University of Technology Ilmenau

Faculty of Electrical Engineering and Information Technology

Dissertation

Engineering the User Experience of Web Products – Development of a Framework to Support UX Centered Software Engineering

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Abstract

User experience (UX) as an engineering discipline is still in its infancy. Although the concept of UX and its importance in software engineering is becoming widely known, its transfer into practical product development is still only low. Practitioners increasingly demand applicable support to integrate the UX concept into daily product development activities.

This thesis presents an approach to effectively support user experience engineering within the context of web products. Therefore, the work builds upon the theory that fulfilling psychological needs elicits positive experiences and provides a framework, which relates psychological needs with product qualities. In order to develop effective support, the research contains four different studies that aim to understand requirements for support in UX centered software engineering, to evaluate and to improve the proposed framework by specifying psychological needs for web products. Especially improving the framework aimed to answer the research question of, which psychological needs are to be fulfilled by web products. Therefore, semi-standardized episodic user interviews were conducted.

The main result indicates that the psychological needs, as put forward by Sheldon et al. (2001), for *autonomy – independence*, *competence – effectance*, *relatedness – belongingness*, *self-esteem – self-respect*, *security – control*, *pleasure – stimulation* and *influence – popularity* are most important within the area of web products. This finding bases upon 24 inductively derived need categories that are specified into 56 need items. Need categories and need items provide a helpful basis to support the UX centered engineering activities conceptualizing UX and evaluating UX.

Results furthermore, can provide a basis for future research and practical UX engineering in different product areas.

Kurzfassung

User Experience (UX) als Disziplin der Mensch-zentrierten Softwareentwicklung befindet sich noch in seinen Anfängen. Obwohl das Konzept sowie die Relevanz der UX in der Softwareentwicklung an immer mehr Bekanntheit gewinnt, fand eine Transformation in die praktische Produktentwicklung bislang lediglich in geringem Maße statt. Produktverantwortliche fordern daher mehr und mehr anwendbare Unterstützung, um das UX-Konzept in tägliche Produktentwicklungsaktivitäten zu integrieren.

Dieses Dissertationsprojekt stellt einen Ansatz zur effektiven Unterstützung der UX-zentrierten Produktentwicklung im Kontext von Web Produkten vor. Basierend auf der Theorie, dass die Erfüllung psychologischer Bedürfnisse grundlegend für positive Erlebnisse ist, präsentiert die Arbeit ein Rahmenmodell, welches psychologische Bedürfnisse mit Produktqualitäten in Beziehung setzt. Für die Entwicklung einer effektiven Unterstützung besteht die Forschung aus vier verschiedenen Studien. Die Studien verfolgen die Ziele, die Anforderungen an eine Unterstützung in der UX-zentrierten Softwareentwicklung zu eruieren sowie das Rahmenmodell für den Bereich der Webprodukte durch Bedürfnisspezifizierungen zu evaluieren und zu verbessern. Insbesondere die Verbesserung des Rahmenmodells hatte zum Ziel, die Frage zu beantworten, welche psychologischen Bedürfnisse für eine positive UX durch Webprodukte erfüllt sein müssen. Um diese Frage zu beantworten, wurden teil-standardisierte episodische Nutzerinterviews durchgeführt.

Ergebnisse zeigen, dass die psychologischen Bedürfnisse laut Sheldon et al. (2001) nach *Autonomie – Unabhängigkeit*, *Kompetenz – Kompetenzmotivation*, *Verbundenheit – Zugehörigkeit*, *Selbstachtung – Selbstwertgefühl*, *Sicherheit – Kontrolle*, *Freude – Stimulation* und *Einfluss – Popularität* relevant im Bereich von Webprodukten sind. Diese Erkenntnis basiert auf 24 induktiv ermittelten Bedürfniskategorien, welche in 56 Bedürfniseinheiten spezifiziert sind. Bedürfniskategorien und Bedürfniseinheiten stellen eine hilfreiche Basis dar, um die UX-zentrierten Entwicklungsaktivitäten UX Konzeptualisierung und Evaluation zu unterstützen.

Weiterhin können die Ergebnisse eine hilfreiche Grundlage für zukünftige Forschungen und praktische UX-zentrierte Entwicklungsaktivitäten in verschiedenen Produktbereichen zur Verfügung stellen.

Contents

1 Introduction

1.1 Research Motivation

When I first heard about the concept of "User Experience" (UX), I was immediately excited. Although I was already studying in the field of Human Computer Interaction and Perceived Media Product Quality, the concept of UX exactly matched my personal philosophical orientation and goal: to improve *human well-being* by focusing on *personal experience* while interacting with products. Further, this is, to support the development of products that improve a person's life.

It is clear that research to fulfill this personal goal requires a practice-driven approach and therefore an environment in which products are conceptualized and managed.

When I started to learn more about this topic in 2009, companies were beginning to appreciate the concept of UX as they understood that considering UX in product development can help to:

- sell the product;
- make people use the product more frequently;
- build a quality image for anticipated experience;
- limit the perceived importance of usability problems and
- provide important insights from people in order to understand mandatory functions from a user point of view[1].

Not only practitioners are concerned with developing a User Experience. For more than a decade, User Experience has been a popular research topic within the academic world. For instance, the DIN norm ISO 9241-210 states that "using a human centered approach to design and development has substantial economic and social benefits for users, employers and suppliers. Highly usable systems and products tend to be more successful both technically and commercially. In some areas, such as consumer products, purchasers will pay a premium for well-designed products and systems."[2]

[1] See the results of expert interviews with practitioners, available in Section B.3.
[2] [DIN EN ISO 9241-210, 2010, p.4].

The approach to design and develop in a human centered way is anchored in Human Centered Design (HCD). HCD is "an approach to interactive systems development that aims to make systems usable and useful by focusing on the users, their needs and requirements, and by applying human factors/ergonomics, and usability knowledge and techniques. This approach enhances effectiveness and efficiency, improves human well-being, user satisfaction, accessibility and sustainability (...)."[3]

However, UX researchers noticed and criticized that the *transformation of human centered theory focusing on improving human well-being is only marginally transferred into practical product development processes*[4]. Saying that, the approach to "make systems usable and useful by focusing on the users, their needs and requirements" seemed to be not properly integrated or translated in a company's product development.

This is an interesting aspect, considering the practitioner's knowledge about the benefits in human centered, respectively UX centered, product development, as described in the listing above. Why is the transformation of UX theory into practical development low although the benefits of UX seem to be clear? This is the initial question that lead to this research project. To *find out challenges in practical development to develop for UX* and, based on this knowledge, to *provide a helpful support for responsible actors to effectively engineer the UX is the core motivation of this work.*

1.2 Research Goal

In order to research challenges in practical development to develop for UX, I conducted expert interviews within the area of software engineering. Interview results substantiate the statement of a marginally transfer of UX in pactical product development and emphasize the need for support in order to develop UX centered[5]. Main challenges are understanding the overall concept of UX as well as applying this concept in practical software engineering, specifically in conceptualizing and evaluating the UX of software.

In order to provide applicable support for conceptualizing and evaluating the UX and to provide an overall understanding about what UX is, it is necessary to look at existing approaches of human centered product quality as well as underlying human aspects that aim to explain why and how this quality is perceived positively or negatively. Especially knowing underlying human aspects help to understand how to conceptualize UX, meaning to proactively develop for positive experiences. Such underlying human aspects can be found in psychological needs. Sheldon and colleagues, for instance, assume that "psychological needs

[3] [DIN EN ISO 9241-210, 2010, p.vi].
[4] See e.g. [Hassenzahl and Tractinsky, 2006] and [Roto et al., 2009].
[5] See Subsection 3.1 for more.

are particular qualities of experience that all people require to thrive"[6]. In Human-Computer-Interaction (HCI) research, the importance of understanding these underlying human needs is discussed extensively[7]. For that reason, psychological needs provide an adequate basis to understand perceived product quality.

The question lays at hand, how psychological needs relate to perceived product quality. Therefore, I proposed an early framework that aims at relating selected psychological needs as proposed by Sheldon et al.[8] to the product qualities usability and attractiveness. In order to investigate the applicability of this early framework, I conducted an empirical study to evaluate the practicability of the framework and to identify limitations of the framework.

The evaluation of the UX framework has shown that further research is required to understand a clear relation between psychological needs and the product quality underlying product features. Considering this, the research question of the following work focuses on *understanding which psychological needs fulfill which product features within the area of web products.*

Saying that, goal of the thesis is to *provide an applicable support for responsible actors in product development in order to understand, conceptualize and evaluate UX.* This is, to *develop products that focus on supporting humans in their everyday lives by focusing on the person's well-being and personal development.*

Therefore, the dissertation project aims to provide *a first step to specifying psychological needs in relation with product features* in order to make UX engineering more applicable and to help transferring the UX concept into practical software engineering.

[6] [Sheldon et al., 2001, p.325].
[7] See e.g. [Norman, 1986], [Gaver and Martin, 2000], [Norman, 2002a], [Wiklund-Engblom et al., 2009], [Hassenzahl et al., 2010], [Jordan, 2000].
[8] [Sheldon et al., 2001].

1.3 Research Scope

This thesis introduces research in the area of UX centered software engineering that provides a background and guidelines on conceptualizing and evaluating user experience of web products (software). It aims at supporting responsible actors in software development, such as product managers, designers, human factors experts and software engineers, to develop UX centered products.
According to Roto and colleagues, the field of UX deals with *"studying, designing for and evaluating the experiences that people have through the use (or encounter) with a system."*[9] and thereby incorporates the following research perspectives:

- "UX as a phenomenon: describing what UX is and what it is not; identifying the different types of UX and; explaining the circumstances and consequences of UX.
- UX as a field of study: studying the phenomenon, for example how experiences are formed or what a person experiences, expects to experience, or has experienced; finging the means to design systems that enable particular UXs and; investigating and developing UX design and assessment methods.
- UX as a practice: envisioning UX, [...]; representing UX, [...]; evaluating UX and; delivering designs aimed at enabling a certain UX".[10]

These research perspectives build an adequate frame to define the scope of the thesis. Considering this, *research scope is mainly UX as a practice with focus on how experiences are formed based on psychological needs within the area of web products.* The research therefore addresses:

- UX as a phenomenon: solely providing a definition of UX in Section 2.1 as the phenomenon is already well described and many definitions exist.
- UX as a field of study: studying the phenomenon and finding the means to design systems that enable particular UXs by analyzing UX models focusing on *perceived product quality* within the area of web products in Subsection 3.2.2 and *psychological needs* in Subsection 3.3; and the development of a model to relate product quality and psychological needs in Subsection 3.4.1 as existing models and studies lack in relating product quality with underlying human motives.
- UX as a practice: transferring the understanding of how experiences are formed by psychological needs and perceived product quality into UX activities within the software engineering process by focusing on *envisioning UX* and *evaluating UX*; that is, because UX in practice is still only researched marginally.

I subsume UX as a phenomenon and UX as a field of study under *UX theory.* By combining both analytical and empirical research, I aim at narrowing the gap between UX theory and practice with this dissertation project.

[9] [Roto et al., 2011, p.5].
[10] [Roto et al., 2011, p.5].

1.4 Thesis Outline

Based on the scope of research, the thesis is structured as follows: relevant terminology for a unified understanding of used terms and concepts defines chapter 2. Chapter 3 provides a theoretical background on challenges in practical software engineering, existing approaches to product quality and psychological needs, as well as an early proposed framework including an early framework evaluation. Chapter 4 builds upon the previous achievements and presents the research question. Chapter 5 provides an extensive overview of the research design of this work. Chapter 6 presents the research results. Chapter 7 closes with a conclusion including a discussion and transferability of results as well as prospective research. Chapter 8 summarizes the research presented in this dissertation.

The appendix provides detailed material about the studies executed for this research. Appendix Section A describes the demand analysis as a starting point to understand the overall goals of the research. Appendix Section B presents an extensive expert interview study with 31 product managers from different national and international companies to understand the state of UX in order to research challenges within practical software engineering and requirements for practitioners to engineer particular user experiences. Appendix Section C introduces a pre-study with the mobile photo sharing service LiveShare by Cooliris that helped to improve the early UX framework and therefore provided indications to frame the research question for this work. Appendix Section D presents additional and detailed material of the work's main study as introduced in Chapter 5 and 6. Figure 1.1 visualizes the thesis outline.

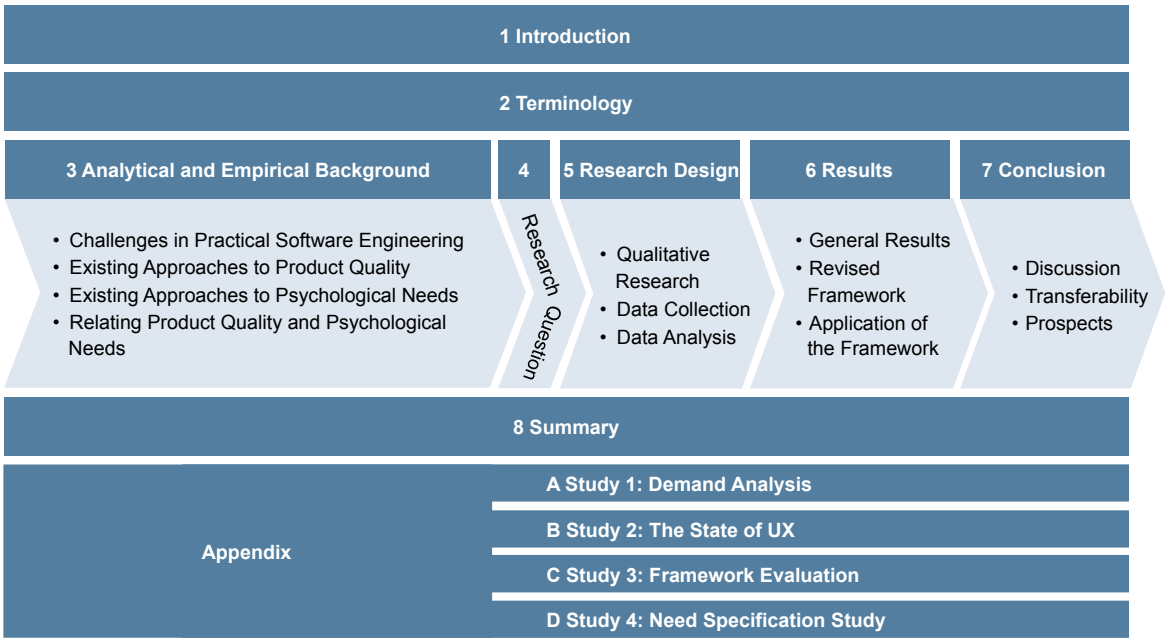


Figure 1.1: Thesis Outline

2 Terminology

This chapter provides an overview and definitions of relevant concepts and terms used in this work. Goal is to define relevant terms for the context of this work as they may be used with varying meanings in other contexts. Hence, section 2.1 briefly defines the concept of User Experience, considering both the phenomenon and practical application. Section 2.2 transfers the concept of UX to the area of software engineering and, therefore, defines UX centered software engineering. As the present work is concerned with engineering the UX of web products, section 2.3 introduces my understanding of web products, product quality and product features.

2.1 User Experience (UX)

2.1.1 Defining User Experience

The question of what User Experience (UX) is has been explored by a number of researchers and practitioners[1]. The following selected definitions illustrate the variety of understanding user experience and indicate the ambiguity of the UX concept:

> "All the aspects of how people use an interactive product: the way it feels in their hands, how well they understand how it works, how they feel about it while they're using it, how well it serves their purposes, and how well it fits into the entire context in which they are using it"[2]

> "Every aspect of the user's interaction with a product, service, or company that make up the user's perceptions of the whole"[3]

> "A consequence of a user's internal state (predispositions, expectations, needs, motivation, mood, etc.), the characteristics of the designed system (e.g. complexity, purpose, usability, functionality, etc.) and the context (or the environment) within which the interaction occurs (e.g. organizational/social setting, meaningfulness of the activity, voluntariness of use, etc.)"[4]

[1] See e.g. [Alben, 1996], [UPA, 2006], [Hassenzahl and Tractinsky, 2006], [Bachmann, 2005].
[2] [Alben, 1996, p.4].
[3] [UPA, 2006, Glossary of the website].
[4] [Hassenzahl and Tractinsky, 2006, p.95].

> "User experience is seen as a superordinate category that includes usability and other aspects such as branding, aesthetics, pleasure, credibility, trust, and communication.[...] user experience moves beyond the usability of a product or service or the specific documentation to the overall product."[5]

These definitions aim to comprehend UX by describing its nature. Unity exists in the general understanding that the *experience* is an expression of an internal attitude. Disagreement is reflected in the inclusion of Usability, the perspective of influencing factors as well as the level of detail of the definition. Firstly, influencing factors of UX during product usage is defined precisely[6] and, secondly, UX is defined generally without naming influencing factors[7] or UX is solely seen as a result of the usage or as a superordinate category[8]. Table 2.1 provides a summary of main statements to define the user experience with a selection of relating authors. Considering these different statements and conceptions of UX, it is necessary to clearly focus

Statement	Author
The product is part of the overall usage context and is influenced by this context.	[Alben, 1996], [Hassenzahl and Tractinsky, 2006], [Ardito et al., 2008], [Sward and Macarthur, 2007]
The UX concerns the perception of the user.	[UPA, 2006], [DIN EN ISO 9241-210, 2010], [Kuniavsky, 2003], [Mahlke, 2008], [IBM, 2009], [Wright and McCarthy, 2004]
UX is the result of an internal human state.	[Hassenzahl and Tractinsky, 2006], [Ardito et al., 2008]
UX includes usability and extends the concept of usability.	[Bachmann, 2005], [Mahlke, 2008]
UX includes aesthetic and pleasurable aspects (hedonic aspects).	[Bachmann, 2005], [Kort et al., 2007], [Mahlke, 2005]
Experiences are measurable through measuring emotional reactions.	[Battarbee and Koskinen, 2005], [Ardito et al., 2008], [Williams and Hole, 2007], [Wright and McCarthy, 2004]
The experience elicited by product interactions relates to requirements, dreams and motivations of people.	[Black, 1998], [Mäkelä and Fulton Suri, 2001]
The experience includes spatio-temporal aspects as the overall experience is formed by expectations, the experience during interaction as well as its reflection.	[Blythe et al., 2003], [Isomursu, 2008], [Wright and McCarthy, 2004], [Forlizzi and Battarbee, 2004]

Table 2.1: Summary of Authors and Statements to Define UX

on *one* definition and specific factors that constitute the UX. A common understanding provides the DIN EN ISO 9241-210 since 2010 by defining UX as *"a person's perceptions and*

[5] [Bachmann, 2005, p.15].
[6] See e.g. [Alben, 1996, p.4].
[7] See e.g. [UPA, 2006, Glossary of the website].
[8] See e.g. [Hassenzahl and Tractinsky, 2006, p.95] or [Bachmann, 2005, p.15].

responses that result from the use and/or anticipated use of a product, system or service."[9]. In academics[10] and in industry[11], this definition is often criticized as too imprecise. For that reason, Law[12] extensively cumulated and linked existing definitions. Although all these definitions and attempts to explain User Experience exist, the thesis follows the definition given by ISO 9241-210 and substantiates the definition with the following characteristics of UX[13]:

- It is a subset of experience as a general concept and related to the experience of using a system;
- It includes encounters with systems, actively and passively;
- It is influenced by prior experiences and resulting expectations;

These characteristics of UX help to describe UX as a phenomenon and focus on the relationship between a system (product) and an individual (user). To capture UX more holistically, the concept of UX includes the transformation of the phenomenon into practical product development activities: user experience in practice.

2.1.2 Defining User Experience in Practice

According to Roto et al., UX in practice includes the following activities[14]:

- *Envisioning UX*: to scope and identify UX factors that are known, based on evidences, or "are thought likely to be the drivers of UX in their particular instance"[15];
- *Representing UX*: to give a sense what experience might be like before a final design is available. This includes stimulating prospective users to participate in user trials in order to gather user feedback, communicating the concepts and designs within the organization and to sustain the UX vision throughout the engineering process;
- *Evaluating UX*: to collect user feedback regarding the anticipated or actual experience with a concept, prototype or products;
- *Delivering designs* aimed at enabling a certain UX: to provide visualizations and/or prototypes that comprise a desired UX.

These activities indicate a structured process for transforming the phenomenon of UX into practical product development containing phases for requirement analysis: envisioning UX, design: delivering designs, and evaluation: evaluating UX that postulate the focus of the user. This user focus, however, is not specified precisely.
The following aims to describe how these activities can be integrated into the software engineering process.

[9] [DIN EN ISO 9241-210, 2010, clause 2.15].
[10] [Law, 2011, p.2].
[11] As derived from interviews with practitioners, see detailed results in Appendix Section B.
[12] [Law, 2011, p.2].
[13] [Roto et al., 2011, p.6].
[14] [Roto et al., 2011, p.5, p.11 and p.12].
[15] [Roto et al., 2011, p.11].

