensive articles for high performance sports. Information about integrated technologies and features are used to justify the price and confirm the consumers in their buying decision.

- **Sport Style - Fashion:** Current fashion trends and outfit combinations from the most popular style leading cities are displayed in combination with marketing videos showing fashion icons and stars. All buttons are represented through graphic elements and music can be manually turned on and off.

- **Sport Style - Urban Lifestyle:** The product concept is illustrated by an interface in the form of a subway map combined with an animation of a retro skyline of a big city. It represents the urban lifestyle of the category's consumer group and integrates popular songs as a sound scenery.

Figure 4.53 – Interactive Fitting Room: User Interface
(left: outdoor, center: fashion, right: originals), adapted from Malcher [2012, pp. 78-81]

It is possible to use any kind of multimedia content and to add additional sport- or even product-specific animations in order to create the immersive environment. Figure 4.54 shows the example of the outdoor use case displayed on the three interactive walls (left, middle, and right wall).

Figure 4.54 – Interactive Fitting Room: Immersive Environment

In the social share section, the system displays an individual QR code for every product. Scanning this code with the personal mobile phone leads the consumer to a mobile optimized web site (cf. Figure 4.55). This site contains a prepopulated post for social media platforms and the respective product image with an embedded link to the online shop. The user has the chance to add a personal comment and to publish the post either only to his/her personal profile or additionally to the retailer's social media presence.

Figure 4.55 – Interactive Fitting Room: Social Share

4.6.2.3 Service Delivery System

By using RFID tags, a product identification mechanism triggers animations and enables consumer interaction. A specifically designed software setup allows displaying the interactive content on the UI in the desired manner. The application consists of the following components:

- **RFID Interface:** As an RFID interface, the detego® You-R OPEN software development kit (SDK) is used to read the product tags and save the respective product IDs into a log file. The interface is also used to configure general RFID parameters like reading range and reading interval. This interval is set to five seconds in order to bridge potential tag losses.

- **Product Databases:** These databases contain product information: available sizes, color ways, cross- and up-selling information, as well as stock data. A content management system (CMS) provides all multimedia data like images, videos, virtual animations, and sound files. During interaction information on the system usage, product movements, and consumer behavior is collected. Thereby it is possible to identify articles that are taken into the fitting room but then returned to the shelves. Furthermore, it is possible to gain insights into favored product combinations.

- **External Platforms:** As the consumer has the possibility to browse through product ratings and recommendations posted online, the system also contains respective interfaces e.g., to the company's online presence or 3rd party platforms.
- **Web-Service:** This component manages the logic of the interactive fitting room and controls the animations and UIs corresponding to the products the consumer entered with. For this purpose the xampp[15] distribution of the Apache web server with PHP support is used. This software component accesses the product log file and triggers actions on the UI. As long as either no, or an unknown product ID is detected, the system toggles to the idle mode. Whenever a known ID is identified, the content related to the product is pulled from the databases and embedded into the interface. It furthermore realizes a logic component that decides on the process in case a consumer enters with multiple articles (e.g., the highest priced article is prioritized). An additional JavaScript module frequently checks, if the product is still listed in the log file. In case a predefined threshold (e.g., five seconds without a detected product) is exceeded, the application switches back to idle mode.
- **User Interface:** The UI is realized in Adobe Flash and displayed through a web browser in full screen mode. Embedded into an HTML file, the application is responsible for showing respective animations and product information which is dynamically integrated. Flash offers the possibility of integrating various different multimedia file formats and is therefore well suited for the use case at hand.
- **Mobile Component:** The possibility to share and recommend products on social networks is realized through a separate component. A QR code displayed on the UI illustrates the entry point to a mobile optimized HTML web site. This web site automatically adapts to the smart phone used (e.g., screen resolution) and provides the possibility of posting the product on the user's private as well as the brand's public profile.

The system interaction design is depicted in Figure 4.56.

[15] cf. http://www.apachefriends.org/de/xampp.html

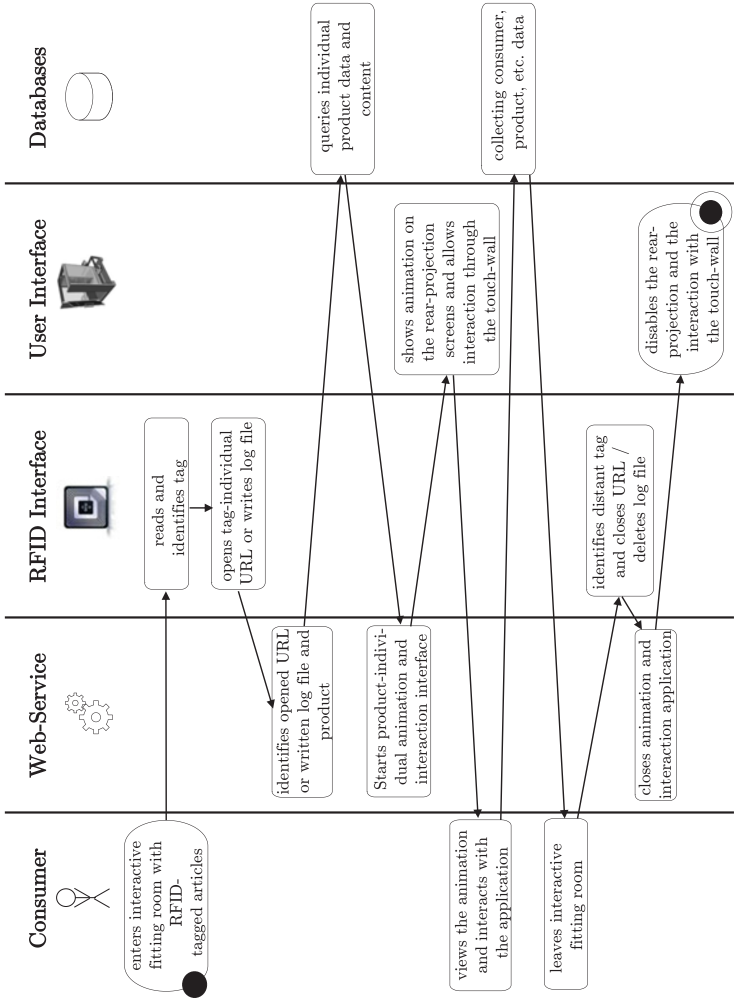


Figure 4.56 – Interactive Fitting Room: Interaction adapted from Malcher [2012, p. 95]

4.6.2.4 Technical Setup

The prototype is implemented under consideration of cost effectiveness. The primary intention is to enable a large-scale presentation of the multimedia content in order to create an immersive environment. To keep costs low and to maximize screen size, a back projection setup is chosen. Comparable to the CAVE (Cave Automatic Virtual Environment) concept presented by Cruz-Neira et al. [1992, pp. 66-72], the display areas constitute the core of the system[16]. While all of the required hardware components are hosted inside of an interior wall, the inside of the fitting room is designed like a traditional one. It offers identical space and also a conventional mirror. The following components constitute the physical setup of the interactive fitting room:

- **Base Construction:** The outer measurements of the prototype's base construction are 304cm to 244cm with a height of 240cm. With 120cm to 140cm, the interior layout represents the measurements of a traditional fitting room. The color selection is oriented on the respective store design. The prototype can be disassembled and transported on two double-size pallets.

- **Interior Wall:** A surrounding second wall provides space for mounting projectors and additional hardware invisible to the consumer. A service door at the back of the SST allows accessing the technical components.

- **Mirror:** A traditional mirror with the measurements of 57cm to 200cm is mounted in one corner of the fitting room. Next to supporting the consumer in his/her fitting process, it virtually increases the perceived space as the display contents are mirrored.

- **Roof:** The roof contains a dimmable LED light construction, covered by white cotton fabric.

- **Acrylic Glass Inlays:** To maximize the display area, acrylic glass for back projection purposes is integrated into the walls. The display area covers 270 degrees of the customer's field of view. The sizes are 97cm to 145cm, 71cm to 145cm, and 138cm to 145cm. [Zagel and Bodendorf 2014, pp. 537-548]

[16] The authors describe the CAVE as a VR visualization system that uses projection technology on multiple walls of a room. Providing enhanced possibilities to visualize scientific content, the system also uses tracking mechanisms and stereo view technology to improve the immersive state. [Cruz-Neira et al. 1993, pp. 135-136]

Figure 4.57 shows the base construction and the placement of the hardware components. For illustration purposes, the outer wall is masked out.

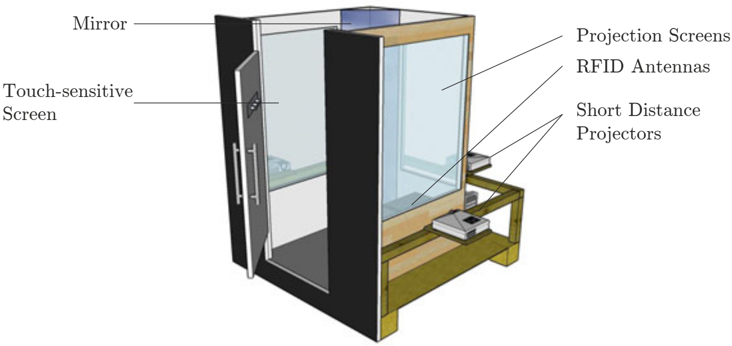


Figure 4.57 – Interactive Fitting Room: Hardware Setup
adapted from Malcher [2012, App. I]

Specific hardware devices are selected to realize the desired functionality. Considering the results of the technology portfolio analysis (cf. Chapter 4.2.2) the following technology is integrated into the prototype:

- **Short Distance Projectors:** ACER U5200 ultra short throw projectors with XGA resolution (1024x768 pixels) are used to display content via rear projection. A distance of 25cm to the projection walls is sufficient to show full screen images on the acrylic glass inlays.

- **RFID Reader and Antennas:** An Impinj Speedway Revolution R420 RFID reader (UHF 869MhZ) in combination with four Kathrein mid-range antennas (100 degrees of radiation angle) serves as the technology to automatically identify RFID-enabled products. The antennas are mounted on the roof as well as behind every wall.

- **Sound System:** A speaker system (Bose Companion 3) allows the integration of sound effects with animations and consequently to stimulate the auditory sense.

- **Capacitive Touch Foil:** One of the projection walls is equipped with a capacitive multi-touch foil. Being able to recognize two parallel touch points, touch gestures like pinch zoom and rotation can be implemented.

- **Multimedia PC:** To control the interactive content, a computer with Intel Core i7 3.4Ghz, 16GB RAM, 128GB Solid State Disk and ATI HD5870 Eyefinity 6 graphics card is used. This setup offers enough graphics power to control all displays with a single PC.

A potential technical issue of the concept is the detection reliability of the RFID tags mounted on the products. Detecting RFID tags works best, if the flat surface of the tag is oriented towards the antenna. The goal is to identify the articles when entering the fitting room and to avoid a loss of the tag during interaction. The prototype of the interactive fitting room uses ultra high frequency (UHF) tags. In contrast to the low frequency (LF) standard[17], UHF allows reading distances of up to several meters. By mounting the antennas on the ceiling and within the interior walls it is possible to cover all three spacial dimensions and consequently the complete internal space. This furthermore allows minimizing reading errors that may be caused through shielding tags. The unique ID stored in the RFID tags attached to the products is used for referencing the product information stored in the databases.

4.6.3 Implementation

A fully functional prototype is constructed in order to prove the concept's feasibility, to achieve a realistic impression of the interactive fitting room, as well as to test all single components and features. Figure 4.58 illustrates the final prototype and the immersive environment created. The furniture is built to withstand public presentations. Safety-relevant as well as ergonomic aspects are considered.

Figure 4.58 – Interactive Fitting Room: Prototype
adapted from Zagel and Bodendorf [2014, p. 539]

[17] For a detailed comparison of RFID standards see Franke and Dangelmaier [2006, p. 18].

Materials and surfaces identical to the ones used in traditional fitting rooms are employed. An additional coat-hanger as well as a stool ensure a certain level of comfort. Although using the prototype in a productive store environment is bound to certain limitations due to the size of the furniture, it is still well suited for evaluating the overall concept of the interactive fitting room. The social share functionality, realized through the smartphone-optimized website, is visualized in Figure 4.59. The design of the mobile UI changes accordingly to the product category at hand.

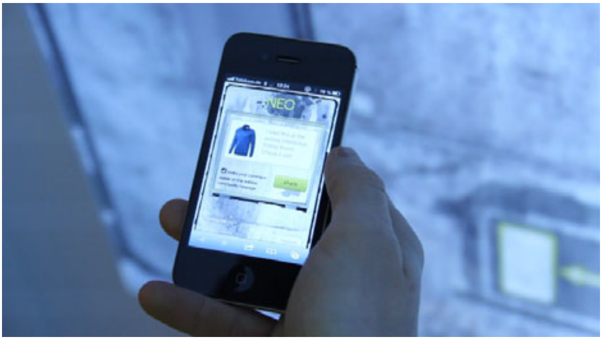


Figure 4.59 – Interactive Fitting Room: Social Share Prototype

4.6.4 Evaluation

4.6.4.1 Overview

The evaluation of the interactive fitting room prototype takes place in a laboratory environment and is performed amongst potential customers. Within the five day period, the subjects are introduced to the system and observed during use. A total of 67 users (28 female, 39 male) take part in the experiment and complete the survey. With an average age of 23.6 years, the study predominantly focuses on the digital generation. Table 4.29 provides an overview about the demographics. [Zagel et al. 2014b, pp. 177-190]

Table 4.29 – Interactive Fitting Room: Overview and Sample Demographics

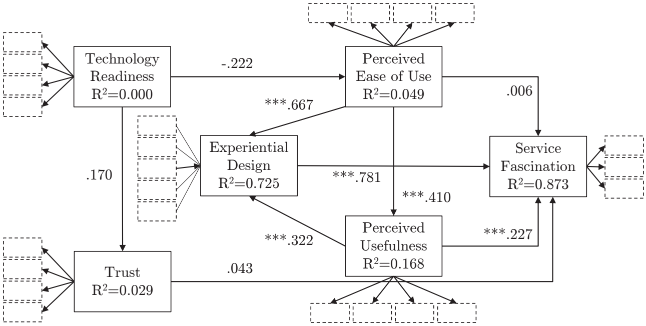
System Status	Prototype, laboratory experiment	
Location	University, Nuremberg, Germany	
Timeframe	05.03.2013 - 09.03.2013	
Samples	Female	28 (41.8%)
	Male	39 (58.2%)
	Total	67
Age	Minimum	14
	Maximum	35
	Median	24
	Average	23.6 (SD=4.73)
Participants	Potential customers, recruited at the university and on a shopping street	

As part of the experiment, the subjects are asked to choose between three different products: an outdoor, a fashion, and an urban lifestyle jacket. The users are therefore automatically directed to the respective product experience when entering the SST.

4.6.4.2 Subjective Measurement

4.6.4.2.1 Overall Model

The structural model is evaluated in SmartPLS 2.0 [Ringle et al. 2005] using 67 cases and 5000 samples (cf. Figure 4.60). On a measurement model level, the reflective constructs are validated based on the criteria of indicator reliability, internal consistency reliability, convergent validity, and discriminant validity. Items four and five of the service fascination construct (SF4 and SF5) are eliminated due to not reaching the thresholds of the Fornell-Larcker test. Experiential design constitutes the formative construct. Items AFF3 and AFF5 are dropped as the Cronbach's α of the affective dimension does not reach the proposed value of 0.7 Nunnally [1978, pp. 245-246]. It is validated using the item's indicator weights and the by examining multicollinearity. Some of the indicators do not provide significant influence towards the latent construct. Therefore, also the loadings of the items are examined. All of them show high significance towards the formative element. [Zagel et al. 2014b, p. 183]



*p<0.1; **p<0,05; ***p<0,001

Figure 4.60 – Interactive Fitting Room: Evaluation Results (Causal Model) adapted from Zagel et al. [2014b, pp. 177-190]

On a structural model level the validation is done using the coefficient of determination, the path coefficients, effect sizes, as well as the predictive relevance (cf. Table 4.30). For the interactive fitting room, H_1 claims a non-significant relationship between the user's technology readiness and perceived trust. [Zagel et al. 2014b, p. 185]

Table 4.30 – Interactive Fitting Room: Hypotheses
adapted from Zagel et al. [2014b, pp. 177-190] and Zagel and Bodendorf [2014, pp. 537-548]

	Hypothesis	*Path Coeff.*	*T-value*	f^2
H_1	Technology Readiness → PEOU	-0.2216	1.6486	0.052
H_2	Technology Readiness → Trust	0.1696	1.3349	0.030
H_3	Trust → Service Fascination	0.0427	1.1307	0.006
H_4	PEOU → PU	0.4095	4.6388	0.202
H_5	PEOU → Experiential Design	0.6673	10.9150	1.149
H_6	PU → Experiential Design	0.3221	4.1759	0.265
H_7	PEOU → Service Fascination	0.0061	0.1226	0.000
H_8	PU → Service Fascination	0.2273	3.6507	0.180
H_9	Experiential Design → Service Fascination	0.7809	8.6650	0.907

PU = Perceived Usefulness; PEOU = Perceived Ease of Use

$t \geq 1.65$ sig. level = 10%; $t \geq 1.96$ sig. level = 5%; $t \geq 2.58$ sig. level = 1%

$f^2 \geq 0.02$ "weak"; $f^2 \geq 0.15$ "medium"; $f^2 \geq 0.35$ "strong"

Also hypotheses H_2 and H_3 cannot be confirmed. Nevertheless, the highly significant relationship between PEOU and PU (H_4) confirms the robustness of the traditional TAM. Both, PEOU as well as PU are found to significantly influence the experiential design. While H_7 cannot be confirmed, PU as well as the experiential design significantly predict service fascination. The strong f^2 effect sizes of PEOU towards the experiential design as well as the one of experiential design towards service fascination underline the hypothesized relationships. [Zagel et al. 2014b, p. 185]

Overall, the system is rated very positive, with an almost homogenous perception of the experiential dimensions (cf. Figure 4.61). The sensory component is rated best, while social component is rated lowest. The subjects show a certain level of trust and describe themselves as technology ready.

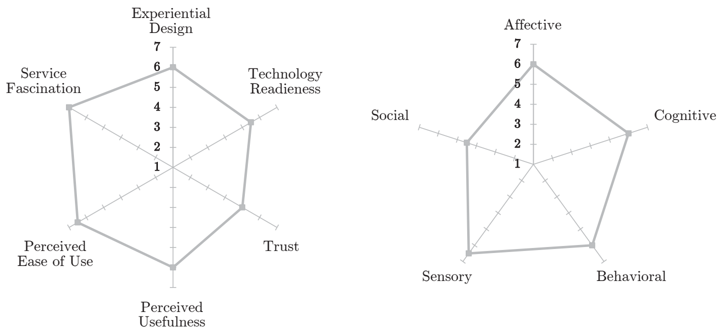


Figure 4.61 – Interactive Fitting Room: Evaluation Results

Furthermore, the interactive fitting room is perceived as easy to use and provides the subjects with a high amount of usefulness. The very positive assessment is reflected in the service fascination component, which constitutes a high overall experience and willingness to recommend and actively promote the SST.

R^2 values of 0.725 and 0.873 argue for a substantial stake of explained variance of the endogenous target variables experiential design and service fascination. The model is consequently well suited for explaining both constructs. All other constructs feature low coefficients of determination, indicating further dependencies apart from the observed variables (cf. Table 4.31). Stone-Geisser's Q^2 values exceed the critical level of 0 and testify a very strong predictive relevance for the service fascination criterion.

Table 4.31 – Interactive Fitting Room: Evaluation Results
adapted from Zagel et al. [2014b, pp. 177-190] and Zagel and Bodendorf [2014, pp. 537-548]

	Dimension	α	*Md*	$\overline{x}$	*SD*	R^2	Q^2
Service Fascination	Perceived Usefulness	0.891	6	6.01	0.79	0.168	0.0909
	Perceived Ease of Use	0.938	6.5	6.10	1.16	0.049	0.0468
	Trust	0.958	5	4.94	1.36	0.029	0.0290
	Technology Readiness	0.719	5.5	5.39	1.14	0.000	—
	Service Fascination *	0.950	7	6.34	0.77	0.873	0.7883
	Experiential Design	—	6	6.01	0.79	0.725	—
Experiential Design	Affective **	0.723	6	6.12	0.91	—	—
	Cognitive	0.847	6	6.00	0.95	—	—
	Behavioral	0.891	6	5.42	1.35	—	—
	Sensory	0.947	6.5	6.17	1.08	—	—
	Social	0.813	5	4.93	1.13	—	—

α = Cronbach's Alpha; Md = Median; $\overline{x}$ = Mean; SD = Standard Deviation; Q^2 = Stone Geisser's Q^2

$R^2 \geq 0.67$ "strong"; $R^2 \geq 0.33$ "medium"; $R^2 \geq 0.19$ "weak"

$Q^2 \geq 0.35$ "strong"; $Q^2 \geq 0.15$ "medium"; $Q^2 \geq 0.02$ "weak"

* Service Fascination: Items 4 and 5 dropped; ** Affective Dimension: Items 3 and 5 dropped

4.6.4.2.2 Gender Splitup

A gender-based segmentation of the results provides additional insights on the system design's effects (cf. Figure 4.62).

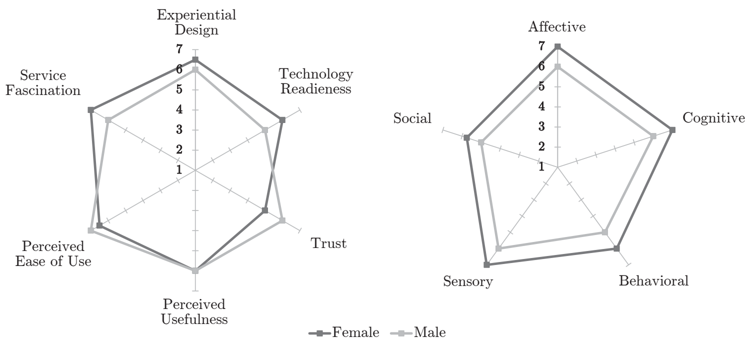


Figure 4.62 – Interactive Fitting Room: Evaluation Results (Gender Splitup)
adapted from Zagel et al. [2014b, pp. 177-190] and Zagel and Bodendorf [2014, pp. 537-548]

An interesting finding is that while women show less trust in technology, the ratings testify a deeper and more positive perception of the experiential system design if compared to men [Zagel and Bodendorf 2014, p. 546]. Table 4.32 shows the ratings separated into genders, including the results of a mean comparison of the independent samples (t-test) and the effect sizes using Cohen's d.

Table 4.32 – Interactive Fitting Room: Evaluation Results (Gender Splitup) adapted from Zagel et al. [2014b, pp. 177-190] and Zagel and Bodendorf [2014, pp. 537-548]

		Females (N=28)			*Males (N=39)*				
	Dimension	*Md*	$\overline{x}$	*SD*	*Md*	$\overline{x}$	*SD*	*p*	*d*
Service Fascination	Perceived Usefulness	6	6.07	0.65	6	5.97	0.89	0.607	0.125
	Perceived Ease of Use	6.5	6.25	0.79	7	5.99	1.37	0.325	0.223
	Trust	5	4.80	1.01	6	5.04	1.57	0.459	0.176
	Technology Readiness	6	5.91	0.85	5	5.01	1.14	0.001	0.874
	Service Fascination	7	6.64	0.68	6	6.13	0.77	0.006	0.695
	Experiential Design	6.5	6.39	0.69	6	5.74	0.91	0.002	0.787
Experiential Design	Affective	7	6.64	0.78	6	5.74	0.82	0.000	1.120
	Cognitive	7	6.29	0.98	6	5.79	0.89	0.037	0.539
	Behavioral	6	5.91	1.09	5	5.06	1.42	0.007	0.657
	Sensory	7	6.54	0.76	6	5.91	1.20	0.011	0.606
	Social	5.75	5.29	1.13	5	4.67	1.08	0.026	0.563

Md = Median; $\overline{x}$ = Mean; SD = Standard Deviation; p = Significance; d = Effect Size

$p \leq 0.05$ sign. level = 5% - $d \geq 0.2$ "small"; $d \geq 0.5$ "medium"; $d \geq 0.8$ "large"

While only trust features a small effect size, each of the experiential criteria show high significances and effect sizes of at least medium magnitude. Both genders accredit the system the same usefulness. Nevertheless, women perceive a stronger service fascination and therefore a higher willingness to use and promote the SST. It is therefore possible to also confirm the hypothesized positive relationship between perceived experiences and the intention to use a system. [Zagel et al. 2014b, p. 185]

4.6.4.3 Objective Measurement

In addition to the completion of the survey, the subjects are observed during interaction. Table 4.33 provides detailed insight into the observed behavior in relation to the basic, rejection, and experiential dimensions.

Table 4.33 – Interactive Fitting Room: Observed Behavior

Basic Dimensions
The combination of the physical product at hand with digital information and the surrounding immersive experience is perceived to provide additional value to the users.
Especially the possibility to receive additional information on colors, product stock, and product characteristics is perceived as a major benefit. The same applies for product combinations proposed.
In some cases the system loses the RFID tag (especially when the user's body shields the tag) which leads the user back to the idle animation. Users get confused as this abruptly stops the interaction process.
Due to the security threshold of the RFID logic component it takes up to four seconds to start the animation after the user entered. This in some cases leads to confusion of the subjects.
Rejection Dimensions
Women show obvious security concerns, especially in regards to the social share functionality.
The major part of subjects do not show any security concerns regarding the RFID technology.
Providing or receiving feedback for products at hand is not perceived as a potential risk, as no personal data is required.
Independent of age or gender, the system is perceived as easy to use and the process is well understood.
Experiential Dimensions
Subjects have fun using the system.
The automatic product detection surprises the users.
The SST creates a state of immersion. Subjects are eager to experiment with the SST and all it's features. They get deeply involved in the system, cut off from what happens around them. This especially applies for women.
The table is continued on the next page

Sound, especially if it is used as an enhancement of the virtual environment (e.g., birds singing), enhances the immersive state of the subjects.
Almost all of the subjects are excited by being surrounded by the animated virtual environment.
The multisensual approach is perceived as appealing.
In contrast to men, women tend to use the system together with their female friends.
The social share feature is almost exclusively used by male subjects.
Women emphasize the emotional value of the system, while men see the value in the utilitarian components.
General Behavior
Users in general see a lot of potential in the system. Many subjects ask, when the technology will be widely available.
Younger customers are more eager to use and experiment with the system.
Men show great interest in how the technology works.
Some subjects express the fear, that in a productive environment the service might work counterproductive as customers would block the interactive fitting rooms for a long time.
Customers that like the experience tend to also experiment with other products.
Cross and upselling information provided as part of the experience leads to an increased awareness of outfit combinations and potentially to additional sales.

The observation confirms the high attractiveness of the self-service system. Especially the immersive environment and the stimulation of multiple senses at once account for the positive experience. An easy understandability of the device's purpose (all of the subjects are used to traditional dressing rooms) supports the affirmative perception.