2.2 User Experience Centered Software Engineering (UXSE)

2.2.1 Software Engineering

The term *Software Engineering* (SE) first appeared in 1968 at a NATO conference in Garmisch, Germany[16]. In its earlier meaning software engineering meant to be the development of (small) *programs* generally by a programmer for an operator or user[17] while the user was often the programmer him- or herself. Modern software engineering involves complex systems, frequently containing multiple components. These software systems are usually developed by a number of programmers, and users are not identical to the programmers. Now *programming* is seen as an *engineering task or method.*
Although, there is no standardized definition of the term software engineering by now, it can be characterized by the following aspects[18]:

- It aims at developing reliable, efficient and trustworthy software;
- It is an engineering (technical and organizational) discipline;
- Activities include specification, development, validation and evolution of software products or systems;
- It is based on the application of engineering principles;
- It includes technical and non-technical aspects and
- It takes economical development (time- and cost-efficient) into account.

Figure 2.1 shows the software engineering process phases containing these aspects that forms the systematic basis to engineer user experience. Modern software engineering processes,

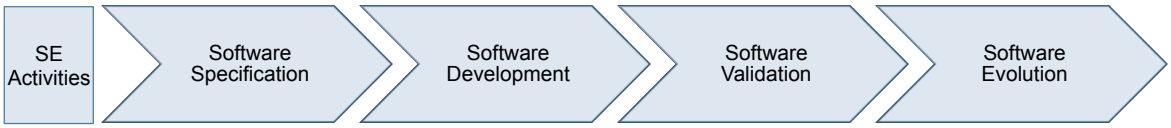


Figure 2.1: Process Activities in Software Engineering (own illustration)

especially in web development, do not follow a sequential process as displayed in Figure 2.1. Such software engineering activities contain many iterations within the single phases in order to ensure flexible product development.

2.2.2 The UX Focus in Software Engineering

As a result from the definitions of user experience in practice and software engineering, I conclude that user experience centered software engineering includes engineering (technology), design (visual appearance) and human factor (psychology) disciplines. As envisioning UX and specifying a software are intertwined, I argue to merge both the SE and the UX activity

[16] See [Pfleeger and Atlee, 2006], [Mayr, 2005, p.32] or [McIlroy et al., 1969].
[17] [Mayr, 2005, p.33].
[18] Summarized from [Mayr, 2005, p.33], [Fairley, 1985], [Sommerville, 2006] and [Sommerville, 2010].

to *Conceptualizing UX*. Conceptualizing UX, therefore, is the specification of software with strong focus on the envisioned user experience. This activity emphasizes the importance of specifying UX in early software development phases.

In conformity with Roto and colleagues, it is important to sustain the UX vision throughout the engineering process[19]. Saying this, besides active UX engineering, the concept and ideas need to be communicated across all engineering activities. Therefore, *Communicating UX* is an important activity that advocates the activity of representing UX.

Goal of UXSE is to engineer a product that elicits positive user experiences. Consequently, it can be characterized by the following aspects:

- It aims at developing useful, usable and attractive software;
- It is an engineering (technical and organizational) AND design discipline;
- Activities include conceptualizing (envisioning and specifying), communicating (representing), evaluating (measuring), and implementing (delivering) UX of software;
- It is based on the application of engineering, design and human factor[20] principles and
- It takes economical development (time- and cost-efficiency) into account.

Figure 2.2 shows the activities of UX in practice based on the systematical basis of software engineering. Although the graphic indicates the focus on the software engineering activity *software specification*, UX still has to be considered in all other software engineering activities. UX activities will be determined more in detail in the empirical and analytical background.

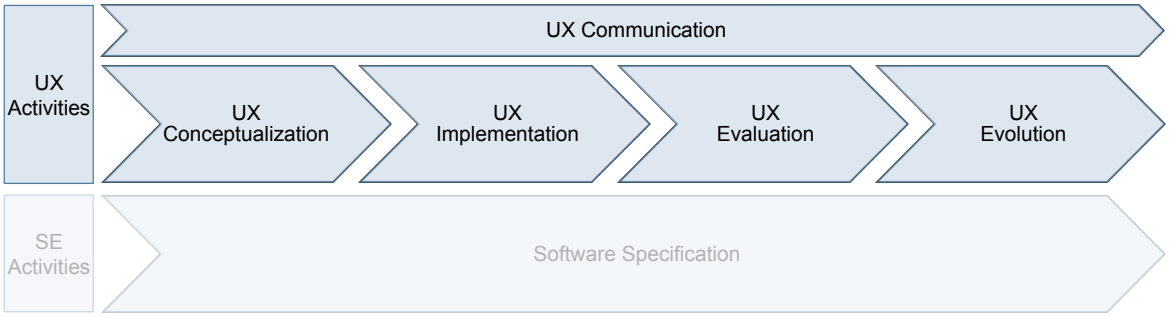


Figure 2.2: UX Focus in Software Engineering (own illustration)

[19] [Roto et al., 2011, p.12].

[20] Human factors, also referred to as *ergonomics* is "the scientific discipline concerned with the understanding of interactions among humans and other elements of a system, and the profession that applies theory, principles, data and methods to design in order to optimize human well-being and overall system performance" according to [IEA, 2012].

2.3 Web Products, Product Quality and Product Features

2.3.1 Web Products

Web products can be classified in different ways. As the development of the mobile internet has had a profound effect on software engineering and, in consequence, people's communication behavior, a classification regarding the access of the web product into *mobile vs. desktop* is appropriate. Mobile web products are designed for small screens and touch and are often referred to as *web applications*, short apps[21]. The term *web application* refers to a software program accessed via a web browser over a network such as the Internet. The W3C Recommendation of Mobile Web Application Best Practices distinguishes web applications from simple web content in "that they include locally executable elements of interactivity and persistent state"[22]. Today, the emergence of web applications has changed the usage behavior of navigating in the web. They have become a filter for users in the World Wide Web enabling to access not only information but also games, photos, music, videos and much more.

Besides the classification of web products into the way they can be accessed, they can be classified according to the way they relate to the operating system into *web/browser vs. native*[23]. A native application is specifically designed to run on a pre-defined operating system. A web application is one that is delivered over HTTP[24] to provide a *native application-like* experience within a web browser[25]. Table 2.2 shows the classification of web products with examples. The classification serves as a further categorization of software products in this work. To design desirable Web applications, engineers take specific product quality factors

	Web	Native
Mobile	Web application designed for small screens and touch, today often based on HTML5. Examples are Asana, FinancialTimes	Mobile applications that are using native software development toolkits. The coding is specific to different platforms such as iOS or Android. Examples are LiveShare or Facebook for Mobile
Desktop	Application delivered over the web intended to run on a desktop web browser. These are traditional websites such as Google.com, Amazon.com or Spiegel.de.	Software system developed for a specific desktop operating system, such as FaceTime for MacOS or Dropbox for Windows.

Table 2.2: Classification of Web Products

into account. Existing international standards of software quality help to develop for certain product qualities.

[21] See [Sommerville, 2010, p.13] for more.
[22] [W3C, 2010].
[23] See [Charland and Leroux, 2011].
[24] Short for HyperText Transfer Protocol.
[25] [W3C, 2010].

2.3.2 Product Quality

With reference to the scope of the thesis, product quality, in this work, relates to and focuses exclusively on software quality. There are a number of approaches to define software quality. For instance, IEEE defines software quality as "the degree to which software possesses a desired combination of attributes (e.g., reliability, interoperability, correctness and performance)"[26]. This definition describes product quality from an engineering perspective, not stating who defines "a desired combination of attributes". Although one critical outcome of quality management in organizations is user satisfaction[27], a more user-centered definition is more advisable. For that reason, the ISO 8402 standard, defining software quality as "the *totality of characteristics* of an entity that bear on its *ability to satisfy stated and implied needs*"[28], is more applicable for this work. Italic parts of the definition point out the relation of the important concept of *need-fulfillment* relating to software quality.

Focusing on need fulfillment when defining the quality of products puts the human being, and therefore the user of the product, into the centre of product quality. This perspective is the basis for user experience as a quality factor of interactive products.

Existing approaches to product quality focusing on the user introduces Chapter 3.

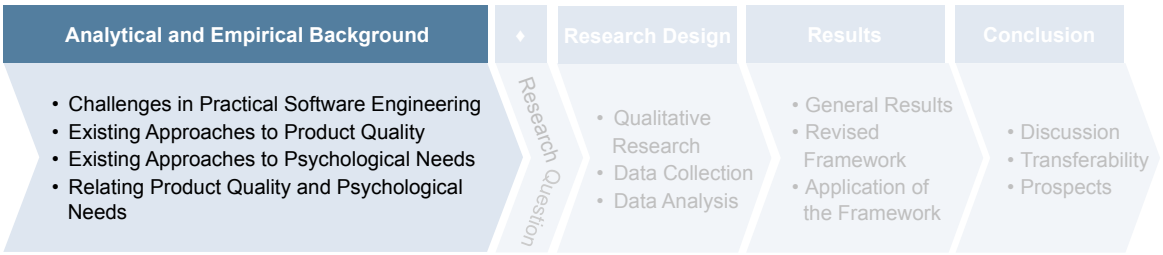
2.3.3 Product Features

Although product features and product quality are often not clearly differentiated in literature, the work defines product features as follows.

Product features are characteristics of a product underlying the product quality. A web product feature is for instance "Search".
From an organizational perspective, a product feature is an implemented product requirement. It contains a function, e.g. for the feature "Search" *to search within the website* and its design. The way a product feature is designed and implemented influences the overall perceived product quality.
From a user's perspective, product features aim to fulfill user requirements and therefore can be seen as the objectively perceived parts of an overall perceived product quality.

[26] [IEEE, 1992].
[27] A number of studies confirm that user satisfaction has a positive impact on organizational cost, profit and sales growth, which is why software quality is a key indicator for a successful product.
[28] [DIN EN ISO 8402, 1994].

3 Analytical and Empirical Background



Considering the motivating goal of how technologies can elicit positive experiences and support users' everyday lives, it is central to understand both organizational and user requirements. Understanding organizational requirements helps to focus on a research goal that supports a company's product development activities. Understanding user requirements helps to comprehend how products can elicit positive experiences and, therefore, how to develop UX centered products. For that reason, this chapter provides a theoretical background on *(1) current challenges in practical software engineering*, *(2) existing approaches to product quality*, *(3) existing approaches to psychological needs* and *(4) an approach to relate product quality with psychological needs.*

Knowing challenges in practical software engineering helps to identify areas that require UX support in software engineering. A theoretical background on product quality provides the product perspective on UX. Psychological needs provide background on the user perspective. Relating both product quality and psychological needs forms the basis of a framework that aims to support software engineering activities. The chapter concludes with a critical summary of the presented background that serves as a basis for the research question of this work.

3.1 Challenges in Practical Software Engineering

To deepen theories in UX as a practice as proposed by Roto et al.[1] and to develop useful support for practitioners, it is necessary to understand current challenges in practical software engineering. To understand challenges in practical software engineering I conducted 29 semi-standardized problem-centered expert interviews with individuals from 20 different national

[1] [Roto et al., 2011, p.11-12].

and international companies who are or were involved in software engineering projects that aim to design particular UXs. Knowledge derived from the interviews builds a basis to frame the current state of UX in practice. Empirical findings reveal main challenges in practical software engineering and indications for guidelines to engineer a particular UX derived from experiential knowledge. These findings indicate a strong demand for support to engineer UX in software engineering. Findings complement comprehensive studies regarding UX best practices as summarized by Degen and Yuan[2] which further consider cultural aspects within an organization. Cultural aspects will not be examined further in this work.

The study has shown that main challenges in developing for UX can be categorized in *understanding UX* and *activities in engineering the UX*.

These main challenges with reference to the UXSE process displays Figure 3.1. Challenges in understanding UX relates to the *holistic concept of UX* whereas challenges in engineering the UX relate to the *engineering process*, respectively, how to implement the concept of UX in practical software projects.

Figure 3.1 furthermore shows that only specific engineering activities appear to be challenging in the context of UX that require to be looked at further.

These illustrated challenges are constitutional to frame requirements for effective support

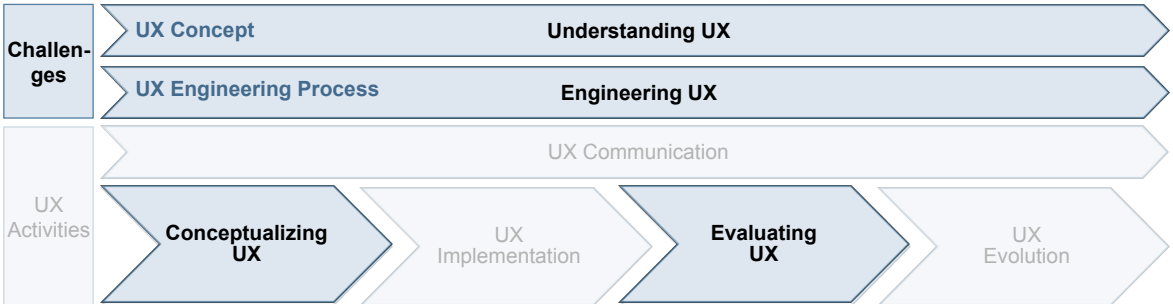


Figure 3.1: Challenges in Engineering the User Experience

in UX centered software engineering. Guidelines derived from best-practice examples provide a well-grounded basis for support. The following provides an overview of key findings and, therefore, further describes identified challenges. Detailed results are available in the appendix in Chapter B.

[2][Degen and Yuan, 2011].

3.1.1 Challenges in Understanding UX – the Overall UX Concept

Different perspectives on UX as well as internal communication difficulties indicate the challenge of a unified understanding of the UX concept. A unified understanding helps to create a shared meaning of UX visions and ideas among stakeholders throughout the engineering process. A company, therefore, has to define which components contribute to its own desired user experience and to communicate this clearly in the company's product philosophy. An own clear definition of UX is necessary to limit communication problems that lead to conceptualization and implementation errors.
Main challenges in *understanding UX* include:

- Understanding relevant guidelines to be considered for engineering UX: guidelines that help to define core features to create a usefulness (utility), guidelines that ensure a usability and user experience of the product[3]
- Prioritizing relevant UX criteria[4] that constitute the UX of a specific planned product

The challenge of understanding UX will not be examined further as a comprehensive collection of what constitutes the UX exists[5].

3.1.2 Challenges in Engineering UX – the UX Engineering Process

Challenges to implement the concept of UX in a structured software engineering process subsume under the challenges in engineering the UX.

Although Roto and colleagues name the four core activities *Envisioning UX*, *Representing UX*, *Evaluating UX* and *Delivering designs aimed at enabling a certain UX*[6], the study revealed main challenges in envisioning and evaluating UX. Representing and delivering UX did not appear to be main challenges. With a stronger focus on software engineering, and consequently the UXSE process as displayed in Figure 2.2, challenges in *engineering UX* contains the two phases: (1) *Conceptualizing the UX* with activities such as envisioning the UX, defining the UX as well as specifying the UX, and, (2) *Evaluating the UX* with assessment activities throughout the development process. These phases are embedded in an iterative process.

Table 3.1 provides an overview of UX centered engineering activities according to Roto and colleagues[7] and challenges in practical UX engineering as derived from the expert interviews. Within these phases practitioners currently face the following challenges.

[3] A meta-model that relates utility, usability and user experience shows [Schulze and Krömker, 2013].
[4] UX criteria are synonymous for UX metrics, UX aspects and UX analytics.
[5] See, e.g., a comprehensive summary and visualization of the UX concept in [Schulze and Krömker, 2013].
[6] [Roto et al., 2011, p.5].
[7] [Roto et al., 2011, p.5].

Activities according to Roto et al. (2011)	Challenges derived from Expert Interviews
Envisioning UX	Conceptualizing UX
Representing UX	–
Evaluating UX	Evaluating UX
Delivering designs	–

Table 3.1: Challenges in UX Centered Engineering Activities

Challenges in Conceptualizing the UX:

- Understanding relevant UX criteria
- Prioritization of UX criteria
- Defining the *core use* – the usefulness of the product
- Specifying core functions for the core experience of the product

Challenges in Evaluating the UX:

- Finding the right criteria
- Feeding evaluation results back into the development cycle for sustainable UX engineering
- Starting evaluations early enough in product development in order to influence design activities from the beginning on by focusing on the user

These challenges indicate a strong demand for support in UX centered software engineering. Therefore, the expert interviews revealed requirements that are most important to effectively support responsible actors within UXSE. Besides demands for applicability and understandability of UX, effective support should address the following requirements:

- *Contains clear UX criteria:* Clear criteria provide a compass about what constitutes positive experiences for prospective users. They can provide a basis for decision making at every stage of the product development cycle in order to prioritize features with a focus on user experience.
- *Contains guidelines that intertwine conceptualization and evaluation:* Although this requirement closely relates to the previous one, it further stretches the importance of clear evaluation criteria. Results of user evaluations should be able to directly flow back into conceptualizing the UX.
- *Focuses on early development:* Most effective support provides insights already in early development as decisions in early development phases define UX with the highest impact and freedom of action.

Summarizing this, the presented challenges can be structured into different steps within the UXSE activities conceptualizing UX and evaluating UX: *envision*, *define*, *specify* and *evaluate*. Figure 3.2 presents this structure visually.

Experiential knowledge based on previous and ongoing projects as well as advices from

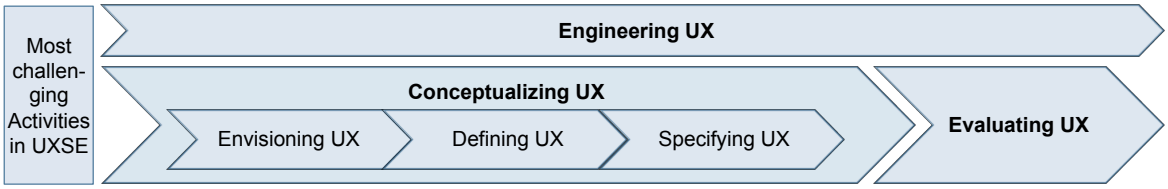


Figure 3.2: Most Challenging UX Activities Along The UXSE Process

product managers and UX consultants furthermore helped to derive guidelines to engineer UX. Based upon the previously introduced challenges in UXSE, Table 3.2 shows a summary of challenges related to guidelines for both conceptualizing and evaluating UX.

The guidelines serve as a basis to provide indications for UX centered software engineering.

	Conceptualizing UX			Evaluating UX
	Envision	Define	Specify	Evaluate
Challenges	Understanding relevant UX criteria.	Prioritization of UX criteria. Defining the core use of the product.	Specifying core functions.	Finding the right criteria. Feeding evaluation results back into the development cycle for sustainable UX engineering. Starting evaluations early enough in product development in order to influence design activities from the beginning on by focusing on the user.
Guidelines	Define a visionary UX goal. Decide on a UX strategy.	Have clear criteria for greatness or great experience. Understand user's personal goals	Allure the user. Reduce options.	Work data driven from the beginning on. Combine qualitative with quantitative data. Evaluate as often as possible. Don't listen to everything the user says. Start with in-house evaluations and then go out. Observe people interacting with your product.

Table 3.2: Summary of Challenges and Guidelines to Develop for UX

Based on the understanding of challenges and guidelines it is helpful to create an applicable and understandable framework that contains clear UX criteria which closer connect UX conceptualization and UX evaluation. In order to define these criteria, the product – user relation has to be examined further. Existing approaches to product quality and human needs are an adequate approach to understand this relation deeper.

3.2 Existing Approaches to Product Quality

For a comprehensive collection of existing approaches, the following presents approaches to product quality from a product creation point of view as well as from a product perception point of view. Products, in the following, are limited to web products.

3.2.1 Product Quality from a Product Creation Perspective

To quantify and evaluate quality of software, the international standard ISO/IEC 9216[8] defines six *quality characteristics* of software products as displayed in Table 3.3. However, scien-

Characteristic	Quantification
Functionality	Suitability, Accuracy, Interoperability, Security, Functionality Compliance
Reliability	Maturity, Fault Tolerance, Recoverability, Reliability Compliance
Usability	Understandability, Learnability, Operability, Attractiveness, Usability Compliance
Efficiency	Time Behavior, Resource Utilization, Efficiency Compliance
Maintainability	Analyzability, Changeability, Stability, Testability, Maintainability Compliance
Portability	Adaptability, Installability, Co-existence, Replaceability, Portability Compliance

Table 3.3: Quality Characteristics of Software as Defined in ISO/IEC 9216

tists in the software engineering field such Pfleeger and colleagues, have expressed concerns about a lack of evidence to support such standards: "Standards have codified approaches whose effectiveness has not been rigorously and scientifically demonstrated. Rather, we have too often relied on anecdote, (...), the opinions of experts, or even flawed research rather than on careful, rigorous software engineering experimentation."[9].
Considering Pfleeger's statement, standards not only have to be proven in practical software engineering. Moreover, each company has to prioritize these standards individually regarding the company goals and, if appropriate, include other factors. For a more UX centered perspective on software quality, the demand arises to extend quality aspects with *experience centered quality aspects*. Experience centered quality aspects put a stronger focus on user

[8] [DIN EN ISO 9126, 2001]. ISO 9216-2 describes External Metrics and ISO 9126-3 Internal Metrics.
[9] see [Pfleeger et al., 2002].

centered quality aspects focusing on a person's well-being than on technology centered quality aspects.