4.6.4.4 Summary

For the evaluated SST, the results show remarkable differences in regards to the perception of male and female users. While women tend to mistrust technology they show a more intense perception of the system's experiential design features. In general, the system is perceived as highly interesting, which leads to desirability. Customers have fun using the device. The entertaining value encourages the subjects to also use the system with different products just to see how the experience changes. While the system is regarded as usable, the RFID component tends to cause issues in regards to bad or slow tag recognition.

Nevertheless, the results of the study are limited by the small sample size of 67 participants. Further investigations and a broader target audience might also reveal more detailed perception differences in relation to the customer's age.

4.6.5 Improvement

Improving the system for achieving maximum success in a productive environment involves a modification of the hardware setup used. This covers two parts: solving the usability issues caused by the RFID system as well as an optimization of the setup for possibly integrating the technology into existing dressing rooms.

A disadvantage of wireless technologies in the ultra high and microwave frequency band is a reduced efficiency caused by electromagnetic absorption. Metal objects and also human flesh heavily influence the detection performance of tags [Chang and Chen 1997, pp. 544-559; Scanlon and Evans 2001, pp. 53-64]. As a consequence the system may loose the tag or tags might not be readable at all if constantly shielded. In the presented prototype this leads to an interruption of the experience. Although the logic component buffers detected tag IDs for several seconds losses still occur, if the tag is covered for an extended time span. This buffer furthermore may lead to an offset of some seconds between entering the fitting room and the start of the product-specific animation. To improve the stability, additional sensors can be integrated. These can be used to detect, if the customer (together with the product) is still inside of the fitting room or not. Furthermore, the exact moment of entering can be detected with increased accuracy. Light barriers are a cheap, robust, and flexible technology that can be used for position sensing and detecting if a person enters the room [Kohl 2004, p. 212]. Next to other motion detection mechanisms, also pressure or weight sensors integrated into the floor may be applied for this purpose [Fraden 2010, pp. 247-248].

For productive environments, the back projection setup furthermore needs to be replaced by large LED screens. This saves store space and furthermore enables displaying the digital contents in a higher resolution. Nevertheless, the biggest advantage is space savings in the store, as the interior wall can be removed or resized to a minimum.

In addition, also a functional enhancement can increase the perceived usefulness of the system and open up interesting business opportunities. An integration of the low-cost body scanner hardware (cf. Chapter 4.4) or using the results of the body measurements (e.g., by linking both systems to a central consumer database) allows a further support of the consumers in their buying process (cf. Figure 4.63). [Zagel et al. 2014d; Zagel et al. 2014c]

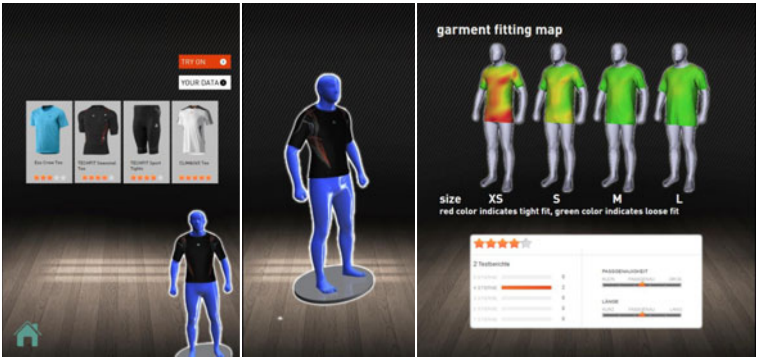


Figure 4.63 – Interactive Fitting Room: Body Scanner Integration

This enhancement not only provides the recommendation of clothes based on the body measurements of the customer. It furthermore allows simulating garments on the customer's body and to visualize the fit of different garment sizes. Additional value can be provided by not only recommending relevant supplements based on the products automatically detected, but also through simulating complete outfits on the customer's body. In a practical environment, this linkage between both self-service systems can happen through a RFID-enabled loyalty card or the customer's personal smartphone. [Zagel et al. 2014d; Zagel et al. 2014c]

4.7 Social Mirror

4.7.1 Motivation and Goal

"Shopping has always been a social experience. Before the invent of cameras and emails and smart phones and Facebook, people always discussed their favorite stores, newly purchased items and that new line of dresses at the shop in town. Similarly, the rise of social media platforms did not stop people from coming into a store, taking a picture of a beautiful pair of shoes and sending it to their friend. Social media simply provided an outlet for people to share this information with a wider audience" [Blackley 2013].

Within retail fashion stores, mirrors are regarded an essential interior design element [Ebster and Garaus 2011, pp. 49-50] that provides the basis for purchase decision making [Begole 2011, pp. 201-226]. Mirrors are usually used to perform a fit and style assessment. This not only includes the shape and drape of the garment, but also an assessment of how well the garment suits the customer. This fit and style perception influences the purchase decision and is to a large extent also mediated by the customer's social context. This for example includes current style trends and the opinions of families and peers [Chu et al. 2010, p. 2533]. In addition, social connectivity and shopping with friends leads to increased happiness amongst teenagers which in turn results in additional purchases [Mangleburg et al. 2004, pp. 101-116]. The positive influence of peers towards the shopping behavior is also proven in further studies [Goodrich and Mangleburg 2010, pp. 1328-1335]. This circumstance not only applies for real-life interactions, but also for computer-mediated social contacts. Opinions towards products or brands, also if posted on the Internet by strangers, show high credibility and relevance to potential customers [Bickart and Schindler 2001, pp. 31-40]. The Internet, especially in the context of social media, furthermore provides a platform for real-time self-portrayal, allowing users to show off and publicly identify with their brands [Qualman 2010, p. 13].

In the recent years, first attempts are done to bring both components together in order to support customers in their shopping process. Social activities are integrated into the retail shopping experiences and companies try to benefit from this changing consumer behavior. Gehrckens and Boersma [2013, p. 66] describe these systems as multi-channel concepts that integrate recommendation processes into local stores. It is furthermore seen as an example for social shopping that enables friend's participation in the shopping experience [Eichsteller and Schwend 2012, p. 412].

The following section presents the prototype of an interactive self-service system that integrates social media into the physical retail store experience. It serves the goal of supporting the customers in their decision making by virtually connecting them with peers. This supports the customer's desire of self-expression and encourages others to provide feedback on the articles at hand.

4.7.2 Ideation

4.7.2.1 Service Concept

The Social Mirror is a SST that allows consumers to connect with their friends and other consumers while shopping in the retail store. The device provides its users with a fun way to take pictures, to record short videos, and to share their look on favorite social networking platforms. In addition, comments can be added to the media content. Next to posting the images on private profiles it is also possible to release the posts to the brand's social media sites. Furthermore, sales assistants can use the system to post content in order to promote articles and to engage with consumers on the social platforms.

While the aim is to provide utilitarian value through integrating third parties into the shopping process, the main goal is to deliver an entertaining element for the retail store (cf. Figure 4.64).

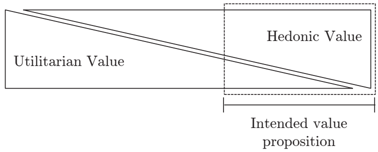


Figure 4.64 – Social Mirror: Utilitarian vs. Hedonic Value

The intended implementation of the basic and rejection components is portrayed in Table 4.34. In order to realize the basic value proposition of taking pictures and uploading them to a social network, certain premises need to be taken into account. A non-fulfillment inevitably leads to not being able to efficiently use the SST.

Table 4.34 – Social Mirror: Basic Design Elements

Dimension	*Realization*
Perceived Usefulness	The system provides the consumer with the possibility to take pictures and upload them to favorite social networks. These pictures can be published on the consumer's own profile as well as on a public brand profile linked to the store. By doing so, the consumers can ask their friends or even strangers for feedback on their outfits. Short comments can be added in order to leave a message to the viewers.
Perceived Ease of Use	All interfaces follow the guidelines of DIN EN ISO 9241 (particularly DIN Deutsches Institut fuer Normung e.V. [1999], DIN Deutsches Institut fuer Normung e.V. [2008a], and DIN Deutsches Institut fuer Normung e.V. [2011a]) and are designed in an easy to use way. After several user evaluations, the interface is simplified to a maximum, allowing efficient and fast interaction. Short user guidelines are displayed in order to explain the functionality and the actual step in the process.

The table is continued on the next page

Trust	Entering the personal login data to social networks happens on the terminal using a separate 15" touchscreen display. Limiting the data entry to this small part of the device ensures a certain level of privacy. Nevertheless, logging in with a personal account is a prerequisite for using the SST.
Technology Readiness	By using state-of-the art touchscreen technology and limiting the functionality to a specific feature set, the goal is to reach a broad consumer group. Hence, being a member of a social network is required for uploading pictures.

The primary goals of the social mirror are reflected in the respective experiential criteria to be implemented. Great importance is attached to integrating a new level of social interaction into the traditional shopping process. By using the system the customer is able to ask others for feedback in regards to their outfits. This intends to reflect on a change of the traditional shopping behavior. Furthermore, the SST intends to enhance the entire shopping experience by providing a service that is fun to use. The intended integration of the experiential components is illustrated in Table 4.35. Technologies and design methodologies identified before (cf. Chapter 4.2.2) are applied. Focus is laid on personalization. By integrating the technology into a standard component of fashion stores (a mirror) unobtrusiveness is achieved.

Table 4.35 – Social Mirror: Experiential Design Elements

Dimension	*Realization*	*Focus*
Affective	Next to its utilitarian value the system is designed to make the shopping experience more appealing by integrating social aspects. A semi-transparent mirror, covering the front surface of the SST, is intended to surprise the customer when revealing multimedia content. Furthermore a state of immersion is realized by showing the user's reflection and the social contents at the same time.	◑
Cognitive	Just as recommendations in online shopping, near-time feedback from friends or other clients over social media confirms or contradicts the consumer's buying decision.	◔

The table is continued on the next page

Behavioral	Consumers hesitate asking store personnel for help. Therefore, the system offers the possibility to integrate friends and strangers into the shopping experience and ask them for feedback, even if they do not physically participate in the purchase process. Positive replies can lead consumers to buy additional products.	◕
Sensory	By integrating visual, auditory, and haptic elements through multimedia content and touch interaction, multiple senses are be stimulated in parallel.	◔
Social	The social aspect is in the focus of the concept. It is possible to use the system together with friends and to connect to others via social media.	●
	● main focus ◕ strong focus ◑ medium focus ◔ minor focus ○ no focus	

4.7.2.2 User Interface and Interaction

Following the goal of supporting the social networks Facebook and Twitter, the UI is split up into three elements. The initial step acts independently of a specific network selection and is used to initiate the first contact with the system (cf. Figure 4.65). A "share your look" communication is used to attract the consumer. As soon as the user taps on the "take a picture" element at the bottom, the capturing process is started. The customer is asked to take position in front of the device and to look at the mirror. Meanwhile, the large display shows a five second countdown as a visual feedback while the picture is taken. Once the picture is captured it is displayed on the touchscreen and the system offers the possibility to either retake the picture or to post it to a social network. After tapping on the "share your look"' button, the system asks for choosing between the networks Facebook and Twitter.

Figure 4.65 – Social Mirror: User Interface Application Flow

Selecting the desired social network forks the navigation into two separate processes. When choosing Facebook as the desired target network, the user is lead to a page where he/she is able to define if the image should be posted only on the personal profile or also to the brand's public photo album (cf. Figure 4.66). The second step allows the user to add a personal message, which is automatically extended by a short promotional text naming the store the picture is taken in.

Figure 4.66 – Social Mirror: User Interface Facebook

Facebook requires its members to release third party applications to interact with their profiles. This also applies to the social mirror. If a customer uses the device for the first time, he/she is asked to opt in. As soon as this step is completed, the image is uploaded and the customer receives a visual feedback of the upload status with a final confirmation.

A similar process applies for the Twitter upload (cf. Figure 4.67). Instead of being able to post the image to the public brand site, the user has the possibility to add a predefined hash tag which is linked to the brand's social media presence. After logging in the image is uploaded and the user receives a confirmation of the successful process.

Figure 4.67 – Social Mirror: User Interface Twitter

4.7.2.3 Service Delivery System

A software application is developed to realize the core functionality. In order to deliver a positive experience consumer observations and usage tracking methods are used to consistently improve the usability of the system during development and to adapt it to changing consumer habits. The software system consists of the following elements:

- **Local Applicaton:** A stand-alone application for installation on the SST is used to realize the desired functionality. This application covers the basic configuration data (e.g., location of the store and respective picture album on the social network) and is implemented using Microsoft .NET 3.5[18] and Windows Presentation Foundation (WPF)[19]. It allows taking pictures or videos and to upload them to the social networks Facebook and Twitter.

- **Social Network API:** The social networks offer APIs that allow connecting third party applications. Facebook therefore employs the Facebook Graph API, making it possible to upload pictures to private and/or to public profiles. The same applies to other social networking platforms like Twitter and Instagram and their individual interfaces.

- **Facebook Application:** In order to connect external applications to Facebook and to realize the possibility of uploading content it is required to create a Facebook application using a developer account. This application also controls the links to public image libraries, the security settings, and allows monitoring the service usage.

- **Picture Albums:** Next to the consumer's private picture album it is possible also to upload images to the store's public social media albums. Therefore, every store

[18] cf. http://www.microsoft.com/net

[19] The Windows Presentation Foundation is part of Microsoft .NET framework and serves as a graphical subsystem [Huber 2011, pp. 39-42].

needs to create its own library, which allows advertizing specific local events and promotions.

- **Network Connection:** As the system needs to connect to the respective social networks it needs to be ensured, that all network ports required are accessible. Furthermore, the upstream of the Internet connection needs to be fast and stable enough to ensure a positive consumer experience.

The Facebook Graph API conforms to Facebook's user and development policies. This means that in some cases the functionality provided to the users is limited due to the user's personal security settings, bugs on the platform, or due to a change in the provider's development focus.