Experience factors are, to some extents, defined in DIN EN ISO 9241. The concept of *Usability*, which is already listed as a software quality characteristic in ISO/IEC 9216, defines DIN EN ISO 9241-11 more in detail[10].
To design a usable system as of DIN EN ISO 9241-11, DIN EN ISO 9241-110 specifies quantifiable *dialogue principles*[11]. Figure 3.3 visualizes how these standards relate to each other[12]. With the raising awareness of creating desirable software that focuses on the user's

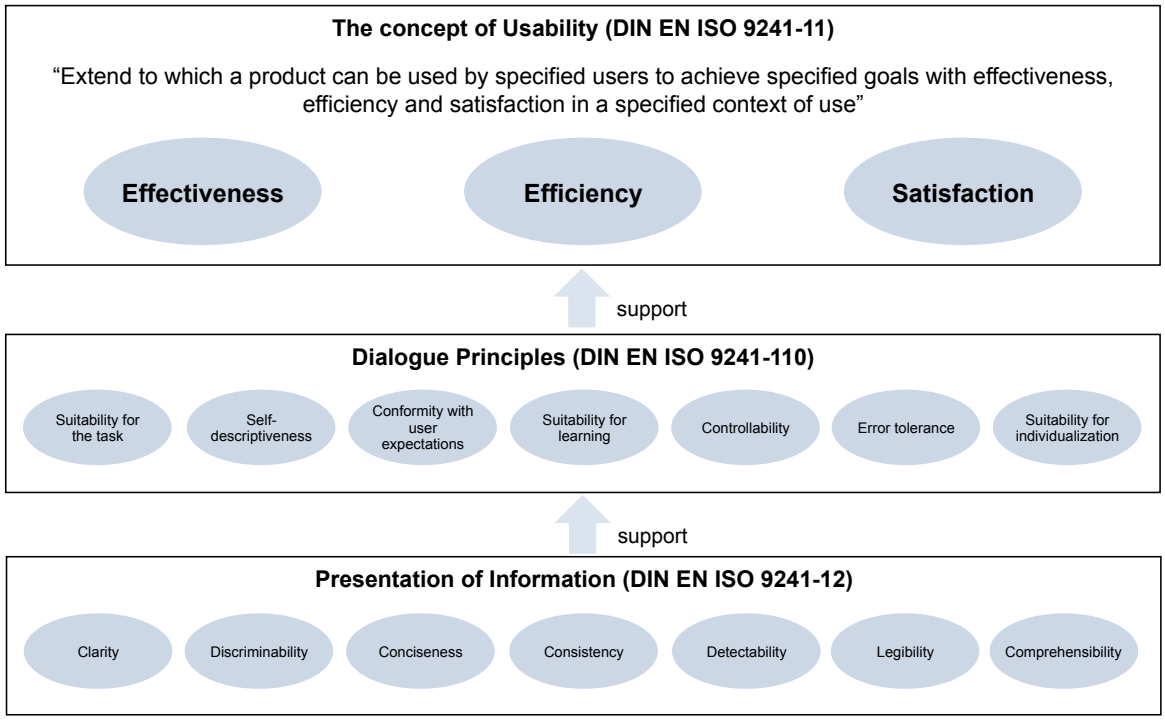


Figure 3.3: Relation between ISO 9241-110, ISO 9241-11 and ISO 9241-12

experience of an interactive system, researchers argue that the concept of usability is not sufficient. Usability focuses on minimizing effort and stress by creating functional, smooth and comfortable products rather than on the perceived well-being during an interaction: whether the user perceives an interaction positively or negatively. However, the concept of *satisfaction*, defined as the freedom from impairment and positive attitude towards product usage[13], provides an indication to identify aspects that influence human well-being. Saying that, a consideration of software quality from a product perception perspective can help to identify *experience centered quality aspects*.

[10] [DIN EN ISO 9241-11, 1997].
[11] [DIN EN ISO 9241-110, 2006].
[12] Adapted from [DIN EN ISO 9241-110, 2006, p.22].
[13] [DIN EN ISO 9241-210, 2010, p.6].

3.2.2 Product Quality from a Product Perception Perspective

Earlier studies on perceived website quality[14] indicate that the individual acceptance and usage of websites is influenced by quality factors such as ease-of use, usefulness and enjoyment[15]. This theory is based on the Technology Acceptance Model (TAM) as put forward by Davis, 1985[16]. TAM adopts the theory of reasoned action (TRA) by Fishbein[17] and builds upon the well-established causal chain of beliefs - attitude - intention - behavior[18]. According to van der Heijden's research, perceived attractiveness contributes strongly to the original TAM. Perceived attractiveness relates to perceived visual attractiveness of the product, which evidently contributes to feelings of usefulness, enjoyment and ease-of-use[19]. Van der Heijden furthermore found that attractiveness helps to explain enjoyment better than it helps to explain usefulness and he argues that "the attractiveness/enjoyment couple is the intrinsic motivation counterpart of the ease-of-use/usefulness couple"[20]. Figure 3.4 displays the revised TAM for the context of website usage. Surrounded blue parts highlight influencing factors on perceived product quality.

Given van der Heijden's statement that *intrinsic motivation* and *extrinsic motivation* in-

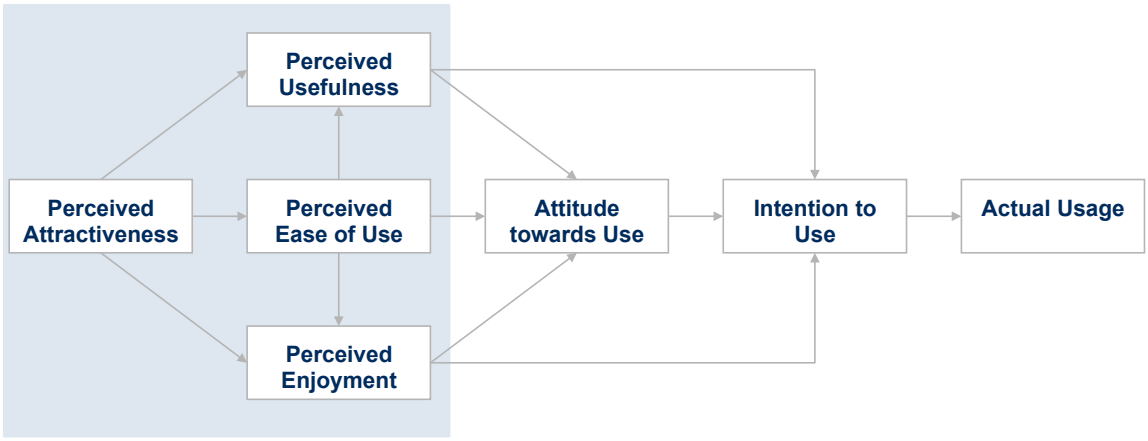


Figure 3.4: Revised TAM adapted from [Van der Heijden, 2003, p.542]

fluence perceived product quality[21], the pragmatic/hedonic model from Hassenzahl provides another approach with a similar point of view to classify influencing factors on perceived product quality. His model, as displayed in Figure 3.5, helps to understand both motivational

[14] Although these studies base on website quality, the transformation to a more general product view is applicable for this work, as websites are common software products.
[15] [Van der Heijden, 2003].
[16] [Davis, 1985].
[17] [Fishbein and Ajzen, 1975].
[18] [Van der Heijden, 2003, p.542].
[19] [Van der Heijden, 2003, p.547].
[20] [Van der Heijden, 2003, p.547].
[21] [Van der Heijden, 2003, p.547].

aspects along the two different dimensions: *pragmatics* and *hedonics*[22]. Hassenzahl argues

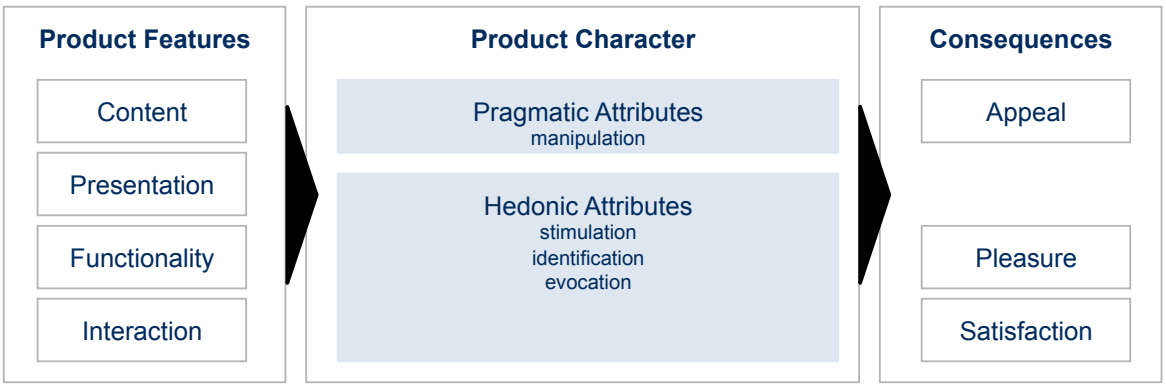


Figure 3.5: Model of User Experience adapted from [Hassenzahl, 2003, p.32]

that people perceive interactive products along the pragmatic and the hedonic dimensions. Pragmatics refer to the user's "do-goals" and hedonics refer to the user's "be-goals". With pragmatic attributes, here *manipulation*, the author refers to utility and usability, specifically "relevant functionality" and "ways to access this functionality"[23]. According to the author, pragmatic attributes "emphasize the fulfilment of individual's behavioral goals"; hedonic attributes, on the other hand, emphasize individual's psychological well-being[24]. Summarizing these thoughts, do-goals relate to the extrinsic motivation, namely usefulness and ease of use; and be-goals relate to intrinsic motivation, namely enjoyment. Mahlke adopted both

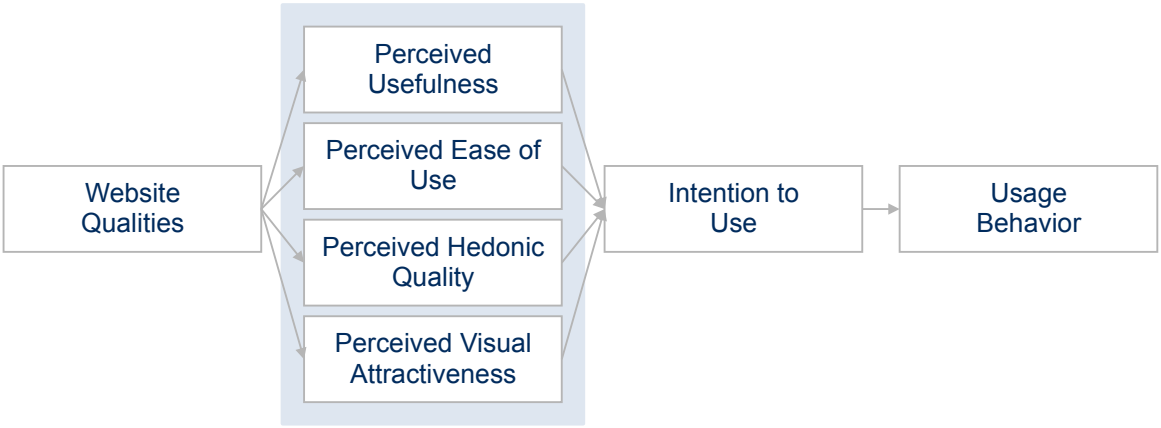


Figure 3.6: Model of User Experience adapted from [Mahlke, 2002, p.846]

the theory of TAM and the pragmatic/hedonic quality model from Hassenzahl to describe influencing factors on the *experience* of product usage, shown in Figures 3.6[25]. Considering

[22] [Hassenzahl, 2007, p.10].
[23] [Hassenzahl et al., 2000], [Hassenzahl, 2003, p.32].
[24] [Hassenzahl, 2003, p.35-36].
[25] [Mahlke, 2002] based on [Hassenzahl et al., 2000] and [Davis, 1989].

the theories above as displayed in Figure 3.4, 3.5 and 3.6, as well as international standards defined in IS0 9241-11[26] and ISO 9241-210[27], I argue that perceived product quality can be described with the two influencing factors Usability and Attractiveness. The dimension hedonic quality got obsolete as visual attractiveness and hedonic quality are considered to be overlapping concepts[28], that made it beneficial to merge both concepts[29]. Utility is not explicitly defined in ISO 9241 and, based on the definition "that the function in principle can do what is needed"[30], can be merged with the concept of Usability, i.e. suitability for the task as defined in ISO 9241-11.
Table 3.4 shows an overview of presented perceived quality aspects from Van der Heijden, Hassenzahl and Mahlke[31] that relate to the overall quality factors usability and attractiveness. Summarizing this, the presented models base on different point of views. A global

Perceived Quality Aspect	Van der Heijden	Hassenzahl	Mahlke
Usability	Perceived Usefulness	Pragmatic Quality	Perceived Usefulness
Usability	Perceived Ease of Use	Pragmatic Quality	Perceived Ease of Use
Attractiveness	Perceived Enjoyment	Hedonic Quality	Perceived Hedonic Quality
Attractiveness	Perceived Attractiveness	Hedonic Quality	Perceived Visual Attractiveness

Table 3.4: Overview of Perceived Quality Aspects that Relate to Usability and Attractiveness

view on perceived product quality presents van der Heijden. A more detailed view including product features introduces Hassenzahl's model of user experience. Mahlke combines both models while focusing on a more phenomenological point of view such as van der Heijden.
Saying that, limitations of all models encompass a lack of explicitly pointing out how to develop and design stated perceived product qualities. Van der Heijden and Hassenzahl however relate the perceived product quality to extrinsic and intrinsic motivation. As extrinsic motivation according to both authors mainly refer to usability, which has been extensively researched in the field of Human Computer Interaction, the intrinsic motivation part requires to be examined more in detail.

Considering this, underlying motives, such as human's psychological needs, play an important role in understanding *perceived* product quality that aims to create *positive user experiences*. This knowledge can help to create perceived attractiveness as shown in Table 3.4.For that reason, the following section introduces existing approaches to psychological needs.

[26] [DIN EN ISO 9241-11, 1997].
[27] [DIN EN ISO 9241-210, 2010].
[28] [Hassenzahl and Monk, 2010, p.254].
[29] [Bargas-Avila and Hornbæk, 2011, p.2696].
[30] [Nielsen, 1993].
[31] [Van der Heijden, 2003, p.542], [Hassenzahl, 2003, p.32] and [Mahlke, 2002, p.846].

3.3 Existing Approaches to Psychological Needs

Psychologists assume that psychological needs are internal sources of motivation. Psychological needs are latent and often not conscious to people. For that reason, looking at psychological needs can help to understand underlying motives of people to use interactive products in order to better understand the user – product relation.

> "By assuming that humans strive for certain fundamental qualities of experience, one is enabled to see unity (or equifinality) within broad diversities of behavior. Need concepts are also attractive because they readily suggest psychosocial interventions. That is, once identified, psychological needs can be targeted to enhance personal thriving, in the same way that the organic needs of plants, once identified, can be targeted to maximize thriving in the plant"[32].

As Deci and Ryan point out, need concepts play an important role in identifying and understanding psychological needs. Therefore, understanding relevant psychological needs provides an indication of the person's well-being when interacting with a product. Consequently, need concepts have the potential to help conceptualizing relevant product qualities.

Within psychology research, Maslow's hierarchy of needs[33] is one of the most popular models. However, other scientists argue that it has received little research support[34]. Another approach to identify underlying motives of people to act followed Reiss. Reiss identified 16 basic desires that motivate human beings and influence their personality[35]. With a link to interactive products, Jordan[36], Hassenzahl[37], Gaver and Martin[38] propose need concepts that focus on the user – product interaction. Kuo et al.[39] and Bauer & Hammerschmidt[40] furthermore focus on needs within the area of web products.

A more generic research on psychological needs is presented by Sheldon et al. The researchers identified 10 psychological needs that, they assume, are "particular qualities of experience that all people require to thrive"[41]. The authors conducted a meta-study to identify a set of candidate needs that build the basis for three triangulating studies with in total 707 students. The resulting top ten psychological needs are very generic and now well-established in psychology. As these psychological needs aim to be independent of age and gender of a person, they build an adequate basis for this work.

[32] [Deci and Ryan, 2000] referenced by [Sheldon et al., 2001, p.325].
[33] [Maslow et al., 1968].
[34] [Sheldon et al., 2001, p.336].
[35] [Reiss, 2000].
[36] [Jordan, 1998a], [Jordan, 2000].
[37] [Hassenzahl, 2003].
[38] [Gaver and Martin, 2000].
[39] [Kuo et al., 2005].
[40] [Bauer and Hammerschmidt, 2004].
[41] [Sheldon et al., 2001, p.325] referring to [Deci and Ryan, 2000] and [Reis et al., 2000].

Table 3.5 summarizes these top ten psychological needs in a hierarchical order. According to the authors, autonomy, competence, relatedness, and self-esteem are the most important needs that make people happiest. Security becomes salient in times of privation; stimulation, meaning, popularity, and physical thriving have shown to be less important in Sheldon's research and therefore do not deserve the "need" status. However, as society changes, stimulation and meaning become more important in our establishing "experience-economy"[42] and should be re-proven in new studies. Money-luxury could not be proven to be a psychological need. Table 3.6 lists the top ten psychological needs from Sheldon et al. together with need

Need	Description
Autonomy – Independence	Feeling like you are the cause of your own actions rather than feeling that external forces or pressure are the cause of your action
Competence – Effectance	Feeling that you are very capable and effective in your actions rather than feeling incompetent or ineffective
Relatedness – Belongingness	Feeling that you have regular intimate contact with people who care about you rather than feeling lonely and uncared of
Self-esteem – Self-respect	Feeling that you are a worthy person who is as good as anyone else rather than feeling like a "loser"
Security – Control	Feeling safe and in control of your life rather than feeling uncertain and threatened by your circumstances
Pleasure – Stimulation	Feeling that you get plenty of enjoyment and pleasure rather than feeling bored and understimulated by life
Self-actualizing – Meaning	Feeling that you are developing your best potentials and making life meaningful rather than feeling stagnant and that life does not have much meaning
Influence – Popularity	Feeling that you are liked, respected, and have influence over others rather than feeling like a person whose advice or opinion nobody is interested in
Physical thriving – Bodily	Feeling that your body is healthy and well-taken care of rather than feeling out of shape and unhealthy
Money – Luxury	Feeling that you have plenty of money to buy most of what you want rather than feeling like a poor person who has no nice possessions

Table 3.5: Top Ten Psychological Needs adapted from [Sheldon et al., 2001, p.346]

models from psychology, user experience and web product development. A relation between need models from Jordan (2000), Gaver and Martin (2000) and Hassenzahl (2003) with Sheldon et al. (2001) presents Hassenzahl and colleagues[43]. The presented Table 3.6 extends this composition with Reiss' 16 basic desires, Maslow's human needs as well as user needs in the area of web products as proposed by Kuo and colleagues[44] and Bauer & Hammerschmidt[45].

[42] [Pine et al., 1999].
[43] [Hassenzahl et al., 2010, p.355].
[44] [Kuo et al., 2005].
[45] [Bauer and Hammerschmidt, 2004].

Top Ten Needs Sheldon et al. (2001)	Reiss (2000)	Maslow (1968)	Hassenzahl (2003)	Jordan (2000)	Gaver & Martin (2000)	Kuo et al. (2005)	Bauer & Hammerschmidt (2004)
Autonomy – Independence	Independence						
Competence – Effectance			Manipulation	Psychopleasure	To extend knowledge and control	Time- and effort- saving, capacity	Clarity, structure
Relatedness – Belongingness	Social contact, family, romance	Love/ belonging		Sociopleasure	Intimacy		Communication
Self-esteem – Self-respect	Acceptance, honor, vengeance	Esteem					
Security – Control	Order, tranquillity	Safety needs				Security, credibility	Trust, reliability, credibility
Pleasure – Stimulation	Curiosity		Stimulation	Psychopleasure	Novelty, surprise, diversion, mystery	Allurement, pleasure, escape from reality	Challenge, entertainment
Self-actualizing – Meaning	Idealism	Self-actualization	Evocation	Ideopleasure	To understand and change one's self		
Influence – Popularity	Status, power		Identification	Sociopleasure			
Physical thriving – Bodily	Physical activity	Physiological needs		Physiopleasure			
Money – Luxury	Saving						

Table 3.6: Top Ten Psychological Needs in Relation with Need Models in Psychology, UX and Web Products (own Composition based on [Hassenzahl et al., 2010, p.355])

The need model from Sheldon et al. is well-established in psychology research and, as a result of its generic character, an adequate basic model to understand people's intrinsic motivation. However, the abstraction makes it difficult to apply the model to software engineering. In order to apply psychological need models to product development, the needs need to be specified (i.e. identifying need items) by relating them to product quality within a specific product area.