4.7.2.4 Technical Setup

The system is implemented to meet the demands of a SST for productive use in ten retail stores. The goal therefore is to fulfill security requirements and to provide a good usability from the start. Being developed to fit the design of the corresponding store furniture, the device comprises the following components:

- **Base Terminal:** The base enclosure consists of a standard eKiosk PHEX 40[20] information terminal. All hardware components required for realization of the use case are embedded. In order to improve the immersive effect, the standard front panel is replaced by a semi-transparent mirror. This mirror hides the display mounted behind and only reveals digital content if shown in high brightness. In order to better fit the store layout and the store furniture, the base plate is changed from a curved to a rectangular shape. Figure 4.68 (left) shows the measurements of the chassis.

- **Large Format Display:** A 40" digital signage display with FullHD resolution (1920x1080 pixels) is used to present large format communication and advertisements. The display has a brightness of 700 cd and is mounted behind the mirror surface of the base terminal.

- **Touchscreen:** An additional touchscreen display attached to the front of the mirror enables the user to interact with the system. The hardware setup includes an ELO 1517L display with iTouch surface wave technology and offers a resolution of 1024x768 pixels at 15".

[20] cf. http://www.ekiosk.de

- **Touchscreen Carrier:** In order to allow a comfortable interaction with the terminal, the touchscreen is mounted on a carrier that is built under consideration of ergonomic factors (cf. Figure 4.68, right).

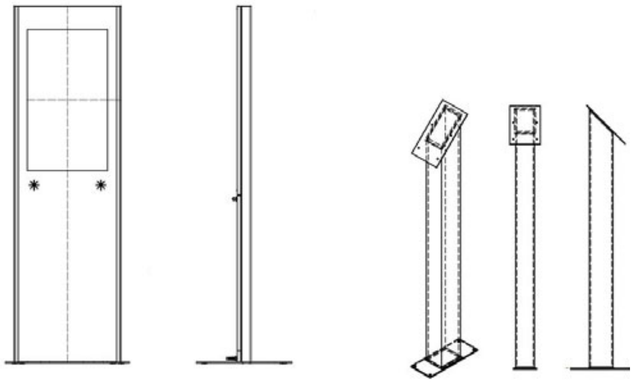


Figure 4.68 – Social Mirror: Housing

- **Sound System:** For integrating audio into the device, a VISION AV-1600 digital amplifier (2x 25 Watts RMS at 8 Ohm) is used in combination with a mechanical vibration speaker. This speaker uses the glass front panel of the base terminal as a resonating body.

- **Camera:** A Logitech QuickCam Pro 9000 is integrated for taking the pictures. This camera is small enough for being mounted into the terminal and offers the possibility to capture videos and still images at a resolution of up to 2 Megapixels (MP).

- **Computer System:** As a central hub to control the application as well as the interfaces to the social media platforms, a DELL Optiplex 990 USFF system is used. The computer is equipped with a Core i7-2600S CPU, 8GB RAM, 128GB SSD and two graphics outputs. This allows controlling the large format display as well as the touchscreen using a single PC.

The items described above form one common self-service system. Figure 4.69 illustrates the physical presence and orchestration.

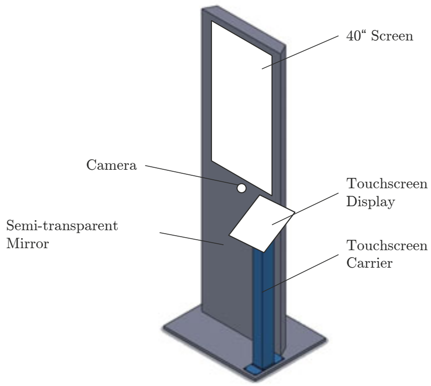


Figure 4.69 – Social Mirror: Construction

4.7.3 Implementation

The term "Social Mirror" is derived from its large, reflective front surface covering the camera as well as the large format display. This semi-transparent mirror glass is used to hide the display and the camera, allowing to only reveal the digital content as soon as the display shows others than black colors. When turned off, it is therefore not possible to recognize the technology assembled behind the glass and the user gets the impression of standing in front of a traditional mirror. The goal is to integrate the technology in an unobtrusive way and to surprise the consumer by messages appearing. The SST presented is in productive use. Eleven devices are placed in ten stores throughout Germany (cf. Figure 4.70). Since 2012, several thousand images are taken and uploaded to the social networks. Hundreds are also released to the brand's public picture album. Comments posted to uploaded pictures furthermore reveal, that the new service has the potential to lead consumers into the store because of their willingness to experience the new technology. This can in a further step result in additional sales through impulse purchases.

Figure 4.70 – Social Mirror: Prototype
© adidas Group

4.7.4 Evaluation

4.7.4.1 Overview

The evaluation takes place in a productive environment within a retail store in Germany. While in total ten stores are equipped with the identical technology, only one store is used for the evaluation. The assessment takes place during shopping hours and by end of 2013, almost two years after the system's initial release. In total, 432 customers entering the store are asked for participation. Nevertheless, only 68 take part in the evaluation and complete the service fascination survey after interacting with the SST. As the brand has a strong focus on girl fashion, the majority of the subjects is female and comparably young. Table 4.36 provides an overview on the study. [Zagel and Bodendorf 2014, pp. 537-548]

Table 4.36 – Social Mirror: Overview and Sample Demographics

System Status	Productive	
Location	Retail fashion store, Nuremberg, Germany	
Timeframe	09.12.2013 - 13.12.2013	
Samples	Female	55 (80.9%)
	Male	13 (19.1%)
	Total	68
Age	Minimum	13
	Maximum	30
	Median	21
	Average	20.35 (SD=4.25)
Participants	Customers, recruited in the store	

4.7.4.2 Subjective Measurement

4.7.4.2.1 Overall Model

As proposed before, the SST is evaluated using the item set developed in Chapter 3.3.2.5. The causal model is analyzed in SmartPLS 2.0 [Ringle et al. 2005] (68 cases, 5000 samples) and validated against the respective quality criteria for PLS modeling. Despite the technology readiness criterion, all reliabilities of the reflective constructs exceed Nunnally's recommended levels [Nunnally 1978, pp. 245-246]. To also reach a Cronbach's α value exceeding the threshold of 0.7, item TECH2 is dropped. All other reflective quality criteria are well accomplished. [Zagel and Bodendorf 2014, pp. 537-548]

For the formative construct experiential design, some of the indicator weights do not significantly influence the latent construct. Consequently, and as proposed by Huber [2012, p. 23], also the loadings are examined which show high significance. A VIF of less than 2,55 indicates low multicollinearity and adheres to the proposed thresholds. Figure 4.71 illustrates the results of the causal model evaluation.

The structural model is assessed by testing the hypotheses in form of the directional paths, the variance explained (R^2), the construct's effects, as well as using the model's predictive relevance. With R^2 values of 0.555 and 0.607, the model is able explain the two target constructs with a medium stake. The low values of the other latent variables indicate the existence of further root causes. [Zagel and Bodendorf 2014, pp. 537-548]

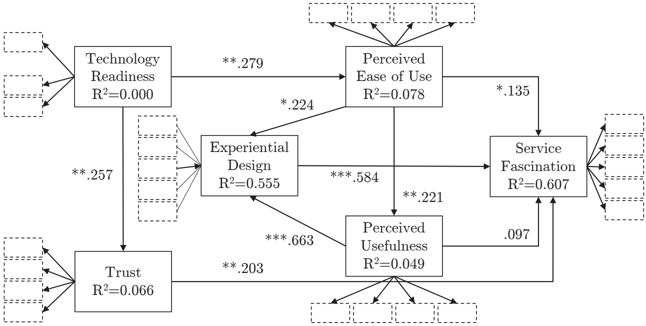


Figure 4.71 – Social Mirror: Evaluation Results (Causal Model) adapted from Zagel and Bodendorf [2014, pp. 537-548]

Detailed results are depicted in Table 4.37. With the exception of H_8, all hypotheses can be confirmed. It is possible to ratify the traditional TAM's robustness through the significant relationship between PEOU and PU.

Table 4.37 – Social Mirror: Hypotheses adapted from Zagel and Bodendorf [2014, pp. 537-548]

	Hypothesis	*Path Coeff.*	*T-value*	f^2
H_1	Technology Readiness → PEOU	0.2788	2.0513	0.085
H_2	Technology Readiness → Trust	0.2574	2.4089	0.071
H_3	Trust → Service Fascination	0.2025	2.3723	0.094
H_4	PEOU → PU	0.2207	2.1433	0.052
H_5	PEOU → Experiential Design	0.2236	1.7622	0.061
H_6	PU → Experiential Design	0.6627	7.2384	0.746
H_7	PEOU → Service Fascination	0.1354	1.6604	0.041
H_8	PU → Service Fascination	0.0969	1.0919	0.010
H_9	Experiential Design → Service Fascination	0.5845	4.8233	0.377

PU = Perceived Usefulness; PEOU = Perceived Ease of Use

$t \geq 1.65$ sig. level = 10%; $t \geq 1.96$ sig. level = 5%; $t \geq 2.58$ sig. level = 1%

$f^2 \geq 0.02$ "weak"; $f^2 \geq 0.15$ "medium"; $f^2 \geq 0.35$ "strong"

Highly significant relationships can also be identified between PU and experiential design, and between experiential design and service fascination. Both furthermore show strong effect sizes, indicating a large influence of the exogenous latent variables towards the endogenous constructs.

The structural model furthermore delivers a predictive relevance of Stone Geisser's Q^2 for all reflective constructs above the critical level of 0 (cf. Table 4.38). The overall results of the evaluation testify a very high technology readiness of the subjects. In general, users perceive the system as easy to use. However the low rating of the two components trust and perceived usefulness indicate potential weaknesses of the system. Especially the lack of trust might be a consequence of the real life scenario and the requirement to log in to the social network in order to being able to adequately use the service. A comparably poor rating applies for the experiential dimensions, leading to a weak overall experiential design grading. Nevertheless, the affective component is perceived slightly positive.

Table 4.38 – Social Mirror: Evaluation Results
adapted from Zagel and Bodendorf [2014, pp. 537-548]

	Dimension	α	*Md*	$\overline{x}$	*SD*	R^2	Q^2
Service Fascination	Perceived Usefulness	0.936	3.75	3.31	1.81	0.049	0.0438
	Perceived Ease of Use	0.851	6	5.93	1.23	0.078	0.0488
	Trust	0.927	3	3.10	1.66	0.066	0.0526
	Technology Readiness *	0.702	7	5.99	1.39	0.000	—
	Service Fascination	0.926	4	4.19	1.87	0.607	0.4510
	Experiential Design	—	4	4.21	1.42	0.555	—
Experiential Design	Affective	0.872	5	5.01	1.64	—	—
	Cognitive	0.868	4	4.41	1.74	—	—
	Behavioral	0.915	4	3.54	1.82	—	—
	Sensory	0.806	4	3.84	1.40	—	—
	Social	0.751	4.5	4.17	1.50	—	—

α = Cronbach's Alpha; Md = Median; $\overline{x}$ = Mean; SD = Standard Deviation; Q^2 = Stone Geisser's Q^2

$R^2 \geq 0.67$ "strong"; $R^2 \geq 0.33$ "medium"; $R^2 \geq 0.19$ "weak"

$Q^2 \geq 0.35$ "strong"; $Q^2 \geq 0.15$ "medium"; $Q^2 \geq 0.02$ "weak"

* Item TECH2 dropped

Figure 4.72 provides a visual representation of the assessment divided into the experiential dimensions as well as the components evaluated through the service fascination questionnaire.

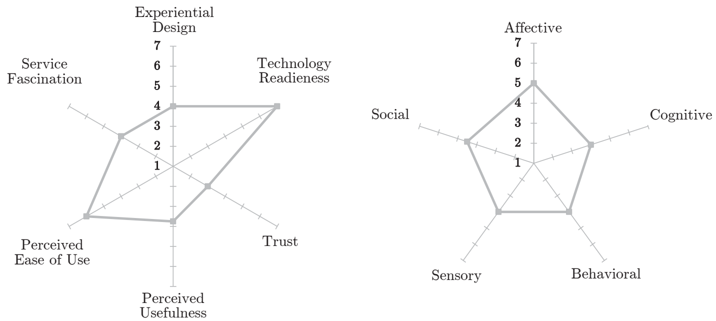


Figure 4.72 – Social Mirror: Evaluation Results

4.7.4.2.2 Gender Splitup

Splitting up the results into feedback provided by male and female subjects provides additional insight on the effects of SST use (cf. Figure 4.73). An interesting finding is that while females show significantly less trust in technology they perceive the experiential design dimensions with a higher or at least the same intensity as compared to men. [Zagel and Bodendorf 2014, pp. 537-548]

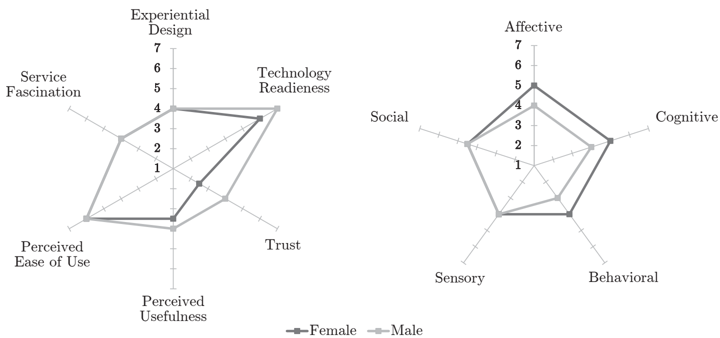


Figure 4.73 – Social Mirror: Evaluation Results (Gender Splitup) adapted from Zagel and Bodendorf [2014, pp. 537-548]

This variation is also confirmed by the given significances (T-test) and effect sizes (cf. Table 4.39). The mean difference of the trust ratings is highly significant with a very strong effect size of 0.761. When examining the experiential elements, except for the sensory component, all dimensions show medium to strong effect sizes. Nevertheless, the results are weakened by the large difference in group sizes (55 females vs. 13 males).

Table 4.39 – Social Mirror: Evaluation Results (Gender Splitup)

		Females (N=55)			*Males (N=13)*				
	Dimension	*Md*	$\overline{x}$	*SD*	*Md*	$\overline{x}$	*SD*	*p*	*d*
Service Fascination	Perceived Usefulness	3.5	3.20	1.72	4	3.77	2.19	0.313	0.314
	Perceived Ease of Use	6	6.06	1.11	6	5.93	1.23	0.164	0.113
	Trust	2.5	2.86	1.51	4	4.08	1.97	0.017	0.761
	Technology Readiness	6	5.84	1.45	7	6,54	0.97	0.111	0.509
	Service Fascination	4	4.22	1.78	4	4.08	2.29	0.809	0.074
	Experiential Design	4	4.29	1.29	4	3.85	1.92	0.314	0.112
Experiential Design	Affective	5	5.18	1.55	4	4.31	1.89	0.085	0.538
	Cognitive	5	4.51	1.69	4	4.00	1.96	0.400	0.293
	Behavioral	4	3.62	1.77	3	3.23	2.10	0.495	0.213
	Sensory	4	3.83	1.40	4	3.88	1.50	0.896	0.035
	Social	4.5	4.28	1.31	4.5	3.69	2.12	0.352	0.396

Md = Median; $\overline{x}$ = Mean; SD = Standard Deviation; p = Significance; d = Effect Size

$p \leq 0.05$ sign. level = 5% - $d \geq 0.2$ "small"; $d \geq 0.5$ "medium"; $d \geq 0.8$ "large"

4.7.4.3 Objective Measurement

An observation of the subjects supports the subjective findings and discloses further insights about the respective dimensions and general user behavior. The observation notes are taken during the assessment and intend to reflect the customer's emotions while using the SST (cf. Table 4.40). The following behavior is observed:

Table 4.40 – Social Mirror: Observed Behavior

Basic Dimensions
Misspellings often occur when entering comments or login data due to the small size of the digital keyboard.
Some users don't see value in using the system, as their modern smartphones offer similar functionality.
Due to a false calibration of the touchscreen people are sometimes not able to enter their data or several tries are required. As a consequence, some of them stop the process due to frustration.
A malfunctioning system leads to bad word-of-mouth which in turn prevents others to use the system.
Some customers do not understand that they have to position themselves in a certain distance for taking a picture of their entire body.
The communication of the software in English language is not well understood. Sometimes it is not understood at all.
Image quality is perceived sufficient despite the camera's low resolution.
Especially girls take multiple pictures in order to chose the one they like best.
Picture upload is too slow, which annoys users.
Rejection Dimensions
Users are afraid of entering their login data to the social networks on a public device.
Especially users above the age of 30 have security concerns about what happens with their login data and the pictures taken.
Around 40% of the users are not able to upload their images due to their personal security settings in the social network.
Some customers take pictures, but then stop the process before uploading.
Only a very small proportion of customers (two customers) also release their image to the company's public picture album.
Some young customers are not able to participate in the evaluation as they are not registered to any social network.
Many users avoid using social networks in general. Uploading pictures of themselves is perceived embarrassing.
Experiential Dimensions
The one-way mirror surprises customers that initially thought it was a standard mirror.

The table is continued on the next page

Sound does not have any effect and is in most cases not recognized at all due to the general loudness in the store.
The system is almost exclusively used by groups.
Customers have fun using the system, especially when used in groups.
Users would like to upload the pictures directly to the profile of their friends.
Customers wish to have the functionality of linking their friends and their social network profiles to the pictures.
General Behavior
Customers do not only use the system when trying on new outfits. The majority of pictures (ca. 90%) is taken with unspecific (e.g., from other brands) garments.
The majority of users is female.
Many of the customers do not recognize the system while striving through the store. The reason is the mirrored surface, because of which the device is believed to be a traditional mirror.
The SST is not well positioned. People do not recognize the device as it is not prominently presented in the store.
Twitter is not used at all. Nevertheless, subjects ask for an integration of Instagram and an email functionality.
Many customers miss a printing or emailing functionality as an addition to the social network share.

Based on the field notes taken it is possible to confirm the major issues already identified in the subjective measurement: a lack in trust and usefulness. In addition and in contrast to the subjective measurement, it is possible to identify several weaknesses regarding the system's usability. Although the subjects rate the system as easy to use, entering user names and passwords on the small touchscreen keyboard causes issues. This in some cases leads to frustration and to a termination of the process. The same applies to the bad comprehension of the English language, especially for younger user groups. Due to the inconspicuous installation of the device, it is by some customers mistaken for a standard mirror. This fact leads to two types of behavior: either customers do not notice the additional functionality at all or they get surprised if they do. In most cases, the device is used by groups of customers. This adds to the social component. Nevertheless, and in contrast to the initial intention of the service, the major part of customers does not take pictures to promote their outfits and styles. Instead, they use the system just for fun, regardless of potential feedback on their outfits by others.

4.7.4.4 Summary

Combining the subjective and the objective findings, several aspects for improvement can be identified. Many of the customers do not see value in using the service, as their modern smartphones offer the same functionality of taking pictures and uploading them to social networks. Also the lack of trust hinders customers from using the SST: they fear entering personal data on a public system. Nevertheless, the system is well accepted and enjoyed by those customers that start and complete the interaction process. The gender-specific differences in perception offer interesting starting points for further investigations. The usage in groups additionally supports the effect towards the social dimension.

It needs to be considered that the assessment takes place almost two years after the SST's first release. Consequently, initial excitement in regards to the system's novelty might have already vanished. Also a long term analysis shows a decline in usage numbers throughout the years, which likewise calls for revising the service. Therefore, the main goal for a refinement is to provide the customer with additional utilitarian value while considering the security concerns.

4.7.5 Improvement

Limitations of the work presented provide starting points for a functional refinement. The system needs to offer certain functional value that is not easy to imitate by competitors.

In order to improve the acceptance of the social mirror, five additional functionalities and usage scenarios are developed and evaluated by 70 potential customers [Fricke and Otten 2014, pp. 15-17]. Next to naming the personal preference on a five item Likert scale (labeled at the end points with "strongly agree" and "strongly disagree") the subjects are also asked about their intention to use the proposed solution and if they would recommend the solution to others. Improvements included in the survey are:

- **City scenario:** The image is enhanced by integrating an individual logo representing the city the picture is taken in. In doing so, customers can take the picture as a souvenir of their shopping trip. The logo furthermore promotes the respective store.

- **Competition:** The idea is to create promotional events around the social mirror. On a weekly basis new challenges are published that customers need to fulfill. These support the social experience as they can only be completed as a group. A challenge can for example include taking pictures with the highest number of people or taking a picture with elderly people.

- **Accessories:** This scenario involves products instead of people. Customers have the possibility of choosing accessories placed next to the mirror (e.g., sun glasses, hats) to enhance their outfit and make their picture more funny and interesting.

- **Disguise:** The company offers a selection of costumes. Linking these costumes to seasons and holidays (e.g., Christmas) or to public events (e.g., soccer world championships) enhances the involvement with the SST.

- **Background:** Users are offered the possibility to take pictures in special environments by digitally placing them into a new background image. This for example creates the impression of being photographed inside a soccer stadium instead of a store. [Fricke and Otten 2014, pp. 15-17]

The results of the customer survey show a clear preference for the background scenario. Hence, this solution is elaborated further. Innovative technologies like depth cameras (cf. Chapter 4.4) allow the cheap development of attractive use cases that so far involved either huge investments or massive implementation effort. An example is image compositing which is "a technique used when two images are combined so that some regions of the resulting image come from the first source image, while the rest comes from the second source image" [van den Bergh and Lalioti 1999, p. 155]. This method is also called chroma keying and often applied in television and movie productions. It traditionally uses a uni-colored (usually green or blue) background in front of which the object/person is placed. The technology then allows exchanging the uniform color by an arbitrary new background [Jack and Tsatsulin 2002, p. 49]. Depth cameras like the Microsoft Kinect® game controller offer the possibility to detect humans and their gestures with skeleton tracking, e.g., by using the OpenNI SDK [Alexiadis et al. 2011, p. 660]. This functionality can also be applied to isolate the human from the respective background scene [Biswas and Basu 2011, p. 102]. It is possible to extract the image of the user (cf. Figure 4.74, Step 1) and to combine it with any given background and optionally also a with foreground image layer (cf. Figure 4.74, Step 2). Additional adjustments of the environment the picture is taken in are not required. Therefore, the solution can be installed in a standard store without modifications.

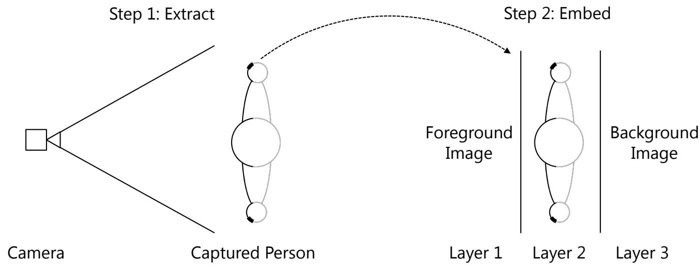


Figure 4.74 – Social Mirror: Object Extraction and Background Exchange

This technology allows an easy and cheap realization of a completely new use case comparable to chroma keying. Customers can select a scene they would like to be photographed in. Soccer stadiums, the beach, or a mountain surrounding can be named as examples (cf. Figure 4.75). Using multiple image layers furthermore allows taking pictures with famous persons like musicians, movie stars, or athletes.

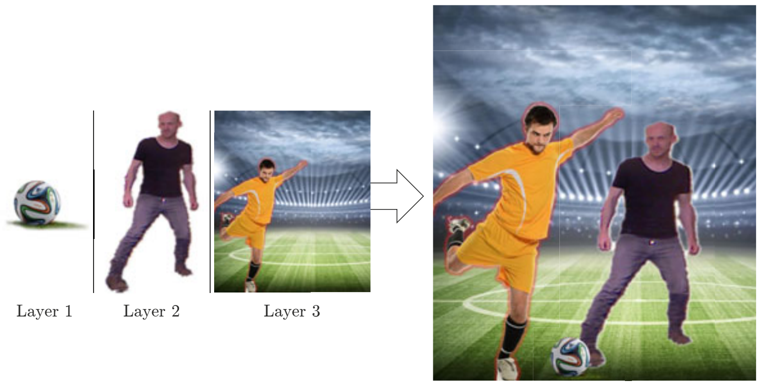


Figure 4.75 – Social Mirror: Realtime Background Exchange
Soccer Player: © Gino Santa Maria - Fotolia.com
Background Image: © efks - Fotolia.com

Adding the new functionality requires exchanging the social mirror's built in standard camera through a depth camera. Additionally, an implementation of the scene exchanging functionality in the software is required. Nevertheless, this new feature not only offers unique value to the consumer. It also can be used to enhance the experiential dimensions by stimulating emotions, using attractive content, and by integrating brand ambassadors.

A second issue of the evaluated social mirror is the lack of trust towards technology. Comparably to the proposed solution of the interactive shopping window use case, the application of QR codes offers a solution that is easy to implement. Instead of entering the login data to the social networks on the public device, the customers use their smartphones to scan the QR code generated after taking the picture. This code links the user to a mobile website. Using the social share functionality, the customers are now able to post their image using their private device.

4.8 Interim Conclusion

The structural model developed is well suited to examine the hypothesized relationships. Just as its reflective and formative measurement models, it is validated as part of the assessment of each of the prototypes. Even though the concept described is a matter of exploratory research, it is possible to fulfill and exceed all of the quality criteria claimed in literature (cf. Chapter 3.3.2.2.2). Table 4.41 discloses an overview on the fulfillment or rejection of the examined hypotheses.

Table 4.41 – Hypotheses Overview

	H_1	H_2	H_3	H_4	H_5	H_6	H_7	H_8	H_9
Interactive Shopping Window†	●	●	●	●	●	●	○	●	●
Low-Cost Body Scanner*	●	●	○	●	●	●	○	●	●
Product Experience Wall*	○	●	○	●	○	●	○	○	●
Interactive Fitting Room*	○	○	○	●	●	●	○	●	●
Social Mirror†	●	●	●	●	●	●	●	○	●

● hypothesis supported ○ hypothesis not supported

† productive shopping environment * laboratory environment

The hypothesized relationship between PEOU and PU (H_4) is supported in each of the studies. Being adapted from the traditional TAM proposed by Davis [1989, pp 319-340], the importance of this correlation in technology-related systems is again confirmed. Another hypothesis that is supported in all of the SSTs presented is H_6. It claims a system's PU significantly affecting the experiential design. A reason may be that PU is of experiential nature and close to the cognitive dimension. This also applies to the PEOU construct, that is only found non-significantly wielding influence on the experiential design construct for one system (H_5). Hypothesis H_9 is confirmed for all of the service technologies evaluated. Hence, the experiential design of a service terminal significantly influences service fascination, leading to positive word of mouth and an active willingness to use and to promote the system. In contrast, H_7 (PEOU towards service fascination) can only be confirmed for one of the systems with a t-value of slightly above the minimum threshold of 1.65 (social mirror). In addition, very weak f^2 effects argue for PEOU acting as a mediator rather than directly affecting service fascination.