3.4 Relating Product Quality and Psychological Needs

Based on the theories as displayed in Figures 3.4, 3.5 and 3.6, it is a logical conclusion that a user's experience with a product consists of perceived product qualities that are influenced by the user's intrinsic and extrinsic motivation. According to well-accepted motivation theories, intrinsic motivation is a result from intrinsic needs that provide energy to act, that is, to fulfill these needs[46]. Therefore, the psychologists Sheldon et al. found 10 psychological needs that are fundamental for human's satisfying experiences[47]. The authors demonstrate that "psychological needs are particular qualities of experience that all people require to thrive"[48]. Hassenzahl adopted the theory to the area of interactive products[49], which serves as the basic need categorization for an early framework to measure UX of web products[50] as displayed in Figure 3.7. As stated earlier, the need theory has strong potential to understand how perceived product qualities can be proactively designed to elicit positive experiences.

The relation shown in Figure 3.7 contains influencing factors such as *emotion*, *motivation*

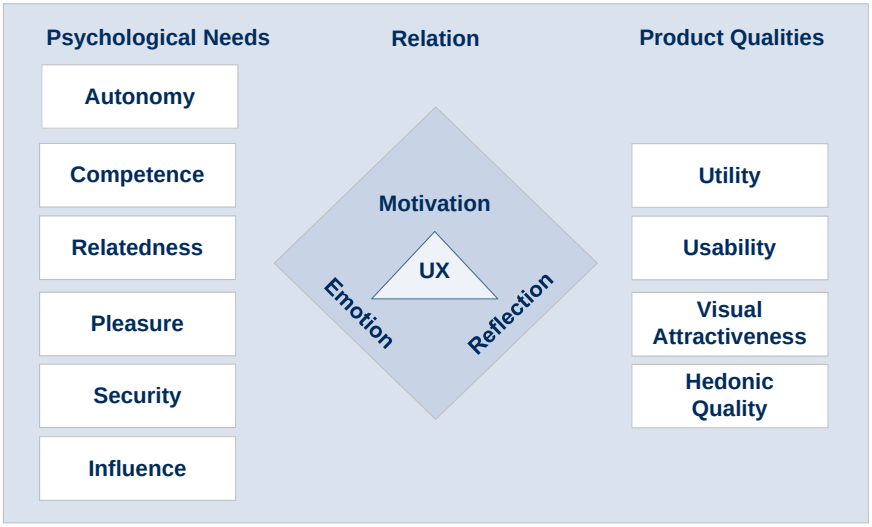


Figure 3.7: Framework of UX Influencing Factors from [Schulze and Krömker, 2010, p.262]

and *reflection*. According to Schulze and Krömker[51], emotion is the consequence of a user's internal state; motivation is causal for activated product experiences and reflection adds the spatio-temporality to the UX concept.

In this early UX framework, I selected six out of the ten needs that I considered the most important within the context of web products. Autonomy plays a central role in Self-

[46] [Deci and Ryan, 1985].
[47] [Sheldon et al., 2001].
[48] [Sheldon et al., 2001, p.325].
[49] [Hassenzahl, 2008], [Hassenzahl et al., 2010].
[50] [Schulze and Krömker, 2010].
[51] [Schulze and Krömker, 2010, p.262].

Determination Theory[52]. Relatedness and influence is named by Jordan (2000) under the concept of socio-pleasure; competence relates to Jordan's concept of psycho-pleasure[53]. Security relates directly to usability requirements and appears in Bauer and Hammerschmidts as well as Kuo and colleagues need concepts as, for instance *trust* and *reliability*.
This early framework excludes the following needs as proposed by Sheldon et al.:

- Physical thriving as web products are intangible and therefore not able to contribute to health or shape of the body.
- Self-esteem as "it could be understood rather as an outcome of need fulfillment than a need itself"[54]. Self-esteem furthermore does not appear in new publications which address needs related to web applications[55].
- Self-actualization is equally not named in new publications which address need related to web applications as presented in Table 3.6. Gaver and Martin name self-actualization (to understand and change one's self) rather as a desire to change experiences of one's self and the world around one within the context of digital hardware devices[56]. Additionally, Jordan's ideo-pleasure relates to "the aesthetics of a product and the values that a product embodies" within the context of hardware devices[57]. I furthermore understand self-actualization rather as an outcome of need fulfillment than as a need itself.
- Money-luxury as it is not a proven need by Sheldon and colleagues[58].

This UX framework serves as a basic theory for this research. More recent results in user experience research helped to improve the framework which is displayed in Figure 3.8.

3.4.1 A Proposed Framework

ISO 9241-210 defines user experience as "a person's perceptions and responses that result from the use and/or anticipated use of a product, system or service" and includes "users' emotions, beliefs, preferences, perceptions, physical and psychological responses, behaviors and accomplishments that occur before, during and after use"[59]. Also Mäkelä and Fulton-Suri propose an experiential view on UX. According to them, experiences are motivated actions in a context, which are influenced by past experiences and in turn shape future expectations[60].

Considering the spatio-temporality of UX, I separated anticipated experiences, momentary experiences and reflected experiences in the framework. A similar separation of time spans

[52] [Deci and Ryan, 2000]; [Hassenzahl et al., 2010, p.335].
[53] [Jordan, 2000].
[54] [Hassenzahl et al., 2010, p.335] and [Sheldon et al., 2001, p.336].
[55] See Table 3.6 referring to [Kuo et al., 2005] and [Bauer and Hammerschmidt, 2004].
[56] [Gaver and Martin, 2000, p.213].
[57] [Jordan, 2000, p.14].
[58] [Sheldon et al., 2001, p.327 and p.329].
[59] [DIN EN ISO 9241-210, 2010].
[60] [Mäkelä and Fulton Suri, 2001].

to focus on UX presents Roto et al.[61]. Consequently, considering the need theory above, anticipated experiences are influenced by user's *expected need fulfillment* through the product; whereas reflected experiences are influenced by the *actual need fulfillment* through the website. The improved framework displays Figure 3.8.

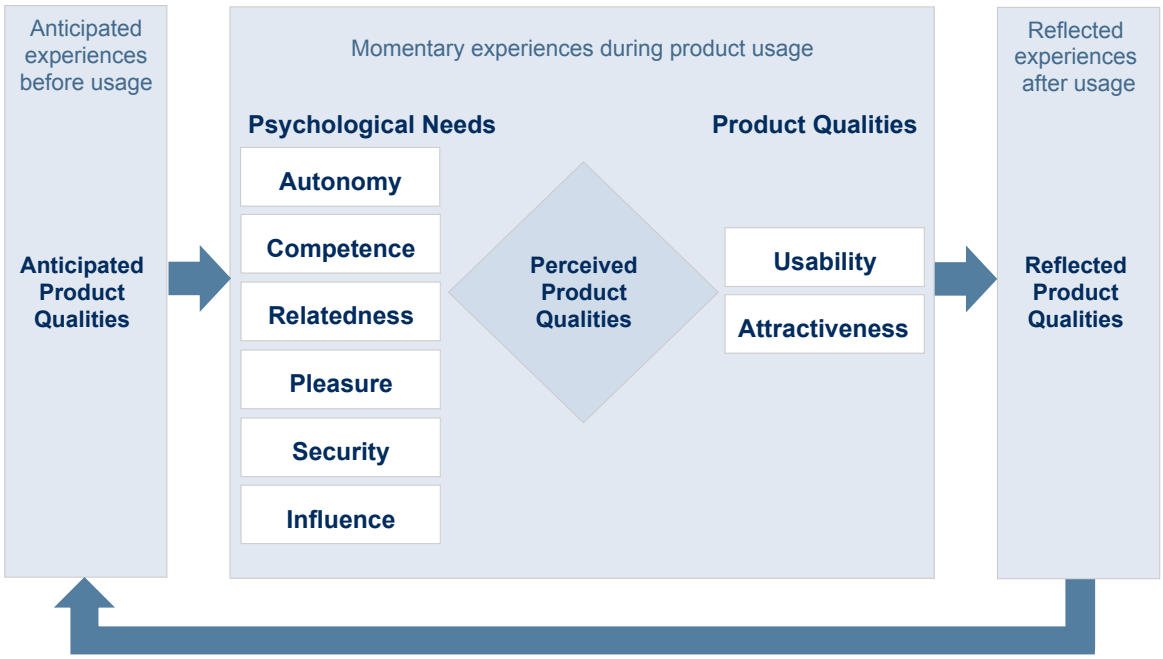


Figure 3.8: Improved UX Framework Based upon the Work from [Schulze and Krömker, 2010]

Anticipated Experiences

Anticipated experiences are a user's *expected perceptions and responses* when interacting with a product, system or service. These expectations are influenced by the presentation and communication of the product within a company's marketing and sales activities (Customer Experience), other's experiences (co-experience) and/or previous experiences with the product or other products of the company. For instance, Hartson and Pyla point out that packaging and presentation of the product influences the overall UX[62]. Anticipated experiences therefore are *imagined experiences before product usage*[63].
Anticipated experiences entail the attitude toward product usage. They therefore contain anticipated product qualities, respectively, the expected need fulfillment.

User's anticipated experiences can be evaluated with questionnaires regarding their expectations towards product use and the product's ability to fulfill these expectations. Knowledge

[61] [Roto et al., 2011, p.8].
[62] [Hartson and Pyla, 2012, p.23].
[63] [Roto et al., 2011, p.8].

about anticipated experiences is helpful to define and communicate product qualities that meet and exceed people's expectations.

Momentary Experiences

Momentary experiences describe the user experience during interaction. The experience here is an *evaluative feeling based on the user's expectations before product use compared with the perceived ability of the product to fulfill these expectations.* Hassenzahl appropriately defines momentary experiences as "a momentary, primarily evaluative feeling (good–bad) while interacting with a product or service" (...) "Good UX is the consequence of fulfilling the human needs for autonomy, competency, stimulation (self-oriented), relatedness, and popularity (others-oriented) through interacting with the product or service (i.e., hedonic quality)"[64].

Therefore, momentary experiences result from the fulfillment or frustration of expectations towards product use (anticipated experiences) and result in an overall evaluation of the product that influences the attitude towards product use and the remembered experience.

User's momentary experiences can be evaluated with psycho-physiological measuring techniques such as PREmo[65], LEMTool[66] or the FaceReader[67] in order to assess a person's emotional responses while interacting with a product. Knowledge about momentary experiences is helpful to understand details of the perceived user experience as it provides insights about emotional responses and underlying interaction behavior.

Reflected Experiences

> "UX does not necessarily end with actual usage. After usage, the pleasure or displeasure, can persist in the user's mind"[68]

Reflected experiences are remembered product qualities that were perceived during interaction with the strongest impact on the overall user experience. They are influenced by the strongest momentary experiences, through sharing individual experiences with others[69] as well as additional services the company offers for their customers and users. For that reason, reflected experiences influence anticipated product qualities and, therefore, the overall attitude towards further product use.

Users' reflected experiences can be evaluated with questionnaires regarding remembered

[64] [Hassenzahl, 2008, p.12].
[65] [Desmet, 2003].
[66] [Huisman and Van Hout, 2008].
[67] [Zaman and Shrimpton-Smith, 2006].
[68] [Hartson and Pyla, 2012, p.23].
[69] See e.g. *co-experience* by [Battarbee and Koskinen, 2005].

product use and individual evaluations of that remembered product usage. Knowledge about reflected experiences is helpful to understand the overall user experience as evaluated by the user.

3.4.2 Empirical Evaluation of the Proposed Framework

An empirical study with the mobile native web product[70] LiveShare by the Silicon Valley startup Cooliris helped to test ideas and methods regarding the applicability of the UX framework that relates psychological needs with perceived product quality. This means, in order to make psychological needs applicable within practical software engineering, needs were specified for the context of mobile social media. Table 3.7 shows specified needs that were examined. The study has shown that evaluating expected needs (anticipated qualities)

Need	Need Specification
Autonomy – Independence	- Decide who can access my content and who cannot
Competence – Effectance	- Understand quickly how it works - Feel competent in the things I am doing
Relatedness – Belongingness	- Share experiences with people that are meaningful to me - Feel that I belong to groups of people - Feel being part of beloved ones
Pleasure – Stimulation	- Discover new things - Not feel bored - Enjoy browsing information (i.e. pictures) of others
Security – Control	- Feel that my data is safe - Have control over my personal information - Have control over the information I share with others
Influence – Popularity	- Feel respected - Feel being liked - Feel that I achieve something

Table 3.7: Examined Specified Psychological Needs in Mobile Social Media

and need fulfillment (reflected qualities) helps to identify implications for user experience centered product improvement. Saying this, deltas between expected needs and fulfilled needs provided implications for experience centered improvement: first, underlying information about what product qualities are relevant and, second, how the product was able to fulfill needs with existing features and perceived qualities. In order to understand implications better for product improvement, an additional questionnaire to evaluate perceived product quality (usability and attractiveness) helped to classify need perception for more structured and comprehensible product requirement improvements.

Consequently, relating both need expectations and need fulfillment with product qualities

[70] See web product classification in 2.2.

helped to gain a deep understanding regarding user requirements in order to derive clear product requirements for new product development as well as product improvement.

In summary, the evaluation study provided valuable information regarding the applicability of psychological need – product quality relations within a practical software development process. It furthermore helped to inductively contribute to grounded theory regarding the relation between user needs and product quality within the area of mobile social media.

Table 3.8 shows the resulted specified needs in the context of mobile social media services. Detailed results and the study approach presents Appendix Chapter C.
The results show that the needs for autonomy – independence, competence – effectance, relatedness – belongingness, pleasure – stimulation and security – control are most important in the area of mobile social media. Note that the results are not statistically proven; results only provide indications based on a qualitative study with 39 individuals.

Need	Need Specification
Autonomy – Independence	- Decide who can access my content and who cannot
Competence – Effectance	- Understand quickly how it works - Feel competent in the things I am doing
Relatedness – Belongingness	- Share experiences with people that are meaningful to me
Pleasure – Stimulation	- Enjoy browsing information (i.e. pictures) of others
Security –Control	- Feel that my data is safe - Have control over my personal information - Have control over the information I share with others

Table 3.8: Most Important Need Specifications for Mobile Social Media Services

Interesting is the missing importance of the need for influence – popularity. This may be related to social desirability. Another reason may be an insufficient specification of the need for influence – popularity, which led to the removal of the need although it may be have been an important driver of product use.

In order to limit such interpretation difficulties, it will be useful to further analyze underlying psychological needs and to understand specified psychological needs more holistically for web products.

The main limitation of the used approach was the complex and time-consuming process to specify psychological needs that are not yet validated. Furthermore, it is questionable, whether the proposed need categories and need specifications are complete in the area of web

products. For that reason, and the earlier demand for understanding specified psychological needs more holistically within the area of web products, it has to be examined further whether there is a general relation between psychological needs and product qualities.
Understanding a general relation with holistic need specifications may help to minimize operationalization efforts by providing a framework for need-quality relations in the area of web products.

3.5 Conclusion

Demonstrations of existing models to encompass UX as well as practitioner's demand to receive support for UX centered software engineering indicate an existing lack of UX models that can easily be transferred and used in practical software engineering to develop for UX.

First, the presented author's models base on different perspectives from phenomenologically perceived product quality[71] to fundamental product features[72].
Second, the models from van der Hejden[73] and Mahlke[74] provide no explanatory information in order to understand underlying human motives that influence perceived product quality. Hassenzahl and colleagues[75] on the other hand, do not provide a clear relation between stated human motives as a driver for perceived product quality and the actual product quality. Similar to all concepts, however, is the importance of the product qualities usability, also referred to as pragmatic quality, and attractiveness, also referred to as hedonic quality that constitute the user experience.

Considering the missing understanding of underlying human motives, previous research in Human-Computer-Interaction has shown that looking at psychological needs is an adequate approach to understand drivers for positively perceived product qualities[76]. Specifically the top ten psychological needs from Sheldon and colleagues serve as an appropriate basis to understand underlying human motives within the area of user's experiences with web products. A comparing examination of psychological need categories in the context of psychology, user experience and web products has shown that the authors agree on numerous psychological needs. The comparison shows that for interactive web products, however, the needs for physical thriving – bodily, self-esteem – self-respect, self-actualization – meaning and money – luxury become less important.

Considering this background, I proposed an early UX framework that aims at integrat-

[71] [Van der Heijden, 2003, p.542] and [Mahlke, 2002, p.846].
[72] [Hassenzahl, 2003, p.32].
[73] [Van der Heijden, 2003, p.542].
[74] [Mahlke, 2002, p.846].
[75] [Hassenzahl, 2003, p.32].
[76] e.g. [Jordan, 2000], [Hassenzahl, 2003], [Hassenzahl et al., 2010], [Gaver and Martin, 2000].

ing both underlying information regarding user motives, which is psychological needs, and perceived product qualities that provide indications about the perceived user experience.

As the UX framework in its existing form is very generic, an empiric study aimed at evaluating the general applicability of the UX framework within practical software development by means of the mobile native web product LiveShare by Cooliris. The study has shown that the framework is generally applicable. However, specifying psychological needs and relating the abstract concept to clear product features still requires high effort.

It is therefore necessary to better understand psychological needs in the area of web products in order to find need items that can directly be used to engineer the UX. A well-defined specified UX framework can build a basis for support for practitioners within UX centered software engineering. As psychological needs are underlying motives for human action, the framework can help to focus on early software development. With clear specifications, the framework furthermore provides clear UX criteria that can be used to envision the UX. These criteria can serve as applicable metrics to conceptualize and evaluate UX.

A limitation of the current model however is still the degree of its applicability. Responsible actors in product development do not receive indications about what features are able to fulfill which needs. For that reason, subsequently to this global evaluation of the applicability of the UX framework, it is necessary to review whether the model helps to understand the relation between psychological needs and product features within the area of web products. Understanding the relation between psychological needs and product features can provide a basic concept for the area of web products. This can serve as a basic understanding and applicable, effective support for practical UX engineering. Specifically, this knowledge can help to understand and test the relevance of specific needs as well as to define the core features within a specific web product area.

3.6 Chapter Summary

This chapter presented an analytical and empirical background for this dissertation project. Qualitative semi-standardized expert interviews with 29 responsible actors within UX engineering revealed current challenges in engineering UX within practical software engineering. The study provided indications for a strong demand to support engineering UX in software engineering and helped to derive general guidelines to develop for UX. However, as interview results substantiate, a useful support requires to be more applicable than general guidelines, it should contain clear criteria for product development to specify core features that elicit positive experiences.

As this support requires understanding both product quality aspects and aspects describing human's perceptions and responses, the chapter furthermore presented a background on existing approaches to product quality and psychological needs. The analytical background on psychological needs showed that the need model from Sheldon et al.[77] builds an adequate basis to understand underlying human motives for product use. This need theory has strong potential for supporting the development of products that elicit positive experiences.

A logical step was then to relate product quality and psychological needs within a UX framework that supports practical software engineering. Therefore, this chapter introduced an earlier developed proposed framework to capture relevant UX aspects. This framework was then empirically evaluated within a three-month study with the mobile native web-product LiveShare by Cooliris. The study helped to test the applicability of the framework within practical software engineering. Limitations of the study helped to frame the research question for this dissertation project and to understand general conditions to provide useful support for practical software engineering.

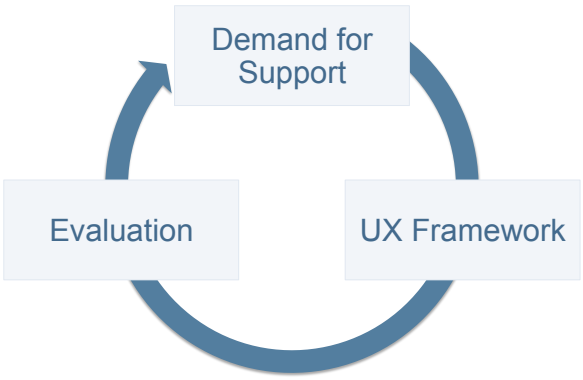


Figure 3.9: Analytical and Empirical Achievements to Frame the Research Question

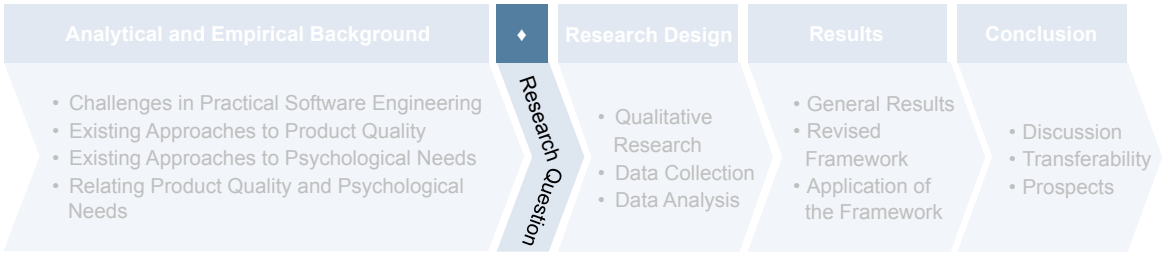
[77] [Sheldon et al., 2001, p.325].