Nevertheless, differences occur between the SSTs evaluated in productive environments (interactive shopping window and social mirror), and those evaluated in laboratory settings. While under realistic store conditions, almost all hypothesizes can be confirmed, laboratory conditions lead to different results. One remarkable distinction is hypothesis H_3 (trust influencing service fascination), that is only confirmed in productive environments. It seems that under these conditions, the subjects face the services with reservations or different expectations.

Finally, the R^2 coefficients of determination of the two target constructs experiential design and service fascination reach at least high medium values for all studies. Especially under consideration of the exploratory nature of the research conducted this again supports the validity of the proposed model. Nevertheless, the low values for all other latent variables argue for the existence of further influences. For the service fascination construct, strong or very strong predictive relevance is found. Each of the evaluations leads to a Stone-Geisser's Q^2 value of well above 0.35, underlining the model's ability to adequately predict the target variable. But also a comparison of the absolute ratings of the single constructs reveals differences between the single SSTs (cf. Figure 4.76).

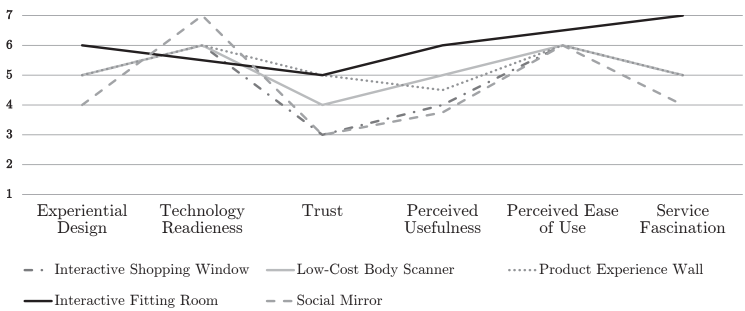


Figure 4.76 – SST Comparison: Service Fascination

Overall, the interactive fitting room is rated best, while the social mirror represents the weakest prototype. An interesting finding is that systems evaluated in a productive environment are perceived as less trustworthy. Supported by hypothesis H_2, technology ready subjects show less confidence in technology. While all of the systems evaluated offer a high level of usability, perceptions regarding their practical usefulness differ.

The data furthermore reveal a certain effect of the combination of functional (PU) and hedonic (experiential design) value towards service fascination. A high rating of both elements leads to a more positive evaluation of service fascination (e.g., interactive fitting room). The opposite proves true for weak ratings of both components (e.g., social mirror). Figure 4.77 provides a deeper insight into the results of the experiential dimensions of the individual prototypes.

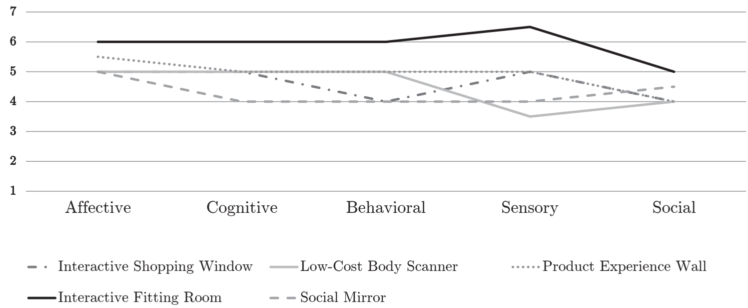


Figure 4.77 – SST Comparison: Experiential Dimensions

All SSTs serve their users with a good level of affective stimulation. Highest variance can be found in the sensory dimension that is closely linked to the technological components applied. SSTs that integrate large display surfaces and realize a multi-sensual experience are rated best. This finding indicates that a high level of immersion leads to a deeper and more positive perception of the service presented.

During the subjective evaluations, the social dimension emerges as the weakest element for all SSTs. Nevertheless, observations conducted as part of the studies reveal that the social factor is obviously higher than reported through the subjective ratings. All of the SSTs presented invite customers to being used in groups of at least two people. This circumstance reflects the fact, that shopping per se is a social experience.

Moreover, observations make it possible to disclose further insights. Differences between subjective and objective evaluations can also be found in the ease of use of a SST. An unstable or not properly working system often leads to frustration of the user, potentially resulting in a termination of the interaction process. As the subjective rating constitutes a reflected opinion as a result over time, initial or occasional issues can only be identified through observations.

An important finding is that customers are willing to provide a system with personal information as long as the value they receive in return is big enough. In fact, customers do not discern between services that mainly provide utilitarian or those that primarily deliver hedonic value. The low-cost body scanner can be named as an example. Even though very personal, health-related data is used, the system's usefulness outweighs potential risk and data security concerns.

Group comparisons between male and female users are done for all of the prototypes created. This happens in the form of mean difference comparisons between the ratings given in order to derive conclusions on trends. In general, women either show the same or significantly less trust (interactive shopping window, social mirror) in technology than men. For all prototypes the experiential dimensions possess noticeable distinctions in their ratings. Female subjects usually provide better ratings, in most cases on a highly significant level. In all other cases the differences are of non-significant nature. These circumstances finally lead to a better overall perception of service fascination for female subjects. For two of the SSTs evaluated (product experience wall and interactive fitting room) this difference is highly significant and furthermore manifests in a medium to large Cohen's d effect size.

Comments and feedback provided by the subjects allow the further elimination of weaknesses as well as the derivation of additional features for the systems. The results of these studies reveal several interesting implications. Nevertheless, the evaluations conducted also face limitations. First, the SSTs are realized and tested in different development stages. Due to the broad period in which the prototypes are built and evaluated it is required to use distinct groups of subjects. This is furthermore substantiated through different evaluation contexts (laboratory and store environment). Unequal sample sizes and a high variation of age groups within the user groups is the consequence. Also the rather small sample sizes of two of the evaluations (interactive fitting room and social mirror) may be seen as a limitation.

Chapter 5

Conclusion

5.1 Summary

The goal of this thesis is to investigate the construct of service fascination. This not only includes the design of an engineering method for the implementation of exciting SSTs, but also the development of a model to measure and to evaluate service fascination and the influence of technologies and their combinations. Insights are transferred into recommendations for action that allow an improvement of the overall service fascination. The research is conducted using the example of a fashion retail store including five exemplified prototypes of technology-based self-service systems. Figure 5.1 presents an overview on the results of each chapter, the methods used, and the research questions answered.

While Chapter 1 provides a general introduction into the topic, Chapter 2 motivates the need for research in the area of customer experiences and experiential SSTs from the perspective of three different domains. Services science, human-computer interaction, and customer experience management are explained and common research gaps are carved out. These include the lack of knowledge about the emotional effects of technologies and the distinct drivers of experiences, appropriate design strategies, evaluation methods, and the need for practical studies and evaluations. The major research trends as well as the most commonly applied methods of each domain are illustrated and serve as a theoretical and practical basis for the subsequent chapters.

Chapter 3 introduces the service fascination research concept. It consists of an engineering model for the human-centered design of experiential SSTs as well as an evaluation model used to assess experiential services. The engineering process starts with a general context analysis of the application domain and ends with an improvement phase that transfers evaluation findings into design and concept optimizations. In a second step the

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service fascination evaluation model is developed. An extensive literature research is conducted to derive and substantiate the most important constructs relevant for the creation of service fascination. Based on a questionnaire a structural model is constructed that can be used to assess previously hypothesized relationships and to uncover strengths and weaknesses of the SST's experiential design. To also capture subconscious elements of user perception, observations complement the subjective reports.

Chapter	I	II	III	IV	V
Method		Literature Research	Literature Research Structural Equation Modeling	Customer Journey Mapping Technology Portfolio Analysis Expert Interviews Prototyping Evaluation & Observation	Synopsis
Result	Motivation	Theoretical Foundation Method Overview Research Questions	Engineering Model Evaluation Model	Moments of Truth within the Retail Customer Journey Technology Evaluation and Selection Five Experiential Prototypes Evaluation Results	Research Result Summary Implications for Future Research
Research Question Answered			RQ 1 RQ 2 RQ 3	RQ 4 RQ 5 RQ 6 RQ 7 RQ 8	

Figure 5.1 – Thesis Summary

The engineering and the evaluation models are applied in Chapter 4. With the help of customer observations and expert validations a detailed context analysis is conducted that provides the starting point for the development of five experiential self-service prototypes. This includes the creation of a customer journey map for fashion retail shopping and the revelation of the most important consumer touch points (moments of truth). A technology portfolio analysis leverages the knowledge of eight experts of the underlying research fields: promising input and output technologies, design methodologies, as well as various types of digital content are identified and assessed from both the company's as well as the customer's perspective. The prototypes address relevant moments of truth of the customer journey and are implemented and evaluated using the presented service fascination research model. Next to the derivation of general knowledge about the effectiveness of the SSTs design, gender comparisons provide further insight into the user's perceptions. Strengths and weaknesses of the experiential design are pointed out and transferred into recommendations for improvement.

The thesis closes with reporting transferable research results and potentials for future investigations. These not only include possible optimizations of the theoretical model, but also starting points for deeper empiric evaluations and implications on managerial effects.

5.2 Research Results

Chapter 4.8 provides a detailed summary of research insights as a subsumption of the individual SST evaluations and hypothesis tests. While these results derive from the individual assessment of five specific SST prototypes it is also possible to conclude more general research results that can be transferred to other self-services, to other domains, and to other contexts of use. These findings correspond to the different stages within the SST creation and utilization process and to the potential business and consumer values created in each stage (cf. Figure 5.2). Next to methods for the strategic development of SSTs as combinations of technologies, these insights also comprise knowledge about their ability to create service fascination as well as a set of evaluation methods.

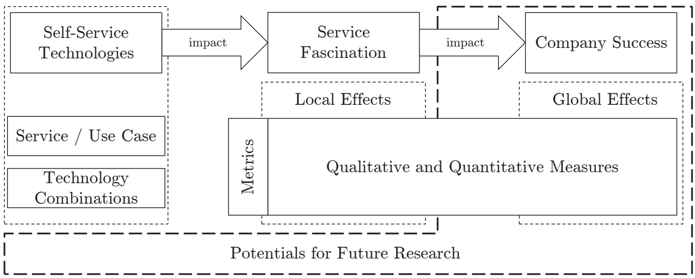

Figure 5.2 – Research Areas Overview

As a result it is possible to derive qualitative and quantitative metrics to be measured on a local level (before, during, and after using the SST) that can finally have an impact on the company's business success on a global level. As postulated by Ambler [2003, p. 1] this global measurement of marketing efforts needs to follow much more sophisticated goals than just pure fiscal parameters. This means that especially the qualitative, soft, and non-financial factors play an increasingly important role [Reinecke 2006, pp. 18-20].

The analysis, the measurement, and the enhancement of service fascination constitutes the core of this research with the goal of improving the success of self-service concepts. These concepts either focus on innovating new or on enhancing existing services through experiential components and especially through the application of innovative technologies. In order to maximize impact, a strategic selection of appropriate services and technical components, following a human-centered design approach, is key.

- **Strategic touch point selection:** Experiential concepts work best for enhancing generally known, but commonly neglected consumer touch points. In a first step, customer journey mapping (cf. Chapter 4.2.1) helps to determine the relevant moments of truth within the interaction process. By individually analyzing each of the touch points and by applying the criteria of innovation benchmarking, it is possible to identify the most promising use cases. These criteria particularly include customer value, market volume, feasibility, and competitive advantage [Voigt 2008, pp. 402-403]. Consequently a touch point is well suited, if it is important to the consumers and if the improvement offers the potential to provide them with superior performance in comparison to competitors. Fitting rooms for example represent a standard element of every retail fashion store that is regularly used. Despite their commonly acknowledged importance within the shopping process, their design, setup, and features are almost equal across different companies. Innovations in this area are rare. As the context of use as well as the various solutions offered by different companies are well known by the customers, already small improvements can lead to a considerable attention and consequently to a differentiation from competitors. Nevertheless, consumer behavior constantly changes. It is therefore also recommended to repeatedly observe the customer journey itself, as new touch points can emerge that previously have not been considered relevant.

- **Uniqueness:** At each of the touch points identified the user needs to be provided a functionality that is exceptional, unique, and not easy to imitate. As described by Barney [1995, pp. 50-56] these questions of value, rareness, and imitability form the core of competitive advantage. Hence, and especially in regards to SSTs, this imitability can not only arise through the competitor's increase in knowledge, but also through technical substitutes. While an innovative service can act as a customer magnet in the beginning, the popularity rapidly decreases if the service or its core features become widely available, for example through new features of smartphones (cf. Chapter 4.7). A concrete finding is that even customers in the consumer goods industry are willing to favor one company over another if a special service is provided (cf. Chapter 4.4.4.3). Monitoring each individual SST's attractiveness in regards to usage numbers, usage time, and comparable metrics provides knowledge about potential upgrade or replacement needs. As described in Chapter 3.2.2 the identification and prioritization is accomplished within the context analysis in which not only the user's needs at each touch point are matched against the company's offerings. It also involves the collection of customer feedback in order to disclose gaps and opportunities within the interaction process as well as for scoring the company's current offerings against the strengths and weaknesses of competitors.

- **Value proposition:** For being successful SSTs need to provide users a combination of hedonic and utilitarian values [Sandström et al. 2008, p. 121]. This leads to a more positive overall perception of the system. It needs to be differentiated between tasks that reflect essential steps within the traditional customer journey (e.g., entering a fitting room for trying on apparel) or optional add-ons (e.g., taking a picture). In addition, and depending on the service provided, especially the perceived functional value can be subject to a diminishing marginal utility. This for example means that a customer will not get an additional functional value by a repeated use of the service (e.g., body-scanning provides identical results if performed multiple times within a short period of time). Nevertheless, the emotional component can lead to a repeated use also if additional utilitarian value can not be achieved (cf. Chapter 4.4). It is found that users show a much higher motivation if they see the possibility of discovering something new, which especially applies to the presentation of new features and visual/auditory experiences instead of displaying additional product information. Particularly the usage of innovative human-computer interfaces plays an important role: in contrast to the obvious effects of pressing a button on a traditional UI (e.g., on a website), the application of life size avatars (cf. Chapter 4.3) or RFID tagged products (cf. Chapter 4.6) inspires users to experiment and to discover hidden features and experiences.

In contrast to traditional services provided through human personnel, self-services leverage combinations of technologies that represent the physical touch point for the customer. This touch point comprises the physical instantiation as well as all interaction possibilities.

- **Engineering experiential SSTs:** The service fascination engineering model (cf. Chapter 3.2) represents a design strategy that can be used to develop new or to improve existing technology-enabled services. Chapter 4 shows in detail that positive experiences can be created in a planned manner by selecting appropriate technology combinations for previously identified touch points and use cases to be enhanced. Nevertheless it is also found that the selection of a specific technology set to a considerable extent depends on the respective context of use (e.g., retail stores), the focus group to be addressed (e.g., different age groups), and the targeted use case. The context analysis (cf. Chapter 3.2.2) therefore constitutes an essential step within the engineering process. While customer journey mapping helps to define the focus group and use cases, the modified technology portfolio method is well suited for a constant monitoring and evaluation of new technologies to be considered.

- **Technology combinations:** It is not the innovativeness of the single technology components that leads to service fascination, but the SST concept as such being assembled of a smart combination of technologies, design methodologies, and digital content (cf. Chapter 4.2.2). Even though SSTs are always perceived in the form of one holistic construct it is possible to identify trends: eye-catching, large-format, and immersive (if possible surrounding) user interfaces lead to an increase in hedonic value (cf. Chapter 4.8). From a user perspective the type of visualization technology (e.g., display or projector) does not have a significant influence. Nevertheless, it is in many cases the design of the user interface that is responsible for the delivery of positive emotions. The usage of realistic, digital, and life-size avatars in combination with products presented in their actual dimensions lead to service fascination. Hence, making the customer feel like interacting with the real world instead of interacting with a computer is key. This effect can furthermore be enhanced by moving away from traditional input devices as mouse and keyboard to using physical objects of the real world (e.g. the product itself) as a means for interaction (cf. Chapter 4.6). In contrast, gesture-based interaction is not well understood by the consumers yet, which can lead to frustration. It is therefore recommended to apply the technology only if required for realizing the specific use case, for example when interacting in three-dimensional space (cf. Chapter 4.3.5).

- **Multi-user design:** While traditionally SSTs are designed for a single-user experience, interaction usually happens in groups when used within the shopping process (cf. Chapter 4.8). Hence it is essential to plan for a multi-user UI from the start. This includes the selection of appropriate input technologies as well as a consideration within the implementation of the software interfaces (e.g., the possibility to sign in two customers at once). As a consequence the interaction surface needs to be large enough for being used by at least two customers at once and additionally support simultaneous inputs (e.g., by using multitouch interfaces). It is found that peers usually interact with the same reference object of the UI (e.g., a virtual avatar) instead of interacting with two separate objects (e.g., a virtual avatar vs. a product shelf). Multi-user design therefore additionally supports the social element of the experiential dimensions (cf. Chapter 3.3.2.4.4). Nevertheless, the concrete implementation of multi-user capability always needs to be adapted to the respective use case at hand.

- **Multi-sensory design:** The explicit and implicit effects of multisensory approaches in the design of positive customer experiences (cf. Chapter 2.4.2.1.4) also prove relevant for the design of experiential SSTs. It turns out that augmenting the human-computer interface with sound in addition to the traditional visual elements can lead to an increase in general coherence. Auditory elements furthermore enhance the chance of customers getting aware of the system and can be used as a means for surprising the user (cf. Chapter 4.6.4.3). It is found that especially in a shopping environment music is not considered as a special feature, as it is anyways played in most stores. Instead, the usage of "natural" sounds like birds singing and wind blowing are considered remarkably different and can lead to a pleasant surprise (cf. Chapter 4.6).

- **Hardware and software issues:** Defective or malfunctioning technologies cause user frustration and in many cases lead to a termination of the interaction process [Kühn 2014, pp. 74-82]. This dissatisfaction can result in a refusal for future use (even though updates may have happened), to negative word of mouth (cf. Chapter 4.7), and in the worst case also to favoring competitors [Kühn 2014, p. 81]. Nevertheless, this risk of dissatisfaction due to defective systems can be faced with an unobtrusive integration of the technology. An example is the interactive fitting room that still can be used like a traditional one if the displays are deactivated (cf. Chapter 4.6) or the social mirror that still is able to serve as a standard mirror, if the hardware is turned off (cf. Chapter 4.7). It is hence recommended to design systems in a way that defects can be hidden from the customer and that, if possible, alternative purposes can still be served.

Service fascination describes an "extraordinary positive emotional state arising through conscious and subconscious effects of self-service technology use" (cf. Chapter 2.1). Next to defining the concept as such, this research also presents an approach for measuring the experiential effects of technology use and their correlations.

- **Evaluating experiential SSTs:** It can be confirmed that the presented service fascination evaluation model (cf. Chapter 3.3) is well suited for assessing SSTs and their components. It is validated using the quality criteria postulated in prevalent literature and consists of a subjective as well as an objective component. This also allows covering subconscious effects of technology use. In addition, the two target variables "experiential design" and "service fascination" are well explained by the model (cf. Chapter 4.8).

- **Trust:** Trust is perceived as a prerequisite for the use of interactive systems (cf. Chapter 4.8). Nevertheless, if users receive an adequate amount of emotional or utilitarian value, they are willing to provide personal information if required to efficiently use the SST. This for example even applies to health-related data (cf. Chapter 4.4). It is therefore recommended to provide the consumer detailed information about the usage purpose of personal information acquired. If possible, the entry of personal account data (e.g., login credentials to social platforms) should be carried out through the customer's own device (e.g., a smartphone). This limits the level of perceived risk in regards to unauthorized use and in regards to the potential influence of unauthorized people (e.g., strangers, hackers). The same applies to the ownership of the personal information that can be stored on the customer's device instead of being stored on the company's server.

- **Genders:** An important finding is that while female users in general show less trust in technology the experiential design elements have a stronger effect on their overall perceived service fascination (cf. Chapter 4.8). This also results in a more positive perception of the service as such.

- **Age:** The experiments conducted indicate that interactive technologies at the point of sale attract customers of various age groups. Nevertheless, for young target groups interaction happens on a more natural and intuitive level due to less technology anxiety (cf. Chapter 4.3). This especially applies to large display surfaces and moving content that also attracts children (aged between three and ten) that have intentionally not been considered as customers (cf. Chapter 4.3.4.3). These children in turn also motivate their parents to use the devices. The findings therefore indicate that systems need to be designed in a way that they can also be used by children. This means, that elements within the UI also need to allow being controlled by short people, e.g., by adjusting the height of the elements displayed on the physical device. Even though large and bright visualizations serve as a motivator and eye-catcher in general, older customers are also satisfied with and show less self-consciousness towards more traditional user interfaces. Therefore it is advised to perform a detailed focus group evaluation as part of the context analysis (cf. Chapter 3.2.2) and to adapt the concrete implementation of the SST to the requirements of the specific user group.

- **Effects on local store traffic:** The usage of experiential SSTs leads to additional store traffic (cf. Chapter 4.3 and Chapter 4.7), which can be ascribed to increased awareness of the store, word-of-mouth via social media, or the consequences of a strategic innovation communication and media presence. An interesting finding is that innovative technology itself can act as a customer magnet, attract visitors, and potentially lead to impulse purchases. Hence, it is not the product but the service offerings that bring new customers to the store. This additional store traffic can finally result in increased turnover.

- **Interaction logging:** Next to personal observations it is also possible to track and log user behavior automatically. This can happen through leveraging the potential of counting individual users and clicks, interaction paths within in the UI, and also by tracking the results of interaction (e.g., products ordered). Taking the social mirror as an example, the number of uploaded images per week provides an indication about how well the system is perceived (cf. Chapter 4.7).

These findings as well as the service fascination engineering and evaluation models allow researchers and practitioners to gain deeper insight into the effects of the distinctive drivers of experiences in service environments. While detailed evaluations of the impact of service fascination towards store business on a local and towards company business on a global level are not the focus of this work, it is possible to provide a first overview about trends identified. These can be seen as side results of the experiments and evaluations conducted, the SSTs operated in the stores, and the projects and prototypes presented to the public and build on user observations as well as interviews with customers, experts, and store personnel. This step provides insights into economic metrics (quantitative and especially qualitative) that can be used to justify the financial efforts of implementing service fascination concepts.

- **Recommendations by users:** Experiential SSTs are well accepted and lead to positive word of mouth, which reflects in an increase of brand image (cf. Chapter 4.3 and Chapter 4.7). This can be used not only as a tool for increasing the application of the SST as such, but also as a means of general innovation communication [Marinova 2014, pp. 44-45].

- **Recommendations by non-users:** An evaluation of an independent self-service system placed in a store of the retail fashion industry indicates that recommendations do also happen through non-users (cf. Chapter 4.3). Simply noticing a digital system without actively interacting can lead to positive effects in regards to the perceived shopping atmosphere as well as to additional shopping inspirations [Kühn 2014, p. 82].

- **Brand image:** Steinhoff and Trommsdorff [2007, p. 8] state that especially from the perspective of a consumer the perception of innovations is very selective. Hence, a concept's success is often dependent on this subjective appreciation of innovativeness. First observations indicate that technology-based service innovations are from the customer's perspective perceived disproportionately more innovative than traditional product improvements and innovations [Marinova 2014, pp. 41-43]. This is also reflected in the media response towards the prototypes presented in Chapter 4.

- **Product value:** By utilizing experiential self-service systems in a store it is possible to realize a higher willingness to pay. First observations and expert interviews indicate an increase in product value perceived by the consumers that interacted with an experiential SST in comparison to those who didn't (cf. Chapter 4.6). The reasons are manifold and range from better information about the product and it's features to a deep emotional connection.

- **Cross- and Upselling:** Technology-based innovations at the point of sale provide enhanced possibilities for supporting sales. This includes the presentation of advanced product information, consumer reviews, complementary products, and features for a more personalized shopping experience transferred from traditional online shopping [Spreer 2013, p. 1; Kühn 2014, p. 89]. In the end, a savvy utilization of product information as a functional component of fascinating self-services can lead to additional sales and to increased revenue [Shapiro 1982, pp. 33-34]. This consequently also affects the conversion rate realized per store (cf. Chapter 4.3, Chapter 4.5, and Chapter 4.6).

Nevertheless, researchers demand for defining and operationalizing the marketing goals and their respective metrics in dependence of the concrete customer target group and prior to undertaking the marketing efforts [Reinecke 2006, p. 18].

In the end this research not only provides methods to strategically design, to measure, and to improve experiential self-service technologies for retail stores, it is also able to take a first step towards explaining the importance of experience delivery form the perspective of marketing controlling. The research conducted as well as the business success indicators identified reveal various potentials for further research that will be discussed in the subsequent chapter.

5.3 Implications for Future Research

Examining customer experiences in the area of SSTs is a complex endeavor. This not only applies to the measurement of the numerous influences towards human perception but also to the structured and goal-oriented design of innovative in-store solutions. Under consideration of these science and practice related factors, an exploratory research design is chosen. The limitations of this research as well as the findings derived provide starting points for future investigations (cf. Table 5.1), mainly relating to the theoretical model, to potentials for advanced empirical studies, as well as to evaluations regarding the economic impact of positive or negative customer experiences. This especially applies to effects on product and brand perception.

Table 5.1 – Future Research Potentials

Domain	*No.*	*Research Demand*
Theory	(1)	Enhancement of the structural model
Empiricism	(2)	Different age groups
	(3)	Gender differences
	(4)	Impact on the holistic customer journey
	(5)	Execution of long-term studies
	(6)	Influence of the evaluation context
	(7)	Effectiveness of improvement treatments
	(8)	Individual technology comparisons
	(9)	Validation of the results in different industries
Management	(10)	Impact on product perception
	(11)	Impact on brand perception

(1) The structural model presented proves valid for all of the SSTs assessed. Also previously defined relationships of the traditional TAM can be confirmed. While the

target constructs are well explained it is found that other variables like trust, perceived usefulness, and perceived ease of use are not well explained, yet. This indicates the existence of further influences towards the latent constructs worth being examined.

(2) All studies conducted in this research predominantly focus on the young generation of the digital natives. Consequently, the majority of the subjects taking part in the evaluations of the prototypes is aged between 18 and 28 years. This small variance does not allow a detailed comparison of different age groups. Nevertheless, observations indicate a higher attractiveness of the systems amongst younger users. It is therefore recommended to execute additional studies to discover individual effects. Also differences in the importance of delivering utilitarian and emotional values may be disclosed.

(3) Within the studies conducted significant differences are identified in the perception of the different genders. While women show less trust in technology, they discern the experiential design more intense than men. This finally leads to a higher service fascination. However, all studies are conducted within the specific context of fashion shopping that is in particular considered to be a female domain. Chang et al. [2004, pp. 185-199] for example identify a generally higher importance of the hedonic shopping values for female customers. Hence, it should be evaluated if the same gender-related results can also be achieved in a different shopping context (e.g., cars, groceries).

(4) The prototypes presented are aligned on a general customer journey for fashion retail stores. Each prototype is individually designed, conceptualized, and implemented. Also, evaluations happen on an individual level. Nevertheless, if implemented as part of a holistic store concept, carry-over effects may occur. This means, that a combination of multiple experiential SSTs may lead to a better experience than the sum of the individual SSTs.