Summarizing this, the three main achievements in defining the analytical and empirical background were (1) researching the *demand* for support in practical software engineering by conducting expert interviews with responsible actors in product development, (2) developing a *UX Framework* as a general basis for UX centered software engineering and (3) *evaluating* this model in practical software engineering environment. These three relating steps shows Figure 3.9. The relation of demand, UX framework and evaluation explains Table 3.9 more in detail. The chapter ended with a conclusion to frame the theoretical background as a basis for the research question of this dissertation project.

Demand For Support	UX Framework	Evaluation
Contains clear UX criteria	Psychological needs, product quality	Need specifications within the area of mobile native web products
Contains guidelines that intertwine UX conceptualization and UX evaluation	Psychological needs	A user study with used UX criteria (specified needs) helped to derive clear guidelines to develop for UX in the area of mobile native web products.
Focuses on early product development	The need concept helps to focus on conceptualizing the UX	The user study was done in a late stage of product development, however, general guidelines will help to derive ideas for new product development.

Table 3.9: Relation between Demand for Support, UX Framework and Evaluation

4 Research Question



As described in the analytical and empirical background earlier, the motivating theory substantiating this study declares that focusing on people's experiences with a product is a success factor in practical product development. Consequently, products that elicit positive user experiences include specific product features that are expressed through product quality.

Goal is to create applicable support for practical software development. As expert interviews have shown[1], it is not clear what needs should be fulfilled to elicit positive experiences and what features fulfill which needs. Therefore, the proposed framework in 3.4.1 builds a basic concept. This study aims to research the relation between psychological needs and product features for the area of web products in order to provide a basic understanding in UX engineering.

Figure 4.1 displays the research concept derived from the UX framework in Figure 3.8 that seeks to understand the relation between psychological needs and product features. The research concept demonstrates the basis for the research question. Considering results from the

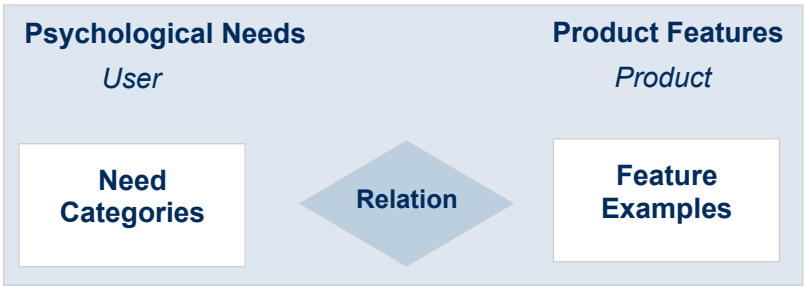


Figure 4.1: Research Concept

[1]See Chapter 3.1.

pre-study in section 3.4.2, the focus of this research is to understand relevant psychological need categories and specified needs within the area of web products. Hence, the perceived relation between features of web products and underlying needs is to be examined. This perceived relation subsumes under the concept of perceived product qualities. To understand perceived product qualities, the perception of product features within the context of a *given product* requires an investigation involving *real users*.
Summarizing these thoughts, the study aims to understand the relationship between product qualities and psychological needs in the area of web products by identifying relevant psychological needs that lead to positive experiences. I assume that understanding this relation helps to support practitioners in software development (such as product managers, software engineers and software designers) to design user experience centered products.
Results can provide basic material for researchers in the field of HCI to further study the relationship between product features and psychological need fulfillment in order to understand the formative development and evaluation of user experience. Additionally, results may provide practical examples on how a particular UX can be engineered into a product by deriving need categories of websites. Considering this overall goal, the research question of the present work is:

> **"The fulfillment of which psychological needs leads to satisfying experiences in web product usage?"**

Sub questions are:

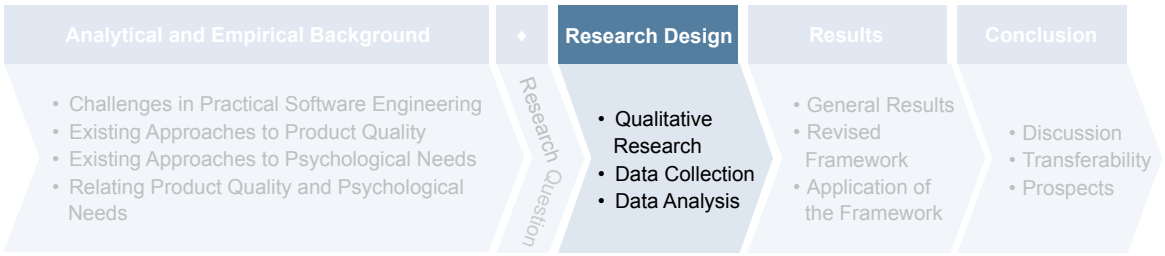
1. *What* need categories play a relevant role within the area of web products?
2. *How* do these need categories relate to product features?

Underlying predictions are:

1. A relation between product features and psychological needs exists.
2. Individual product features can be attributed to at least one need (or the other way around).

This research aims to provide the first step towards identifying and understanding a meaningful relation between psychological needs and product qualities that influence the actual usage of a web products.

5 Research Design

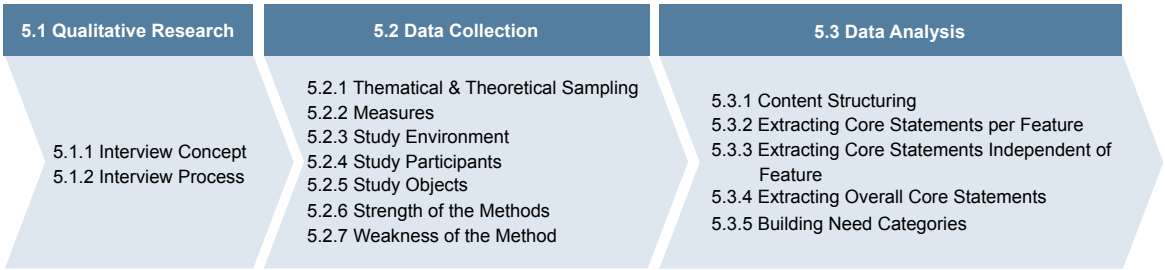


As the research question requires gaining deep understanding of complex relations between psychological needs and product features, I chose a qualitative research design that aims to contribute to grounded theory[1]. The qualitative character helps to understand structures of meaning users generally are not conscious about[2]. Qualitative descriptions furthermore help to convert qualitative scales for purposes of statistical analysis, while it is "not possible to work the other way around and convert purely quantitative measures into detailed, qualitative descriptions"[3].

This chapter guides through the research design of this work. Section 5.2 explains the applied research method; section 5.3 introduces the way data was collected and Section 5.4 demonstrates the data analysis process.

5.1 Overview of the Research Design

The chapter is structured as follows:



[1] [Strauss and Corbin, 1994].
[2] [Froschauer and Lueger, 2003, p.16].
[3] [Patton, 2002, p.253].

5.2 Qualitative Research

To answer the research questions by allowing a mixed inductive and deductive approach, I decided to do *problem-centered semi-structured episodic interviews* according to Witzel with real website users[4]. The problem-centered interview helps to reveal underlying structures for meaning as well as the person's relevance system[5]. Episodic interviews help to display experiences in a general and comparable way while telling the different episodes[6]. Combining story-telling with question-answer sequences realizes the triangulation of different accesses to data as a basis for data collection[7].
Problem-centered interviews are known to get broad and deep information to an explorative research field and to capture complex relations within emotional topics. According to Lamnek, the problem-centered interview is well suited for building and proving theories, and, therefore, combining induction and deduction[8]. For that reason, the problem-centered interview is an appropriate method to deductively prove this existing theory as proposed in the UX framework in Figure 3.8 and to inductively modify and deepen the theory to understand relations between product features – that build the basis for product quality – and psychological needs. Induction helps to understand relevant psychological needs within the area of web products that may have not been addressed in earlier frameworks.

Table 5.1 shows an overview of the study approach containing study method, study goal, used sample size, test objects and the interview approach.

	User Interviews
Method	Semi-standardized guideline supported, problem-centered interview within lab environment, about 45 minute duration
Goal	Understanding need categories that relate to product features of websites
Sample Size	31 individuals
Test Objects	5 websites = 50 evaluations, 10 evaluations per website
Approach	Funnel questions from general (open) to specific (closed) to assure induction and deduction, Thinking Aloud [Jordan, 1998b], Questions according to the Valence Method [Burmester et al., 2010]

Table 5.1: Study Approach

[4] [Witzel, 1989].
[5] [Keuneke, 2005, p.260] according to [Lamnek, 1995, p.22ff].
[6] [Flick, 2011, p.238ff].
[7] [Flick, 2011, p.245ff].
[8] [Lamnek, 1995, p.75].

5.2.1 Interview Concept

The interview concept provides a general structure for the semi-standardized interviews in order to ensure a general comparability. The detailed interview guideline in original German language is displayed in the appendix. Interview questions are structured into three parts:

1. **Overall Retrospective Evaluation – Most Memorable Features:** "Please visit [name of the website]. If you remember your previous usage of the website, which features, spontaneously, led to positive or negative experiences in the past? Why?"
2. **Momentary Evaluation – Spontaneously Used Features:** "Please use [name of the website] for three minutes the way you would use it at home." Interviewer allows time for usage. "You just now used the feature [name of the feature]/clicked the link [name of the link]. Why?". "How important is that feature to you on a scale from −3: very unimportant to +3: very important? Why?"
3. **Momentary Evaluation – Pre-Selected Features:** "We will now take a look at specific features. Please use the following feature [name of the feature]. Why do you use this feature/would you use this feature? How important is that feature to you on a scale from −3: very unimportant to +3: very important? Why?"

The questions cover the evaluation of retrospective and momentary experiences within the UX framework. Figure 5.1 shows the focus of the interview questions on the basis of the UX framework.

Part one starts with an open question. This question aims at relaxing the interviewees

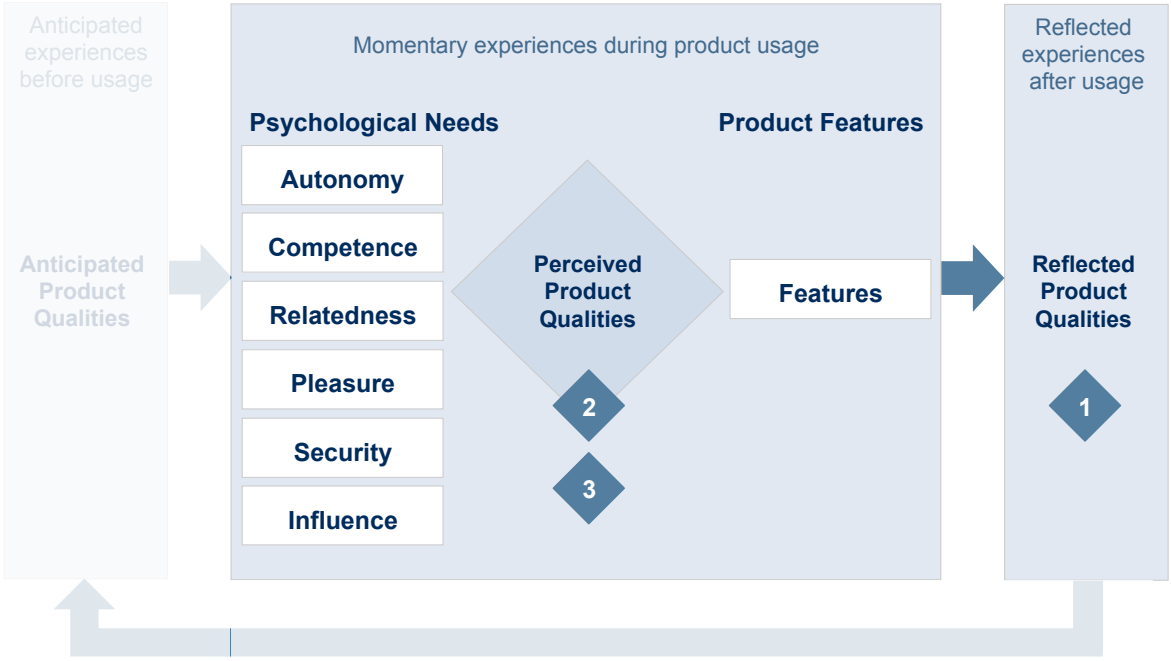


Figure 5.1: Interview Concept Questions in Relation to The UX Framework

and easing the atmosphere. It seeks to get to know features with the strongest influence in the past on perceived experiences. The interviewer keeps inquiring the underlying need fulfillment or frustration that leads to a positive or negative experience.

The second part asks for a familiar usage of the website to get to know features that are used intuitively and which therefore influence the daily user experience. The beginning of this interview process phase[9] is characterized by an open usage. The interviewer observes used features and notes them for further inquiry. Questions relating to used features follow subsequently to the usage.

Part three follows up with pre-selected features that did not yet appear during the interview. The third part aims mostly at assuring a comparability of investigated features, whereas the second part also reveals features that were not pre-selected.

Prior to the interviews, ten pre-interviews helped to iteratively develop a routine and basic knowledge regarding the research topic. Pre-interviews aimed at improving the guideline and the interview process by understanding what questions to ask the right way in order to receive the desired information with the selected study participants.

5.2.2 Interview Process

The interview process follows the sequence as presented in Table 5.2. During the interview phase, I asked open questions to understand the person's relevance system. Answers helped to inquire the relevance system of each individual more in detail.

Phase	Description	Time
Introduction	- Declaration of agreement - Pre-Questionnaire regarding general internet usage - Choice of the two websites to be evaluated	3min
Interview	- Retrospective experiences with the selected websites - Experiences with features during actual usage of the website - Experiences with pre-selected features	40 min (20 min/ website)
Closing	- Closing and incentive handout	2 min
		Total: 45 min

Table 5.2: Interview Process

[9]Interview process phases are displayed in Table 5.2.

5.3 Data Collection

5.3.1 Thematical and Theoretical Sampling

To raise the comparability of empirical material, the sampling of participants is *thematically based*. Thematical sampling bases on groups whose perspective regarding the research object are mostly applicable and, therefore, is pre-defined[10]. To choose specific cases within the groups, *theoretical sampling* helps to acquire a sufficient number of participants[11]. Thematical sampling enables the collection of data by following an approach that allows comparability across given topics while it guarantees openness for each point of view.

5.3.2 Measures

To understand the relation between needs and product features, I use two basic measures. First, the *valence of the retrospective overall experience* with a given feature that presumably provides information regarding positive and negative need – product quality relations[12]. Second, the *personal relevance of features* that relates to the importance of the feature and further the overall user experience. Personal relevance furthermore aims at helping to relativize the impact of a need – product quality relation. These quantitative measures provide a first indication of the person's relevance system in order to then analyze deeper with open questions to openly research underlying structures of meaning.

5.3.3 Study Environment

The one-on-one interviews were conducted in a laboratory environment at the usability laboratory at Deutsche Telekom AG Products & Innovation in Darmstadt, Germany, as well as the usability laboratory at Ilmenau University of Technology in Ilmenau, Germany. Both laboratories provide computers running the Windows XP operating system and the Mozilla Firefox web browser. Conducting interviews in a laboratory environment ensures a standardized quality of the atmosphere, limited unplanned interruptions, and displaying all information on websites as displayed without an ad-blocker or other customizations by the user. These settings help to keep environment variables constant.

5.3.4 Study Participants

Study participants were selected according to thematical sampling[13]. Participants are typical users of websites with a general high frequency of internet usage as well as strong experience in usage of at least two of the websites evaluated in the study. In total, 31 individuals participated in the study.

[10] [Flick, 2011, p.402].
[11] [Flick, 2011, p.402].
[12] [Burmester et al., 2010].
[13] See section 5.3.1.

Participants were characterized by the following:

- 13 female and 18 male
- 21 with Abitur[14] and 10 with a university degree as the highest educational level
- Frequency of internet usage: at least 5-15 hours per week
- Strong experience in usage of at least two of the websites displayed in Table 5.3: at least 4-10 hours per week

5.3.5 Study Objects

Study objects are web desktop products[15], precisely websites, representing web products. I pre-selected a total number of 10 websites in order to base results on a broader selection of web products. A broad selection aims at understanding whether psychological needs can be linked to product features in different fields of web products. The selection classifies into the website classes Social Network, eCommerce, Search, Email and News/Information. This broad selection furthermore intends to limit misconceptions of results.

The selection of subject websites is based on the 20 most frequently used websites in Germany according to Nielsen/Statista 2012. It is a reasonable assumption that most frequently used websites have high perceived usability and attractiveness. Consequently, frequently used websites are most likely fulfilling psychological needs and, therefore, have the potential for positive user experiences. For that reason, the selected websites are mostly suitable for this study. Table 5.3 displays the websites and classes. Out of 10 pre-selected test objects, 6

Website	Class
Facebook	Social Network
Ebay	eCommerce
Amazon	eCommerce
Google	Search
Spiegel Online	News/Information

Table 5.3: Websites and Classes

test objects were chosen for final evaluation as of total website usage: Facebook.de, Ebay.de, Amazon.de, Google.de, GMX.net and Spiegel.de. After conducting the first interviews with GMX users, I had to eliminate GMX from the list as users often only used the website to delete Spam messages; reading, organizing and writing emails was mostly done with Outlook

[14] Abitur is a diploma from German secondary school qualifying for university admission or matriculation.
[15] See web product classification in 2.2.

or another locally used e-mail program. In total, 5 study objects as displayed in Table 5.3 helped to collect data.

5.3.6 Strength of the Method

Problem-centered interviews promote to deductively prove previous theories and inductively improve these theories to constitute grounded theory regarding the relation between psychological needs and product features. The open question-style stimulates users to verbalize underlying needs of feature usage and perceived experiences. Early interviews have shown that participants were surprised about their own behavior and that the interview style called their attention regarding their own usage. All participants felt comfortable and were therefore openly talking about their usage behavior, experiences and motives.

Another strength of the method is the offered suggestion about how to document the context and how to manage secondary information for a structured data analysis[16]

5.3.7 Weakness of the Method

Limitations of the method are mostly generally known limitation in qualitative research: results are only a first step in order to research a tendency and a basic understanding. A small sample size is not representative of a large population and has to be investigated further to generalize findings[17]

As a result of the limitations of an exclusively qualitative research design, it is arguable whether a combined qualitative and quantitative research design may have been more effective to validly answer the research question. However, considering the explorative research stage as well as the limited available resources, I argue that the presented research design was a realistic and effective decision to approach the research question.

From an industry point of view, another weakness of the method is that all evaluated websites are free services. For that reason it has to be investigated further whether results can be used as a general basis for paid services as well.

[16] [Flick, 2009, p.165].
[17] [Silverman, 2009].

5.4 Data Analysis

According to the research question, the goal of data analysis is to derive need categories for the usage of web products. The data material consists of 50 website evaluations with nearly 500 statements regarding usage motives of product features. Statements come from 31 individual interviews about the 5 websites listed in Table 5.3.
To capture the extensive amount of qualitative data from problem-centered episodic interviews, Mayring proposes the *selective protocol*[18]. The selective protocol allows for pre-defined criteria that determine the data to be recorded. Criteria base on the research question in order to eliminate unnecessary data. To analyze the data, Mayring and Flick promote a generic approach to structure content[19] that builds the grounding for the following data analysis approach.

Website features build the basis to structure content. Content is the participant's experiences and needs that are to be fulfilled or frustrated by these features during website usage. I therefore use the following approach to analyze data:

1. Content structuring of interviews based on features.
2. Extracting core statements per feature per website.
3. Extracting core statements independent of features per website.
4. Extracting core statements independent of features and websites.
5. Summarizing core statements to build need categories independent of features and websites.

Figure 5.2 visualizes the data analysis process.

5.4.1 Content Structuring of Interviews Based on Features

Characteristic website features build the basis of structuring content. Needs became approachable as (1) participants stated features that elicit positive or negative experiences in the past based on their memory, (2) features that were used during spontaneous usage and (3) pre-selected features that were not yet addressed by the person[20].

Example from a participant who uses the Facebook feature chat:[21]
Question: *"Why do you experience the feature chat positively?"*

Answer: *"I used ICQ earlier and there I have to add numbers, I didn't find people there. With Facebook I get a good overview of people and can contact them directly. It is my main*

[18] [Mayring, 2003, p.97–99].
[19] [Mayring, 2003, p.97–99],[Flick, 2011, p.404].
[20] Section 5.2.1 provides a more detailed overview of the interview guideline.
[21] The example is translated from its original language German.