(5) A question remaining unanswered is how time impacts the effectiveness of experiential SSTs. Within the current research, the system featuring the poorest rating is also the one with the longest time period between its first publication and the scientific evaluation (Social Mirror, cf. Chapter 4.7). Between its retail introduction and the experiential evaluation a serious amount of time passed. This can be an indication for decreasing effectiveness of experiential SST design throughout time. One reason might be the broader availability of modern technologies or the emergence of more advanced technologies applied in end-consumer devices. Long-term studies need to be conducted in order to gain further knowledge about the importance of the time factor.

(6) Due to their divergent development stages the SSTs presented are assessed in different contexts (laboratory vs. productive environments). The results indicate that this context may influence perception, especially in regards to trust. Further research

needs to be done in order to gain deeper insights into these correlations. This can happen by comparing evaluation results before and after the SST's introduction to retail.

(7) Based on the assessment results, improvements are proposed to enhance the experiential design, to improve the utilitarian and/or hedonic value, and to add further features. However, the effectiveness of the recommendations is not validated yet. A simple group comparison test (cf. Chapter 3.3.2.3) conducted before and after implementation of the improvements can provide further insight into the practical adaptability of the concept.

(8) First trends are identified regarding the experiential effects of a smart technology application. Especially large display surfaces and a multi-sensory approach lead to a state of immersion and promise good results when carefully applied. Nevertheless, every SST presented is perceived by the user as one holistic construct and not as a bundle of individual technologies. In order to being able to compare single technologies, a different approach needs to be taken. This can happen by repeatedly evaluating the same SST with modified components. Using the example of the product experience wall (cf. Chapter 4.5), the large projection surface can be changed to a simple display or a multi-touch tabletop, while keeping the identical software and its features.

(9) The self-service systems developed as well as the related empirical studies conducted specifically address the fashion industry. Due to negligence of this area in the past it is well suited for the introduction of experiential services. The garment shopping process consists of a modular customer journey that allows the segmentation into individual elements. Each of these elements can then be supported by experiential SSTs. Nevertheless, restricting the research to a specific area is usually accompanied by reasonable doubts regarding generalizability. Furthermore, especially garment shopping is a task that emotionally connects the customer to a product and/or brand. It is therefore recommended to examine the emergence and effects of customer experiences also in the context of other products and industries (e.g., the automotive industry).

(10) Especially within shopping environments the use of SSTs is implicitly connected to the products offered by the service provider. Making use of SSTs always follows the goal of supporting the customers in their buying process. Within the example of apparel shopping this can happen through advanced ways of product presentation (e.g., interactive shopping window or product experience wall) or by integrating the physical product as a vital element into the experience delivered, for example while trying on the garment in the interactive fitting room or when taking a picture with the social mirror. Further technologies can be used to offer advanced options for selecting the right product (e.g., low-cost body scanner). Nevertheless, experiential SSTs installed in the store might not only result in positive feelings towards the shopping process, but also affect the perception

of the product itself. This can lead to an increased willingness to pay, repurchases, reduced return rates, and finally positive word of mouth. It is advised to perform an advanced study using experiential SSTs and to compare the evaluation results with a standard shopping process. Positive results can be used to justify the implementation costs of future self-service systems.

(11) Finally, the outcome of using experiential SSTs is not only the short-term enhancement of the customer's shopping process. Successfully introducing innovative technologies into retail environments differentiates a company from its competitors. Brakus et al. [2009, pp. 52-68] prove that as a consequence customers show a higher level of satisfaction and loyalty to the brands. But positive word of mouth and media presence also lead to a more innovative image of the brand which can result in additional long-term benefits and sales. A positive effect of a company's innovativeness towards the overall business performance is confirmed by Hult et al. [2004, pp. 429-438]. That said, until today the question of how customer experience concepts add to the monetary profits of the company in the long term remains unanswered.

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Appendix

A.1 Service Fascination Questionnaire - German Version

Table A.1 – Service Fascination Questionnaire - German
adapted from Zagel et al. [2014b, pp. 177-190] and Zagel and Bodendorf [2014, pp. 537-548]

	Item	*Adapted from*
Perceived Usefulness		
(PU1)	Durch Nutzung des Systems verbessert sich mein Erfolg beim Einkaufen.*	Davis [1989, p. 324], also used in Davis et al. [1989, p. 991], Venkatesh and Davis [1996, p. 480], and Venkatesh and Davis [2000, p. 201]
(PU2)	Durch Nutzung des Systems verbessert sich meine Produktivität beim Einkaufen.*	Davis [1989, p. 324], also used in Davis et al. [1989, p. 991], Venkatesh and Davis [1996, p. 480], and Venkatesh and Davis [2000, p. 201]
(PU3)	Durch Nutzung des Systems verbessert sich meine Effektivität beim Einkaufen.*	Davis [1989, p. 324], also used in Davis et al. [1989, p. 991], Venkatesh and Davis [1996, p. 480], and Venkatesh and Davis [2000, p. 201]

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C. Zagel, *Service Fascination,* DOI 10.1007/978-3-658-11673-6,

(PU4)	Ich finde das System nützlich beim Einkaufen.*	Davis [1989, p. 324], also used in Davis et al. [1989, p. 991], Venkatesh and Davis [1996, p. 480], and Venkatesh and Davis [2000, p. 201]
Perceived Ease of Use		
(PEOU1)	Die Nutzung des Systems ist klar und verständlich.	Davis [1989, p. 324], also used in Davis et al. [1989, p. 991], Venkatesh and Davis [1996, p. 480], and Venkatesh and Davis [2000, p. 201]
(PEOU2)	Die Nutzung des Systems erfordert keine große geistige Anstrengung.	Davis [1989, p. 324], also used in Davis et al. [1989, p. 991], Venkatesh and Davis [1996, p. 480], and Venkatesh and Davis [2000, p. 201]
(PEOU3)	Ich finde, dass das System einfach zu nutzen ist.	Davis [1989, p. 324], also used in Davis et al. [1989, p. 991], Venkatesh and Davis [1996, p. 480], and Venkatesh and Davis [2000, p. 201]
(PEOU4)	Ich finde es einfach, das System dazu zu bringen, zu tun, was ich möchte.	Davis [1989, p. 324], also used in Davis et al. [1989, p. 991], Venkatesh and Davis [1996, p. 480], and Venkatesh and Davis [2000, p. 201]
Trust		
(T1)	Ich bin besorgt darüber, dass das System zu viele persönliche Informationen von mir sammelt.†	Chen et al. [2004, p. 30], based on Smith et al. [1996, pp. 167-196]
(T2)	Ich bin besorgt darüber, dass das System meine persönlichen Informationen ohne meine Zustimmung für andere Zwecke missbraucht.†	Chen et al. [2004, p. 30], also used in Koch et al. [2011]

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(T3)	Ich bin besorgt darüber, dass unberechtigte Personen (z.B. Hacker) Zugriff auf meine persönlichen Informationen haben.†	Chen et al. [2004, p. 30], also used in Koch et al. [2011]
(T4)	Ich bin besorgt über die Sicherheit meiner persönlichen Informationen während der Datenübertragung.†	Chen et al. [2004, p. 30], based on Smith et al. [1996, pp. 167-196]
Technology Readiness		
(TECH1)	Ich habe Angst davor, Technologien zu verwenden.†	Raub [1981, pp. 132-139], also used in Meuter et al. [2005, p. 80]
(TECH2)	Technische Ausdrücke klingen für mich wie eine verwirrende Fremdsprache.†	Raub [1981, pp. 132-139], also used in Meuter et al. [2005, p. 80]
(TECH3)	Ich bin bereits Technologien aus dem Weg gegangen, weil ich nicht mit ihnen vertraut war.†	Raub [1981, pp. 132-139], also used in Meuter et al. [2005, p. 80]
(TECH4)	Ich vermeide es, Technologien zu nutzen, weil ich Angst habe, etwas falsch zu machen, was ich nicht wieder korrigieren kann.†	Raub [1981, pp. 132-139], also used in Meuter et al. [2005, p. 80]
Service Fascination		
(SF1)	Ich würde anderen von meiner positiven Erfahrung der Nutzung des Systems erzählen.	Maxham [2001, p. 23], also used in Kim [2006, p. 34]
(SF2)	Ich würde die Nutzung des Systems empfehlen.	Maxham [2001, p. 23], also used in Kim [2006, p. 34] and Kim et al. [2008, p. 560]
(SF3)	Die Nutzung des Systems ist aufregend.	Childers et al. [2001, p. 531], also used in Kim [2006, p. 34]
(SF4)	Ich bin mir sicher, dass ich das System nutzen würde, wenn ich die Möglichkeit dazu hätte.	Venkatesh and Davis [2000, p. 201]
(SF5)	Ich werde das System in Zukunft wiederholt nutzen.	Gu et al. [2010, pp. 287-297]

* Adaption of the item set to fit the respective field of application (e.g., shopping).

† negative wording / inverse coded item.

A.2 Experiential Design Questionnaire - German Version

Table A.2 – Experiential Design Questionnaire - German
adapted from Zagel et al. [2014b, pp. 177-190] and Zagel and Bodendorf [2014, pp. 537-548]

	Item	*Adapted from*
Affective Dimension		
(AFF1)	Die Nutzung des Systems ist unterhaltsam.	Davis et al. [1992, p. 1116], also used in Venkatesh and Bala [2008, p. 313]
(AFF2)	Der Prozess der Systemnutzung ist angenehm.	Davis et al. [1992, p. 1116], also used in Venkatesh and Bala [2008, p. 313]
(AFF3)	Es macht mir Spaß das System zu nutzen.	Davis et al. [1992, p. 1116], also used in Venkatesh and Bala [2008, p. 313]
(AFF4)	Ich nutze das System alleine aus dem Grund, Spaß mit diesem zu haben.	Childers et al. [2001, p. 531], also used in Kim and Forsythe [2007, p. 507]
(AFF5)	Durch die Nutzung des Systems fühle ich mich gut.	Childers et al. [2001, p. 531], also used in Kim [2006, p. 34]
Cognitive Dimension		
(C1)	Mit den Informationen, die mir durch das System gegeben werden, bin ich zufrieden.*	Chen et al. [2004, p. 30], based on Daft and Lengel [1986, pp. 554-571]
(C2)	Das System bietet eine Vielzahl unterschiedlicher Informationen (z.B. Text, Bilder, Animationen, Audio, Video).*	Chen et al. [2004, p. 30], based on Daft and Lengel [1986, pp. 554-571]
(C3)	Die Nutzung des Systems ist interessant.	Childers et al. [2001, p. 531], also used in Kim and Forsythe [2007, p. 507]
(C4)	Insgesamt bietet das System eine hohe Qualität.	Chen et al. [2004, p. 30], based on Cronin and Taylor [1992, pp. 55-68]

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(C5)	Das System erlaubt es mir, überlegte Entscheidungen zu treffen.*	New item, based on Gentile et al. [2007, pp. 395-410] and Schmitt and Mangold [2004, pp. 38-43]
Behaviroal Dimension		
(B1)	Die Nutzung des Systems könnte mein Verhalten verändern.*	New item, based on Gentile et al. [2007, pp. 395-410], Schmitt and Mangold [2004, pp. 38-43], and Verhoef et al. [2009, pp. 31-41]
(B2)	Die Nutzung des Systems könnte mein Verhalten beeinflussen.*	New item, based on Gentile et al. [2007, pp. 395-410], Schmitt and Mangold [2004, pp. 38-43], and Verhoef et al. [2009, pp. 31-41]
(B3)	Das System zeigt mir alternative Wege auf, meine Aufgabe zu erledigen.*	New item, based on Gentile et al. [2007, pp. 395-410], Schmitt [1999, pp. 64-72], Schmitt and Mangold [2004, pp. 38-43], and Verhoef et al. [2009, pp. 31-41]
(B4)	Das System passt zu meinem persönlichen Lebensstil.	New item, based on Gentile et al. [2007, pp. 395-410], Schmitt [1999, pp. 64-72], Schmitt and Mangold [2004, pp. 38-43], and Verhoef et al. [2009, pp. 31-41]
Sensory Dimension		
(S1)	Insgesamt finde ich, dass das System attraktiv aussieht.	van der Heijden [2003, p. 548]
(S2)	Das System stimuliert meine Sinne (Sehen, Hören, Fühlen, Schmecken oder Riechen).	New item, based on Gentile et al. [2007, pp. 395-410], Schmitt and Mangold [2004, pp. 38-43], and Verhoef et al. [2009, pp. 31-41]
(S3)	Das System stimuliert mehrere meiner Sinne gleichzeitig.	New item, based on Gentile et al. [2007, pp. 395-410], Schmitt and Mangold [2004, pp. 38-43], and Verhoef et al. [2009, pp. 31-41]
(S4)	Die ganzkörperliche Interaktion (mit allen Sinnen) empfinde ich als angenehm.	New item, based on Gentile et al. [2007, pp. 395-410], Schmitt and Mangold [2004, pp. 38-43], and Verhoef et al. [2009, pp. 31-41]

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Social Dimension		
(SO1)	Insgesamt bietet das System gute Möglichkeiten für die Interaktion mit anderen.	Liu et al. [2010, p. 609]
(SO2)	Das System motiviert dazu, es gemeinsam mit anderen zu nutzen.	New item, based on Gentile et al. [2007, pp. 395-410] and Liu et al. [2010, pp. 600-610]
(SO3)	Meine Freunde wären neidisch auf mich, dass ich die Möglichkeit hatte, das System zu nutzen.	New item, based on Schmitt and Mangold [2004, pp. 38-43] and Venkatesh and Bala [2008, pp. 273-315]
(SO4)	Die Möglichkeit, das System zu nutzen, ist wie ein Statussymbol.	New item, based on Schmitt and Mangold [2004, pp. 38-43] and Venkatesh and Bala [2008, pp. 273-315]

* Adaption of the item set to fit the respective field of application (e.g., shopping).