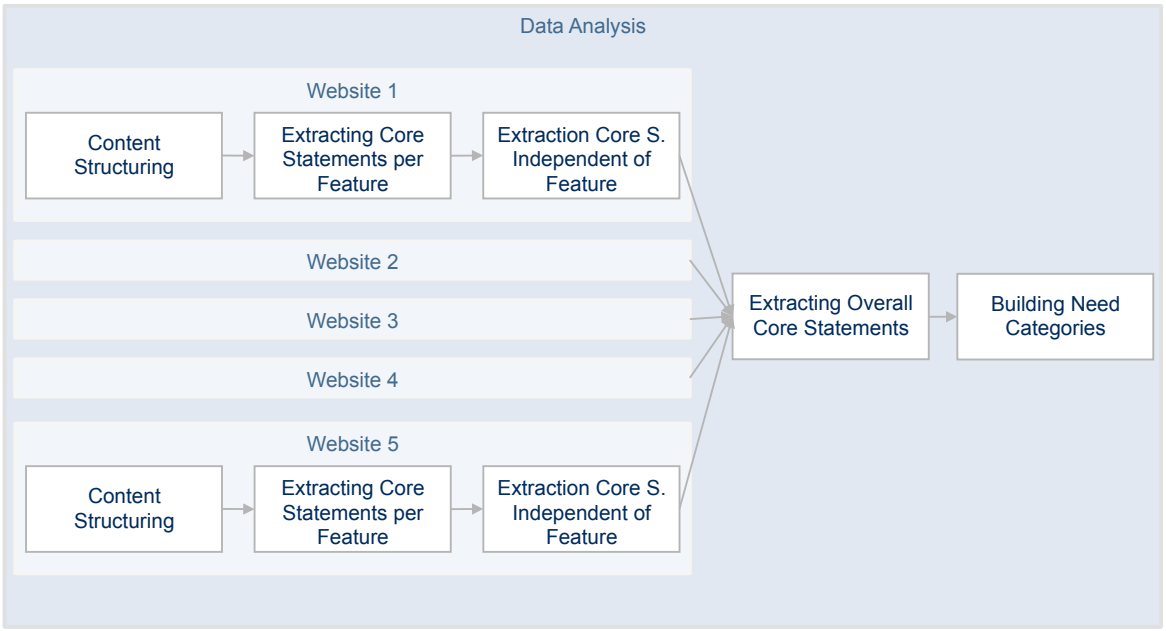


Figure 5.2: Data Analysis Process

communication medium on the internet. To stay in touch with friends, people from my hometown, to make dates. That works well to then meet up. It gives me pleasure to chat with people I haven't seen for a while. It got very easy with the internet."

Table 5.4 shows an example of a content structure with statements of a participant who evaluated Facebook. The above example presents feature number 2. The quantitative data valence (abbreviated with Val.) and relevance (abbreviated with Rel.) serve only to weigh and interpret the meaning of participant's statements. As the data is not statistically valuable, I do not analyze them further.

5.4.2 Extracting Core Statements per Feature per Website

From the selective protocol as displayed in example Figure 5.4, I extract core statements related to features that provide indications for psychological needs. Core statements often contain *need statements* and *product attributes*.
Product attributes, such as *easy* and *fast* represent a *description of product qualities*. These descriptions add an *implementation quality* to a need statement. Saying this, needs provide the background about *WHAT* is needed (the feature). Product attributes describe the *HOW* (in which quality/with what characteristics) the WHAT is to be implemented.

Example: *"It gives me pleasure to chat with people I haven't seen for a while. It got very easy with the internet."* The extracted need statement is *"To chat with people I haven't seen for a while"*. The product attribute describing the implementation quality is *"easy"*.

Nb	Feature	Val.	Rel.	Description
1	News Stream	+	3	Ist besser geworden in letzter Zeit, nutze Facebook, weil ich auch so Unternehmensseiten abonniert habe oder Handelsblatt, kann ich hier so gut nachlesen. Ist eine gute Sammlung, muss nicht auf die einzelnen Seiten gehen, man sieht wenn was neues da ist, ist gut aufbereitet mit dem Logo unter kleinen Box. Ich nutze auch Twitter häufig, für mich ist Internet Information, Meldungen von anderen Seiten zusammenfassen.
2	Chat	+	3	Ich habe früher ICQ benutzt und da muss man Nummern hinzufügen, da hat man die Leute nicht gefunden. Bei Facebook hat man einen guten Überblick über Leute und kann die direkt kontaktieren. Ist mein Hauptkommunikationsmittel im Internet. Mit Freunden in Kontakt bleiben, Leuten aus der Heimat, zum verabreden. Das geht gut um sich dann zusammenzutreffen. Es bereitet Freude wenn man mit Leuten chattet die man lange nicht gesehen hat. Ist sehr einfach geworden im Internet.
3	Groups	+	1	Um Arbeitsgruppen im Studium zu organisieren. Zur Kommunikation untereinander, wenn man auch nicht unbedingt befreundet sein muss auf Facebook, dafür ist das ganz gut. Wenn ich eine Gruppe vom Studiengang nutze, schaue ich ob eine Veranstaltung vom Studiengang stattfindet oder ausfällt, das kann man ja ganz einfach da rein schreiben. Da sind relativ viele Leute drin, man kann Dokumente teilen und Fotos teilen und sich darüber austauschen. Die Gruppen sind so lose zusammenhängende Sachen wo man sich trifft. Ist einfach zu organisieren und wenn ich zum Studium eine Frage habe, ist es schon einfacher eine Frage zu stellen zur Prüfungsvorbereitung.
4	Notifications	+	2	Wenn ich online gehe, schaue ich ob was neues da ist oder eine Nachricht gekommen ist, schaue zuerst die Benachrichtigungen an, weil das einen ja direkt betrifft. Wenn etwas kommentiert wird von einem selber, das ist sehr aktuell. Wenn einer was kommentiert oder so dann ist es schon so eine Art Bestätigung.

Table 5.4: Example of Content Structuring by Means of Facebook.de

I focus on extracting the need independent from product attributes in order to not influence the meaning of an extracted need.

To extract core statements per feature, I first summarize similar statements[22] and related formulations per feature. A similar statement can for example be reduced from “belong to the life of meaningful people” and “be part of the life of meaningful people”. To not lose the original meaning of statements I decide to use one of the two formulations.
Statements of related formulations merge to one. For example “to communicate my opinion” and “to communicate with my environment” combines to “to communicate my opinion with my environment”.
I furthermore only elaborate positive experiences and positive statements. Negative experiences help to improve the single website, but only help little to derive need classes. I justify this approach with the fact that need frustration is the exact opposite of need fulfillment.

[22]Similar statements are statements with the same meaning.

Table 5.5 shows an example of this reduction step by means of the website facebook.de. To keep the overview, the example shows 4 features out of the total of 20.

Feature	Reduction of Need Statements
Nachrichten	- Gefühl wichtig zu sein - Dem Leben wichtiger Menschen dazuzugehören - Private Kommunikation / nicht jedem alles erzählen - Kontakte pflegen
Chat	- Mit Freunden in Kontakt bleiben - Mit Menschen die wichtig sind verbunden zu sein - Leute kennen lernen - Erreichbar sein - Mit Leuten in Kontakt stehen (bspw. um auf Neuigkeiten hinweisen) - Menschen näher sein
Geburtstagserinnerung	- Hilft Dinge zu merken - Bietet Gelegenheit zur Unterhaltung - Respekt zeigen
News Stream	- Informiert sein/Bescheid wissen - Organisiert sein - Dabeisein/dazugehören - Sehen was andere erleben/Neugier - Neuigkeiten mitbekommen - Auf neuestem Stand sein - Ablenkung/ Zeitvertreib/ Gemüt auflockern - Spaß haben

Table 5.5: Example of Extracting Core Statements by Means of Facebook.de

5.4.3 Extracting Core Statements Independent of Features

Extracted core statements per feature are the basis for further reductions that are independent from features. The final reduction of core statements per website follows the same approach as described above with features. The goal of this step is to extract need statements that generally relate to website usage.

In order to understand relevant topics and directions of underlying needs, I summarized related statements and defined topical categories based on user statements.
Topical categories are for instance “freedom of choice”, “cognition/knowledge/education”, “belonging”, “individuality”, “curiosity”, “overview” or “reputation”.

5.4.4 Extracting Overall Core Statements Independent of Features and Websites

In this fourth step I compare previously reduced core statements within my summarized topics of all five websites and, if necessary, reduced them again. Reduction is done according to the rules as presented in step 3: similar statements and related formulations with the same meaning are summarized; complementary statements combined. This step serves to recognize need statements from *all evaluated websites* in order to build a basis for general need categories for websites.

5.4.5 Summarizing Core Statements to Build Need Categories Independent of Features and Websites

The goal of this step is to define need categories with a basic specification that are relevant for positive experiences in website usage. I therefore summarize the previously extracted core statements independent of feature and websites and combine related topical categories. This serves as a basis to build need categories. In order to base categories on psychological needs, insights from humanistic psychology serve as a helpful and adequate basis.
Therefore, the need model from Sheldon et al.[23] is most applicable. This classification bases upon an extensive analysis of existing psychological need models and was already a helpful basis to categorize needs in the research field of interactive products[24]. Considering this, the basic model of psychological needs from Sheldon et al. can serve as an adequate criterion to reduce core statements within my topical categories and to define my categories more accurately.
As this model with ten basic psychological needs is not specific, it serves as a frame that has to be specified for web product. This specification can build a first general need categorization within the area of web products.
As I am taking all top-ten needs into account when assigning need statements, the existing UX model with six of these ten needs can be deductively confirmed and inductively expanded and improved[25].

5.5 Chapter Summary

This chapter introduced the qualitative research design by providing insights into the applied research method, the data collection approach as well as the approach to analyze collected data. Goal of the research design was to find an appropriate approach to understand which fulfilled psychological needs lead to positive experiences in website usage. I therefore conducted problem-centered semi-structured episodic interviews with 31 users who evaluated 5

[23] See [Sheldon et al., 2001] and Table 3.5.
[24] See section 3.4 for more.
[25] See detailed results in Chapter 6.

websites that were representative for websites that presumably elicit positive experiences. Test objects were the websites *Facebook.de*, *Google.de*, *eBay.de*, *Amazon.de* and *Spiegel.de* covering the website classes Social Network, Search, eCommerce and Information.

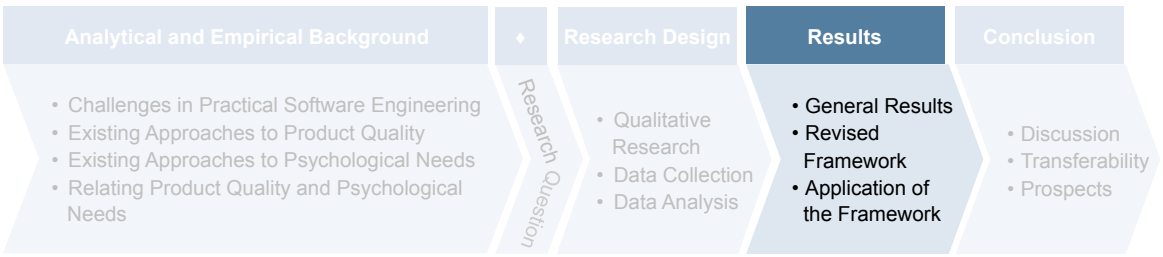
Data analysis was structured into a 5-step process. The goal of this process was to derive need categories from statements of users regarding their personal usage motivation. These need categories relate to features of web products.

In order to extract core statements as a basis for need categories, I defined topical categories. To define need categories it was then applicable to refer to existing need models from humanistic psychology. Therefore, the basic model of psychological needs from Sheldon et al.[26] is most suitable as it builds upon other existing need models[27]. The generality of this need model serves as an adequate frame to structure own need categories. I used all ten psychological needs as a reference to compare statements with these needs and to assign them according to the reference. This helped to specify psychological needs in the area of web products. Therewith, I was able to combine a deductive approach to confirm the existing UX framework and an inductive approach while adding not assignable statements to new categories to improve the UX framework.

Results of the data analysis presents Chapter 6.

[26] [Sheldon et al., 2001].
[27] See more about the need models in the background Section 3.3.

6 Results

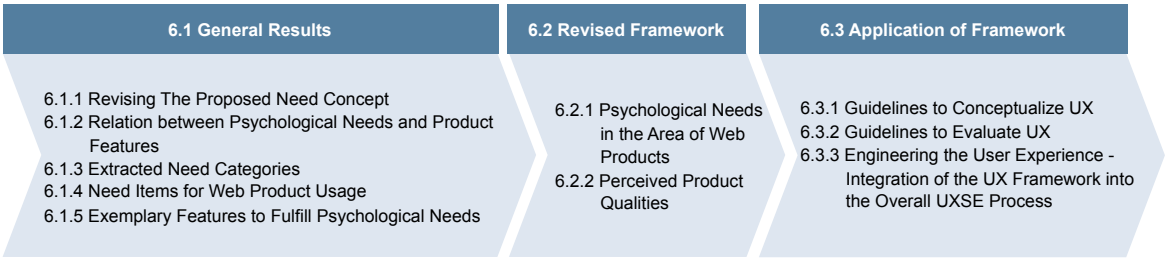


The user study helped to understand relevant psychological needs in the area of web products by researching the relation between web product features and positive experiences that can be traced back to need fulfillment.

This chapter presents the results of the study by introducing general results in section 6.2. General results contain findings regarding the need fulfillment of evaluated websites, extracted need categories that build a basis for need items for website usages as well as relations between needs and features. Exemplary product features that fulfill specific psychological needs based on user statements substantiate the relation. These general results build the grounding for the revised UX framework presented in section 6.3. Section 6.4 provides indications to apply the framework by presenting recommendations to conceptualize and evaluate UX.

6.1 Overview of the Result Chapter

The chapter is structured as follows:



6.2 General Results

6.2.1 Revising the Proposed Need Concept

The analysis process as introduced in Section 5.4 helped to improve the existing need model used in the early proposed framework as introduced in Figure 3.8. While assigning statements to needs categories, the following statements and terms were challenging to assign to psychological needs as proposed by Sheldon et al.[1]:

- "To give pleasure to others" (German: "Jemandem eine Freude bereiten")
- "To help others" (German: "Anderen helfen")
- "Individuality/identity" (German: "Individualität/Identität")
- "Esteem" (German: "Achtung")
- "To get feedback from others" (German: "Rückmeldung von anderen bekommen")
- "To profit financially" (German: "Einen finanziellen Profit schlagen")
- "To make a good deal" (German: "Ein gutes Geschäft machen")
- "To save money" (German: "Geld sparen")

Insights from humanistic psychology helped to understand that statements such as "to give pleasure to others" relate to the concept of *reciprocity* for establishing a long-term social relationship respectively for maintaining affection[2]. For that reason, the statement "To give pleasure to others" can be assigned to the need for relatedness – belongingness.

"To help others" is, as well, conform to the concept of reciprocity and can, if related to unknown persons, be ascribed to the need for influence – popularity. In such cases psychologists talk about *indirect reciprocity*[3]. This definition is suitable for further analysis and will be used as a basic understanding of reciprocity in the following. Participants do not explicitly express that they expect a reaction from the other. This presumably relates to social desirability respectively an action-reaction self-conception. Features that support to give pleasure to others are for instance "to like" (Facebook), "to comment" (Facebook), "to rate product purchase" (eBay) or "to recommend an article" (Spiegel).

Reciprocity works because positive or negative signals of the other person influence one's self-esteem. Realizing that the opposite, here virtual, person likes the one by, e.g., posting positive statements on the profile (Facebook), providing positive ratings (eBay) or sharing the same opinions and interests (e.g. commenting on Facebook or recommending an article on Spiegel), confirms one's self-concept[4] and, therefore, his or her self-esteem/self-respect. *Self-esteem – self-respect* is one of Sheldon's top-ten psychological needs. For that reason,

[1] [Sheldon et al., 2001].
[2] [Zimbardo and Gerrig, 2008, p.651].
[3] [Zimbardo and Gerrig, 2008, p.682].
[4] [Zimbardo and Gerrig, 2008, p.744].

the statement "to get feedback from others" subsumes under *direct reciprocity* within the need for self-esteem – self-respect.

Features that influence the self-esteem – self-respect are for instance the reciprocal features on "to like", "to comment", "to rate product purchase" or "to recommend an article": *"to receive a like", "to receive a comment", "to receive a product purchase rating"* or *"to receive a recommended article"*. This differentiation of needs as well as other statements from participants such as "to be accepted" or "to receive approval from others" leads to my conclusion to complement the existing six needs within the UX framework with the need for self-esteem – self-respect.

Moreover, the need for self-esteem – self-respect takes up the aspect of individuality/identity as social feedback influences the constitution of the self-image[5]. For that reason, interactive products can support this need with virtual gestures such as "like" or "recommend an article". Especially the missing local personal closeness and attractiveness through web products make reciprocity and shared interests more relevant. That is why such *social* features have a special importance for positive experiences.

I therefore conclude that social features such as "like", "comment" and "recommend an article" follow the concept of reciprocity. The active "liking" could, if it creates a positive feeling and both are in an emotional relationship, raise the affection of a person to another. As stated earlier, "to give pleasure to others" for that reason can support the need for relatedness – belongingness. On the other hand, "to receive a like" also can release affection and therefore support the need for relatedness – belongingness. "To receive a like" furthermore can release feelings for recognition or approval; that is why the feature can also support the need for self-esteem – self-respect as a result of a positive external image.

Table 6.1 provides an overview how statements were assigned according to the principle of reciprocity. Statements such as "to profit financially", "to make a good deal" and "to save money" made me think about including the need for *money-luxury* into the UX framework. From my perspective, money can serve as an incentive to receive a universally usable medium that helps to fulfill psychological needs. The wish to profit financially or to save money can serve for the purpose to purchase products or persons to fulfill needs. Money can help to rent or buy a sports car in order to feel pleasure while driving (need for pleasure – stimulation). Or it helps to satisfy the need for security – control while money can be used to finance an alarm system. The wish for money can furthermore, depending on the personality, help to satisfy needs for self-esteem – self-respect and influence – popularity. Such thoughts, however, move away from the research field of UX in interactive products.

[5] [Zimbardo and Gerrig, 2008, p.531].

User Statement	Explanation with Reciprocity	Need
To give pleasure to others	Reciprocity for establishing a relationship respectively for maintaining affection. Indirect reciprocity.	Relatedness – Belongingness
To help others	Reciprocity for reputation. Indirect reciprocity.	Influence – Popularity
Individuality	Self-affirmation and constitution of self-perception based on direct reciprocity.	Self-esteem – Self-respect
Esteem	Similar to acceptance and appreciation. Direct reciprocity.	Self-esteem – Self-respect
Get feedback from others	Self-affirmation and constitution of self-perception based on direct reciprocity.	Self-esteem – Self-respect

Table 6.1: Summary of Assigning Statements according to Reciprocity

As Sheldon et al. could not prove the need for money – luxury[6], I conclude that within the area of web products the need for money – luxury does not deserve the need status. For that reason I will not look at it further and exclude statements related to money – luxury from the analysis.

Furthermore, core statements that were assigned to need categories often contained statements with an action focus, only seldom with a need focus. The action focus indicates activities to fulfill these needs (*"to do"*); the need focus indicates the underlying motive of website usage (*"to be"*)[7]. To specify psychological needs clearly, I separated action statements from need statements. An example need focus within in the need for pleasure – stimulation is "to be curious", a related exemplary action focus is "to browse" or "to distract myself". The example shows that an action statement is a possible solution to fulfill a psychological need. Action statements thus provide indications for responsible actors in product development to design features that fulfill psychological needs and further elicit positive experiences. Detailed results are presented in Subsection 6.2.4.

Figure 6.1 shows the overall resulting needs that are relevant in the area of web products. Self-esteem was the only addition to the existing needs. However, as the other needs could be proven to be relevant in the area of web products, the improved need concept is more substantial and therefore useful for practical product development.

[6] [Sheldon et al., 2001, p.327 and p.329].
[7] See e.g. [Hassenzahl and Roto, 2007].

Figure 6.1: Resulting Relevant Needs in the Area Of Web Products

6.2.2 Relation between Psychological Needs and Product Features

In general, the study shows that each website focuses on a few specific needs that make the website overall useful for people. These specific needs constitute a *need fingerprint* which is manifested in every website and which describes the overall usefulness of the system. This usefulness is also defined as the *suitability for the task*, while a task refers to the user's intrinsic and extrinsic motivational goals, and was earlier part of the framework as *utility*.

Website features mainly relate to these specific needs and, therefore, support the need fulfillment of the entire website. This shows that explicitly the core use as main indication for the usefulness of the product was named in relation with the needs. Therefore, the *utility relates directly to psychological need fulfillment and should be re-added to the overall UX framework.*

Figure 6.2 presents the revised product quality classification. Understanding the relation between psychological needs and product qualities aims at providing recommendations to prioritize product features in order to make the product's ability to fulfill psychological needs clear and understandable. This knowledge has strong potential to assist finding a product's core value based on psychological needs and to prioritize features that support fulfilling these needs.

The following examples provide the need fulfillment tendency visualized as *need fingerprints* of evaluated websites. Need fingerprints visualize the profiles of the products need fulfillment. The examples show how successful websites focus on specific needs and which product

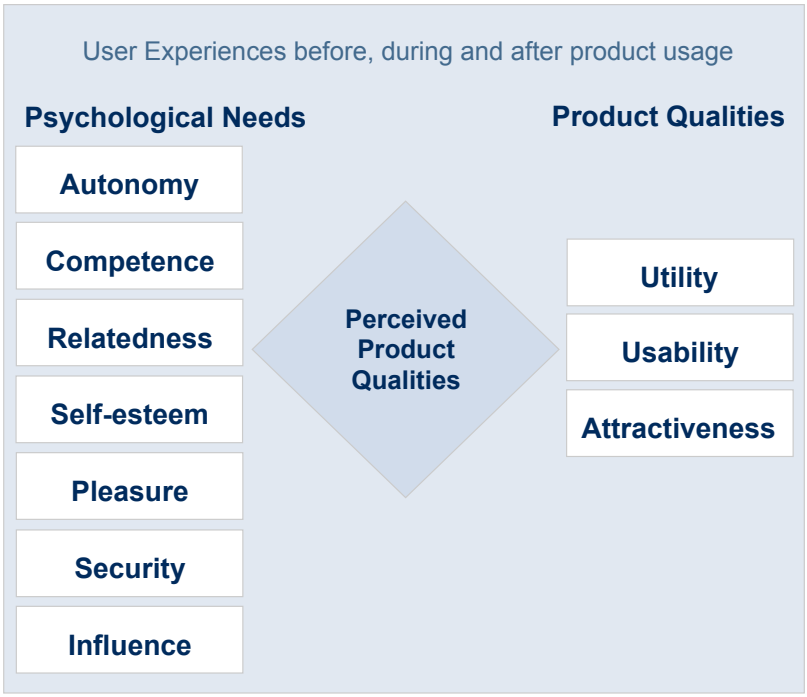


Figure 6.2: Revised Product Qualities

features support fulfilling these needs. The measures relevance ratings, number of named features and valence helped to derive a tendency result number regarding the importance of needs. First analysis show that clear tendencies can be derived. Further research should include quantitative studies to validate these tendencies.

Facebook's Need Fingerprint

Facebook is a Social Networking Website founded in February 2004 promoting the mission "to give people the power to share and make the world more open and connected."[8]. Extensive research has been done regarding the "Facebook experience"[9] and motives to use Facebook[10]. Using the uses and gratification approach, Joinson for instance found that "users derive a variety of uses and gratifications from social networking sites, including traditional content gratification alongside building social capital, communication, surveillance and social networking surfing", Facebook enables users to "engage with the site as a self-presentation tool"[11]. These insights indicate that Facebook mainly focuses on the psychological needs for influence, relatedness and stimulation.

[8] [Facebook.com, 2012].
[9] [Hart et al., 2008].
[10] See e.g. [Joinson, 2008].
[11] [Joinson, 2008, p.1035].

Results from the study confirm the previously assumed insights and additionally emphasize the importance of the need for self-esteem – self-respect. Consequently, study results indicate that Facebook primarily fulfills needs for relatedness – belongingness, pleasure – stimulation, self-esteem – self-respect and influence – popularity. Furthermore, results show that Facebook is frustrating needs for autonomy – independence and security – control. Figure 6.3 intends to provide an impression about Facebook's overall need fulfillment based on the participant's relevance ratings. Please note that the graphic only shows a tendency, not a statistically valid need fulfillment result. The following features base upon user evaluations

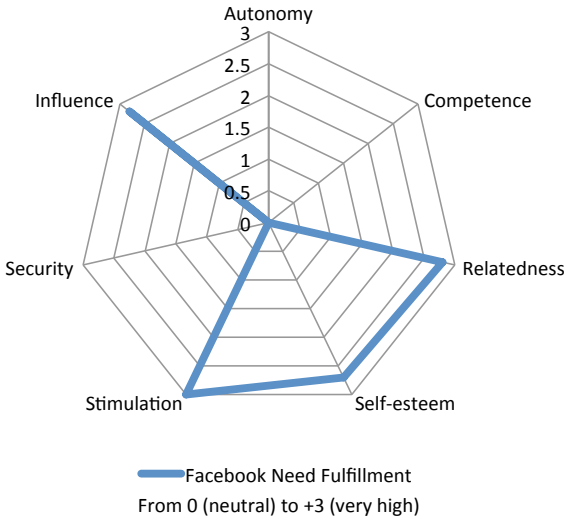


Figure 6.3: Tendency of Facebook's overall Need Fulfillment

to fulfill psychological needs. They preferentially support the primary needs for relatedness, stimulation, self-esteem and popularity.

Need	Facebook Features that Fulfill Psychological Needs
Competence – Effectance	Birthday Reminders, Event Reminders, Event Planner, Groups
Relatedness – Belongingness	Chat, Comments (read and write), Like, Contact List, Status Update (Share/ Read), Share Photos, View Photos, Documents (Share/ View), Group Chat, Messages
Self-esteem – Self-respect	Comment (receive), Like (receive), Messages (receive)
Pleasure – Stimulation	Games, Videos, Status Updates (Read), Friend's Profiles, Notifications, Personalized Advertisements, News Stream
Influence – Popularity	Status Update, Comment (write), Share Photos, Share Documents

Table 6.2: Facebook Features that Fulfill Psychological Needs

Ebay's Need Fingerprint

Ebay.de is an online auction and shopping website that enables people and businesses to buy and sell a broad variety of goods and services. Ebay.de is an eCommerce website in Germany managed by the American multinational internet consumer-to-consumer corporation Ebay Inc. User study results as presented in Figure 6.4 shows that features displayed in Table 6.3 preferentially support needs for competence – effectance, pleasure – stimulation and security – control.

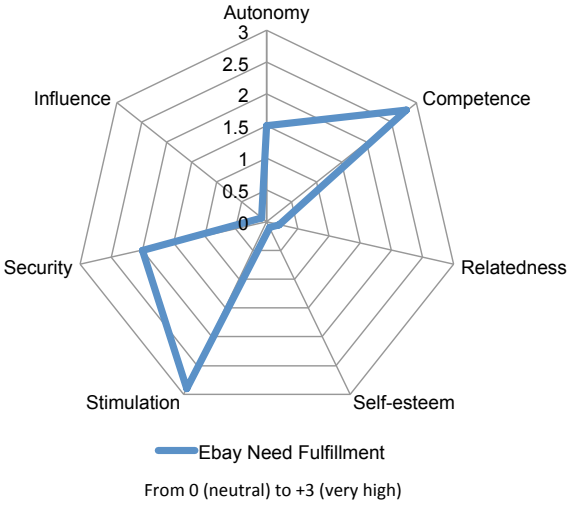


Figure 6.4: Tendency of Ebay's overall Need Fulfillment

Need	Ebay Features that Fulfill Psychological Needs
Autonomy – Independence	Variety of Offers, User Reviews (read), Buy-Now Option, Search Filter, Result Filter, Individualization of Views, Price Comparison, Product Comparison
Competence – Effectance	Search, Bid, Auction, Buy, Auto Completion of Search Terms, Observation Lists
Relatedness – Belongingness	Review
Self-esteem – Self-respect	Review (receive)
Security – Control	Navigation, Categories, Observation List, Product Photos, Pay Pal Integration, Help, Contact
Pleasure – Stimulation	Categories, Bid, Auction

Table 6.3: Ebay Features that Fulfill Psychological Needs

Amazon's Need Fingerprint

Amazon is a multinational electronic commerce company headquartered in Seattle, Washington, USA. The company has several separate retail websites such as Amazon.de in Germany. Figure 6.5 presents the overall fulfillment of needs for autonomy – independence, competence – effectance and pleasure – stimulation. The features displayed in Table 6.4 preferentially

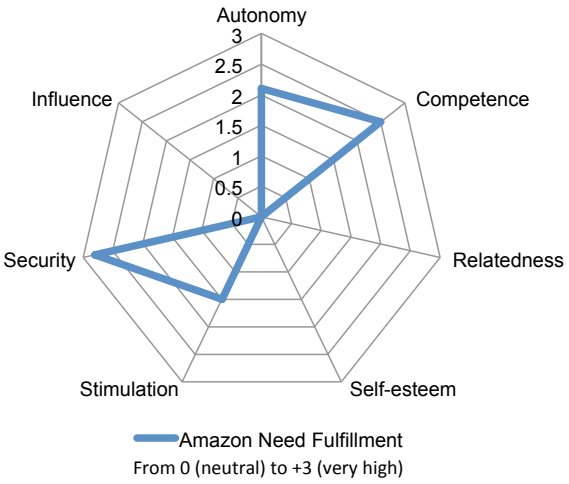


Figure 6.5: Tendency of Amazon's overall Need Fulfillment

support needs for autonomy – independence, competence – effectance and pleasure – stimulation.

Need	Amazon Features that Fulfill Psychological Needs
Autonomy – Independence	Variety of Offers, Search Filter, Result Filter, Product Comparison
Competence – Effectance	Search, Buy, Auto Completion of Search Terms
Self-esteem – Self-respect	Personalized Recommendations, Personalized Welcome Page
Security – Control	Navigation, Categories, Account, Welcome Page, Shopping Cart, Data Protection, Product Photos, Product Detail Page, Help, Contact
Pleasure – Stimulation	Personalized Welcome Page, Wish List, Displaying Related Articles, Categories
Influence – Popularity	Review (write)

Table 6.4: Amazon Features that Fulfill Psychological Needs

Google's Need Fingerprint

Google.de is the German website of a web search engine owned by Google Inc. Google Search is the most-used search engine in the web. Google fulfills primarily needs for competence – effectance as well as autonomy – independence and pleasure – stimulation. The main purpose for users is the website's ability to effectively gain various knowledge by searching the web for answers and to feel entertained and inspired when finding information they were not conscious about or they did not expect. Another interesting aspect of Google Maps is its ability to make users feel prepared and tactical by providing information for planning and preparation. Considering the primary needs as emphasized in Figure 6.6, features displayed

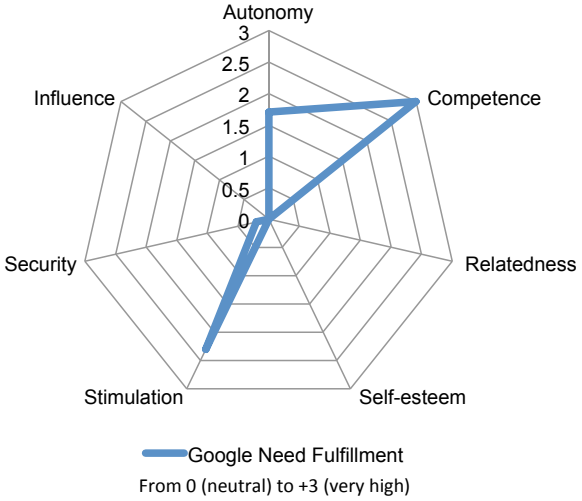


Figure 6.6: Tendency of Google's overall Need Fulfillment

in Table 6.5 mainly support needs for autonomy – independence, competence – effectance and pleasure – stimulation.

Need	Google Features that Fulfill Psychological Needs
Autonomy – Independence	Variety of Content, Product Comparison
Competence – Effectance	Search, Auto Completion of Search Terms, Highlighting of Search Terms, Link Preview, Route Planner (GoogleMaps), Time Information (GoogleMaps), Route Information (GoogleMaps), Location Search (GoogleMaps)
Security – Control	Navigation
Pleasure – Stimulation	Image Search, Satellite View in Maps, Web Search

Table 6.5: Google Features that Fulfill Psychological Needs

Spiegel's Need Fingerprint

Spiegel.de is the online version of the German weekly news magazine *Der Spiegel*. It is one of the most visited news websites in Germany. As of its news character, the website's primary need fulfillment focuses on needs for competence – effectance and pleasure – stimulation. Users mostly appreciate the website's ability to satisfy curiosity and to gain knowledge in order to feel being educated and up-to-date. Considering Figure 6.7, features displayed in

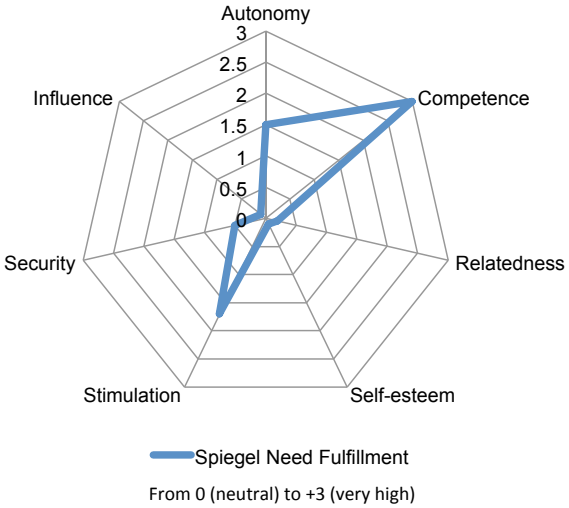


Figure 6.7: Tendency of Spiegels overall Need Fulfillment

Table 6.6 preferentially support needs for competence – effectance and pleasure – stimulation.

Need	Spiegel Features that Fulfill Psychological Needs
Autonomy – Independence	Feedback to an Article(write)
Competence – Effectance	Read Articles
Pleasure – Stimulation	Videos, Photo Streams, Links to Related Information, Contextual Additional Information, Categories
Influence – Popularity	Status (share), Comment (write), Recommend an Article, Review (write)

Table 6.6: Spiegel.de Features that Fulfill Psychological Needs

6.2.3 Extracted Need Categories

The data analysis helped to derive 24 overall need categories that classify relevant needs in the area of web products. These need categories were derived according to the described analysis process as introduced in Section 5.4. Categories build upon need and action statements by users relating to features that elicit positive experiences. Table 6.7 provides an overview and

descriptions of the categories. Descriptions base on user statements and aim at providing a context for a better understanding of the categories.

Category	Description
Freedom of Choice	To feel being self-dependent, unrestrained and self-determined when consuming content online.
Freedom of Opinion	To feel being honest, profound and informative when disclosing information online.
Independence	To feel being uncommitted and unrestricted when purchasing goods online.
Success	To feel being effective and capable when searching in or working with web products.
Planning	To feel being considered and tactical when preparing for an event or route.
Knowledge	To feel being educated, informed and up-to-date when consuming content online.
Exchange	To feel being involved in groups of people and reachable with online products.
Altruism	To feel being inspiring, selfless and helpful when disclosing content online.
Participation	To feel being existent for others when disclosing and sharing content online.
Approval	To feel being accepted, respected and noticed when receiving information online.
Individuality	To feel being unique and individual when consuming content online.
Excitement	To feel being playful and excited when using the web.
Curiosity	To feel being curious and attentive when consuming web content.
Inspiration	To feel being explorative when consuming content or purchasing goods online.
Creativity	To feel being imaginative and artistic when consuming and sharing content online.
Distraction	To feel being entertained, amused and relaxed when consuming web content.
Surprise	To feel being astonished with things one did not expect.
Overview	To feel being structured, sorted and orientated when searching and consuming web content.
Self-control	To feel being prudent and controlled when disclosing and consuming content and purchasing goods online.
Certainty	To feel being secure, protected and safe when consuming and disclosing information as well as purchasing goods online.
Ease	To feel being assured and carefree and have a peaceful mind when purchasing goods online.
Trust	To feel being confident and trusting when searching for and purchasing goods online.
Reputatation	To feel being influential and exemplary when disclosing information in the web.
Presence	To feel being attendant and regarded when disclosing information in the web.

Table 6.7: Resulting Need Categories in the Area of Web Products

6.2.4 Need Items for Web Product Usage

Table 6.8 shows the specified psychological needs, called *need items*, according to the model of psychological needs from Sheldon et al. (2001).

Need	Category	Need Items
Autonomy – Independence	Freedom of Choice	- To be self-dependent - To be self-determined
	Freedom of Opinion	- To be honest - To be profound - To be informative
	Independency	- To be uncommitted - To be unrestricted
Competence – Effectance	Success	- To be successful - To be capable - To be effective
	Planning	- To be tactical - To be prepared
	Knowledge	- To be educated - To be experienced - To be informed - To be up-to-date
Relatedness – Belongingness	Exchange	- To be involved - To be available
	Altruism	- To be inspiring - To be selfless - To be generous - To be helpful
	Participation	- To be participating - To be existent
Self-esteem – Self-respect	Approval	- To be approved - To be accepted - To be appreciated - To be respected
	Individuality	- To be individual
Security – Control	Overview	- To be structured - To be oriented
	Self-control	- To be self-controlled - To be prudent
	Certainty	- To be safe - To be certain - To be protected
	Ease	- To be assured - To be carefree
	Trust	- To be confident - To be trusting
Pleasure – Stimulation	Excitement	- To be playful - To be excited
	Curiosity	- To be gawping - To be curious - To be attentive
	Inspiration	- To be explorative - To be inspired
	Creativity	- To be imaginative - To be artistic
	Distraction	- To be entertained - To be amused - To be relaxed
	Surprise	- To be surprised
Influence – Popularity	Reputation	- To be influential - To be exemplary
	Presence	- To be regarded

Table 6.8: Resulting Need Items in the Area of Web Products

6.2.5 Exemplary Features to Fulfill Psychological Needs

The study has shown that single features relate to the fulfillment or frustration of at least one psychological need. Table 6.9 shows exemplary features that fulfill psychological needs. Exemplary features are all features from the evaluated websites facebook.de, ebay.de, amazon.de, google.de and spiegel.de that lead to positive user experiences as stated by the study participants.

Knowing exemplary features that fulfill psychological needs provide an indication to conceptualize the user experience.

Need	Exemplary Features That Help to Fulfill Psychological Needs
Autonomy – Independence	Variety of Content, Variety of Offers, User Reviews (read), Buy-Now Option, Search Filter, Result Filter, Individualization of Views, Comment (write), Feedback Functions, Price Comparison, Product Comparison
Competence – Effectance	Search, Bid, Auction, Buy, Auto Completion of Search Terms, Highlighting of Search Terms, Link Preview, Observation Lists, Birthday Reminders, Event Reminders, Route Planner, Event Planner, Group Function, Articles (read), Time Information, Route Information, Location Search, NewsStream, Groups
Relatedness – Belongingness	Chat, Comments (read and write), Like, Contact List, Review, Status Update (Share/ Read), Share Photos, View Photos, Documents (Share/ View), Group Chat, Messages
Self-esteem – Self-respect	Comment (receive), Review (receive), Like (receive), Recommendation (receive), Messages (receive), Personalized Recommendations, Personalized Welcome Page
Security – Control	Navigation, Categories, Account, Shopping Cart, Data Protection, Observation List, Profile View from Others Point of View, Profile Limitations, User Reviews (read), Product Photos, Pay Pal Integration, Comments (read), Product Detail Page, Help, Contact
Pleasure – Stimulation	Games, Videos, Image Search, Satellite View in Maps, Web Search, Photo Stream, Status Updates (Read), Personalized Welcome Page, Wish List, Friend's Profiles, Links to Related Information, Contextual Additional Information, Auto Completion of Search Terms, Displaying Related Articles, Categories, Personalized Advertisement, News Stream, Profile Information, Notifications, Bid, Auction
Influence – Popularity	Status (share), Comment (write), Recommend an Article, Review (write)

Table 6.9: Examples of Features that Fulfill Psychological Needs in the Area of Web Products

6.3 Revised Framework

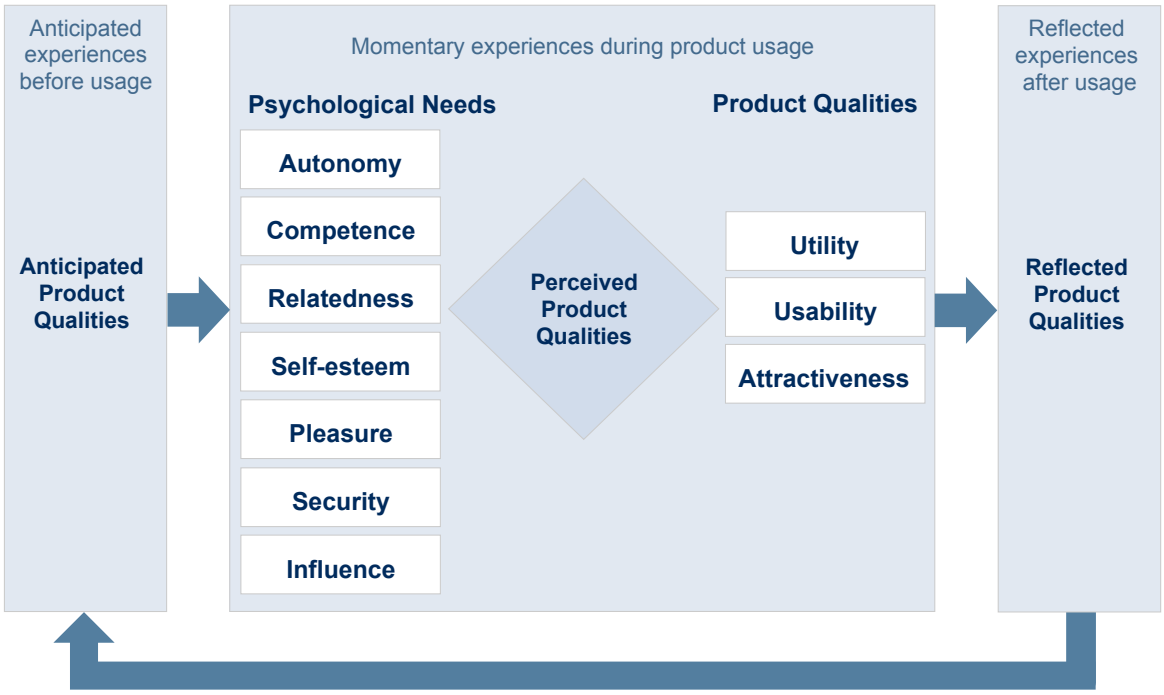


Figure 6.8: Revised UX Framework

Based on the earlier introduced findings, Figure 6.8 presents the revised UX framework[12]. Considering psychological needs for autonomy, competence, relatedness, self-esteem, pleasure, security and influence builds a basis to create satisfying experiences before, during and after interaction with a product in the area of web products. Relevant product qualities separate in utility, usability and attractiveness.

The framework is complementary to existing software engineering and design approaches and provides a human centered perspective that can be integrated into different development and design processes in a way that it is appropriate to the particular context. The framework, for instance, provides an applicable background for human centered design as defined by ISO 9241-210[13]. It provides indications specifically for specifying the user requirements and for evaluating the designs against requirements.

The following describes the framework in the context of web products with emphasis on psychological needs more in detail. Conceptualizing and evaluating the product qualities utility, usability and attractiveness will not be examined further as these have been subjects of numerous previous research that has been solved extensively.

[12]The early framework was introduced in Section 3.4.1 in Figure 3.8.
[13][DIN EN ISO 9241-210, 2010, p.11].

6.3.1 Psychological Needs in the Area of Web Products

According to insights from psychology, psychological needs are internal sources of motivation and influence a person's well-being. Based on the presented results, fulfilling the needs for Autonomy – Independence, Competence – Effectance, Relatedness – Belongingness, Self-esteem – Self-respect, Security – Control, Pleasure – Stimulation and Influence – Popularity therefore have the potential to elicit positive experiences with web products. Fulfillment or frustration of these needs by a web product influences the perceived product quality and therefore the overall attitude towards product usage. Table 6.10 defines the needs within the context of web products.

Need	Description and Related Need Categories
Autonomy – Independence	Feeling like you are self-dependent, profound and unrestricted in your own actions rather than feeling that you are dependent, superficial and restricted. Freedom of choice, freedom of opinion, independency.
Competence – Effectance	Feeling that you are successful, prepared and educated in your actions rather than feeling unsuccessful, unprepared and uneducated. Success, planning, knowledge.
Relatedness – Belongingness	Feeling that you have contact with people who are meaningful to you and be part of others lives rather than feeling lonely and not part of others lives. Exchange, altruism, participation.
Self-esteem – Self-respect	Feeling that you are an approved and appreciated person who is appearing individually rather than feeling being unapproved, unappreciated and not individual. Approval, individuality.
Security – Control	Feeling safe, sorted, self-controlled, carefree and trusting in using web products rather than feeling uncertain, unstructured and unconfident by using web products. Excitement, curiosity, inspiration, creativity, distraction, surprise.
Pleasure – Stimulation	Feeling that you are excited and amused rather than feeling bored and uninspired by web products. Overview, self-control, certainty, ease, trust.
Influence – Popularity	Feeling that you are exemplary, regarded, and have influence over others rather than feeling like a person whose advice or opinion nobody is interested in. Reputation, presence.

Table 6.10: Psychological Needs in the Area of Web Products (following the style of [Sheldon et al., 2001, p.346])

6.3.2 Perceived Product Qualities

According to ISO 8402[14] and the previous results, perceived product qualities are *the totality of characteristics of a web product that bear on its ability to satisfy psychological needs.* These characteristics categorize in utility, usability and attractiveness characteristics. The following defines these characteristics more in detail.

[14] See [DIN EN ISO 8402, 1994] and subsection 2.3.2.

Utility

According to Nielsen, Utility is "the question of whether the functionality of the system in principle can do what is needed"[15]. It therefore can be seen as an intermediate stage between the need that motivates for action and accomplishing an action. The utility specifies whether the product is suitable for a task (see ISO 9241-11), respectively useful or expedient in order to fulfill a psychological need. Saying this, the utility describes the *usefulness*[16] of a product. For that reason, the utility is part of the usability of a product and can be measured as part of established usability measurement methods with direct questions regarding usefulness.

Usability

ISO 9241-11 defines usability as the "extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use."[17]. According to this definition, usability focuses on *effectiveness*: "accuracy and completeness with which users achieve specified goals", *efficiency*: "resources expended in relation to the accuracy and completeness with which users achieve goals" and *satisfaction*: "freedom from discomfort, and positive attitudes towards the use of the product." Perceived usability includes the concept of perceived ease of use and is, together with perceived usefulness also known as the "pragmatic quality" of a product[18].

Principles to describe usability are defined in DIN EN ISO 9241-110[19] with *Self-Descriptiveness*, *Conformity with User Expectations*, *Suitability for Learning*, *Controllability*, *Error Tolerance* and *Suitability for Individualization*. These principles primarily support the need fulfillment of needs for Autonomy – Independence, Competence – Effectance and Security – Control.

Attractiveness

Attractiveness defines the perceived enjoyment when interacting with a product. It goes beyond perceived qualities of usefulness and ease of use and focuses on qualities that relate to *pleasure in product use*. Scientists argue that attractive products motivate people and positively influence the individual acceptance of the product[20].

Perceived attractiveness therefore includes the concepts of perceived hedonic quality and perceived visual attractiveness[21] and is often subsumed under the concept of a product's "hedonic quality".

[15] [Nielsen, 1993, p.25].
[16] See e.g. [Van der Heijden, 2003], [Mahlke, 2002] and Section 3.2.2 for more.
[17] [DIN EN ISO 9241-11, 1997].
[18] See Table 3.4.
[19] [DIN EN ISO 9241-110, 2006].
[20] See e.g. [Jordan, 1998a], [Norman, 2002b] [Van der Heijden, 2003] and Subsection 3.2.2 for more.
[21] See Table 3.4.

Characteristics to describe attractiveness based on the presented results are *Suitability for Sociability* and *Suitability for Stimulation*. These characteristics support secondary need fulfillment of needs for Relatedness – Belongingness, Self-esteem – Self-respect, Pleasure – Stimulation and Influence – Popularity.

6.4 Application of the Framework

The application of the framework aims to make the described UX framework manageable within the entire software engineering process[22]. Therefore, the earlier introduced guidelines to conceptualize and evaluate UX[23] will be presented more in detail and related to the UX framework as well as UXSE activities as displayed in Figure 6.9[24]. The guidelines were derived from expert interviews with 29 practitioners[25].

Figure 6.9 shows activities of UX in practice as introduced earlier in Chapter 2.2. Focus here are the most challenging activities conceptualizing and evaluating UX that are to be supported by the UX framework. Conceptualizing UX, as a result of the expert interviews, subdivides into the activities envisioning UX, defining UX and specifying UX[26].

Figure 6.9 only shows UX activities in a sequential order. However, as interviews with

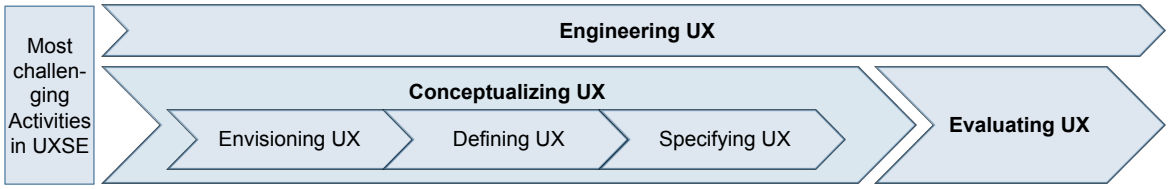


Figure 6.9: UX Activities in UX Centered Software Engineering

practitioners emphasize, an iterative approach is highly advisable and applicable. Considering this, Figure 6.10 shows an iterative UX process containing the main UX activities: *(1) envisioning UX*, *(2) defining UX*, *(3) specifying UX*, *(4) implementing UX* and *(5) evaluating UX*. Iterations end as soon as the system satisfies the specified UX.

This approach is considered to be mainly applicable in small, agile projects within web software development. Considering the scope of this dissertation project, the step *(4) implementing UX* will not be described further. Although this is an UX activity as subsumed by

[22] See e.g. [Roto et al., 2011].
[23] See Chapter 3.1.
[24] Earlier introduced in Chapter 2.2, Figure 2.2.
[25] See Chapter 3.1 and detailed results in appendix B.
[26] See Table 3.2 for a summary.

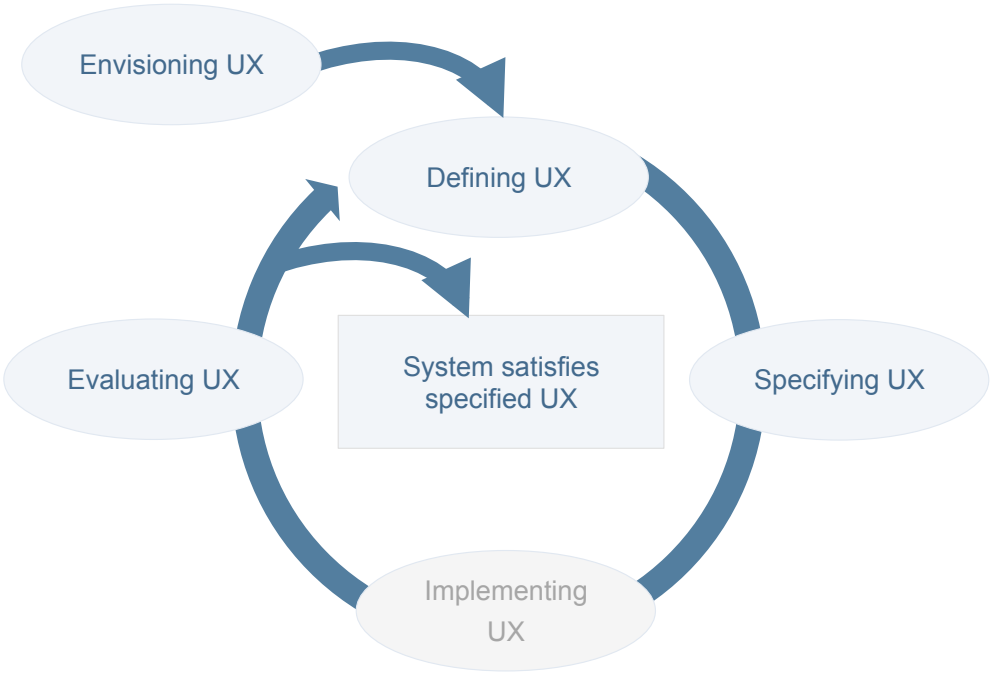


Figure 6.10: Iterative UXSE Process

Roto and colleagues under "*delivering designs aimed at enabling a certain UX*"[27], support is mainly required in the steps related to conceptualizing UX (envisioning UX, defining UX and specifying UX) as well as evaluating UX.

Each step will be described in detail while relating activities with guidelines to envision, define, specify and evaluate UX. Each step incorporates the application of the UX framework.

For a more complete consideration, Hartson and Pyla propose general *guiding principles for the UX practitioner*[28] which serve as overall guidelines throughout the UX centered software engineering process:

- "Be goal-directed.
- Don't be dogmatic; use your common sense.
- Context is everything.
- The answer to most questions is 'it depends'.
- It's about the people.
- Everything should be evaluated in its own way.
- Improvise, adapt, and overcome."[29]

[27] [Roto et al., 2011, p.5].
[28] [Hartson and Pyla, 2012, p.22].
[29] [Hartson and Pyla, 2012, p.22].

The following UX guidelines intend to be more specific within the context of each UX activity. To enhance the applicability of guidelines, each step includes the *goal*, *guidelines to consider* and *desired results* of the activity. *Examples* provide a helpful demonstration about how to transform guidelines to applicable UX criteria. Applicable UX criteria include both psychological needs and the product qualities utility, usability and attractiveness. Considering both emphasizes the relation between psychological needs and product qualities. The example by means of the website Facebook.de closes the link between psychological needs and product features for a more useful demonstration.

6.4.1 Envisioning UX

Goal of this very first step is to scope and identify UX criteria that are known, based on evidences, or are thought likely to be the drivers of UX in their particular instance[30]. This is, to find and understand these relevant UX criteria and to include this understanding into the need structure within a need fingerprint.

Guidelines to envision the UX include:

G-C1: Define a visionary goal. Define a long-term vision including a time-frame that explains why the product is supporting people in the future. Defining this visionary goal helps to communicate the product conceptual idea and provides the starting point for building a roadmap for product development.

G-C2: Decide on a UX strategy. Based on the understanding of the market place and human needs, decide on a UX strategy that is either market-driven or market-driving. A market-driven strategy (or *demand-pull*) orientates on existing products in the market. Typical tasks refer to learning, understanding, and responding to stakeholder perceptions and behaviors within a given market structure. A market-driving (or *technology-push*) strategy on the other hand aims at waking latent existing human needs and is characterized by changing the composition and/or roles, and/or the behaviors of players in the market. Typical tasks include the proactive change of people's demands by identifying latent needs and behavior and/or a market structure.

The UX framework supports understanding the user's personal goals and tasks by providing a general classification of psychological needs. Saying that, the framework provides a basis to work data driven at the very beginning of any software development activity. Knowing relevant psychological needs may not only help to identify human goals and therefore overall goals of the system, it furthermore provides a context to what life area of the user can be improved. Methods to envision UX can be a survey of existing users or a field study/user observation[31].

[30] [Roto et al., 2011, p.5].
[31] See a description of methods in [Maguire, 2001, p.594-598].

Results of envisioning UX are a *defined visionary goal*, a *defined need fingerprint* as well as a *decided UX strategy*. Results provide a basis to define the UX.

Examples show Table 6.11 and Figure 6.11. Table 6.11 presents an example on defining a visionary goal and deciding on a UX strategy with reference to the UX framework. Figure 6.11 shows an example of a defined need fingerprint. The need fingerprint example bases on the result of the user study as described in Subsection 6.2.2.

Guideline	UX Criteria	Example (Facebook.de)
Define a visionary goal	Utility of the product. Focusing on a few specific psychological needs.	To help people to connect and share with the people in their life (See Facebook.com). Focus on the needs for Relatedness – Belongingness, Self-esteem – Self-respect, Pleasure – Stimulation and Influence – Popularity.
Decide on a UX strategy	Based on the UX visionary goal, the overall utility of the product and envisioned customer experience with reference to psychological needs is to be decided. This includes creating an technological, design and marketing/communication strategy.	Envision and communicate features to fulfill the needs for Relatedness – Belongingness: Status, Chat, Comment, Like, Messages; Self-esteem – Self-respect: Like (receive), Comment (receive), Messages (receive); Pleasure – Stimulation: Games, Videos, Photos, Profiles; and Influence – Popularity: Status Update, Comment (write), Share Photos, Share Documents.

Table 6.11: Example to Envision UX based on Guidelines and Criteria

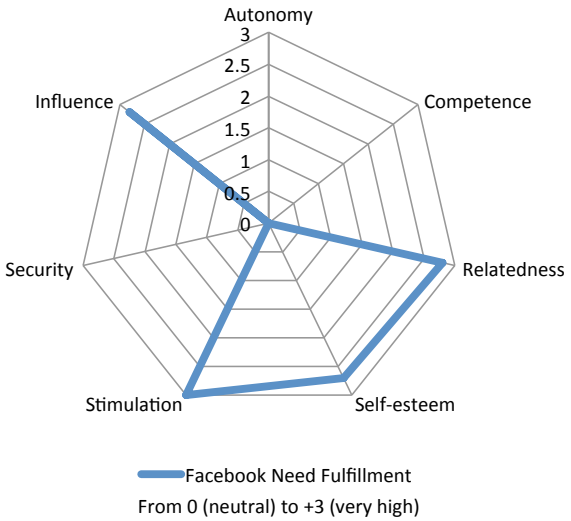


Figure 6.11: Example of a Defined Need Fingerprint by Means of Facebook.de

6.4.2 Defining UX

Goal of this step is to prioritize UX criteria by specifying the previously defined need fingerprint. Defining the UX, therefore, clarifies the UX visionary goal and fingerprint by clearly understanding and describing human's personal goals, tasks, problems and constraints of humans that relate to the envisioned target system.

Guidelines

G-C3: Have clear criteria for greatness or great experience. Define clearly what makes a good user experience in order to check throughout product development if these criteria are met. UX criteria furthermore provide metrics for UX evaluations.

G-C4: Understand user's personal goals. Understanding user's personal goals helps to fulfill underlying needs and therefore to create demand in market. It furthermore helps to define use cases and to prioritize features as the user's goals provide indications whether a product is useful.

Result of this step is a clarified need fingerprint with defined need categories that serve as criteria for great experiences. The result of defining UX provides the basis for specifying the UX in detail.

Example

Guideline	UX Criteria	Example (Facebook.de)
Have clear criteria for greatness or great experience	Previously prioritized psychological needs provide the frame for criteria for a great experience. The need items provide clear criteria that make the experience distinct. Considering the product quality, these clear criteria support defining the Usability and Attractiveness of the system.	Exchange, altruism, participation, approval, individuality, excitement, curiosity, inspiration, creativity, distraction, surprise (see Table 6.8 for need items).
Understand user's personal goals	Understanding relevant psychological needs provide the basis for user's personal goals.	Needs for Relatedness – Belongingness, Self-esteem – Self-respect, Pleasure – Stimulation and Influence – Popularity within a specific context the product aims to fulfill the needs in.

Table 6.12: Example to Define UX based on Guidelines and Criteria

6.4.3 Specifying UX

Goal of this step is to specify the perceived usability and attractiveness of the product by specifying need categories into need items and relating them to product features. The importance of this step substantiates the ISO norm 9241-210 by "in most design projects,

identifying user needs and specifying the functional and other requirements for the product or system is a major activity. For human centered design, this activity shall be extended to create an explicit statement of user requirements in relation to the intended context of use and the business objectives of the system"[32]. The UX Framework supports specifying explicit user requirements based on the previously defined need items. Need items in combination with knowledge from specifying the context of use help to focus on relevant contextual needs that provide clear user requirements in order to specify core functions and, consequently, core features.

Guidelines

G-C5: Allure the user. Guide the user and provide a way to navigate through the product. This builds upon the theory that people often not clearly know what they want or what exactly they are looking for. To reach the (often underlying) goal of the user, the product should allure the person to reach that goal - to fulfill his or her needs. Guiding the user helps her or him to navigate through the product with the least effort.

G-C6: Reduce options. Reducing options for users to interact with the product helps to make the product more understandable and usable. It can help to assure a minimal entry threshold. Saying this, goal of reducing options is to minimize complexity by offering fewer features.

Result of specifying the UX is a clear understanding of the usability and attractiveness of the desired product as well as its need items to fulfill. That said, results include the *specified need fingerprints related to product features* that aim at fulfilling the relevant need items. Product features incorporated into first design drafts distinguish the results of specifying the UX. The result of this UX activity builds the basis for implementing UX and, therefore, for the concept, prototype or product to be evaluated.

Example

Guideline	UX Criteria	Example (Facebook.de)
Allure the user	Focus on the need for pleasure – stimulation by including possibilities that activate the user's curiosity.	Focus on excitement, curiosity, inspiration, creativity, distraction, surprise.
Reduce options	Usability of the product. Focus on fulfilling the need for competence – effectance that makes the user feel being capable to use the product.	Reacting on posts with only "Like" and "Comment".

Table 6.13: Example to Specify UX based on Guidelines and Criteria

[32][DIN EN ISO 9241-210, 2010, p.12].

6.4.4 Evaluating UX

Goal of evaluating UX is to *prove the planned fingerprint* by collecting user feedback regarding the anticipated and/or actual experience with a concept, prototype or product. "Evaluating rough prototypes and mock-ups of potential designs will help obtain a deeper understanding of user needs, as well as providing initial feedback on the design concepts"[33].
Guidelines

G-E1: Work data driven from the beginning on. Start early with knowledge about the user in order to understand user trends, stay up-to date in order to be truly user centered. Early user experience research guide the developing process from the beginning on. Late evaluations only limit options to improve the product that aims to be user experience centered.

G-E2: Combine qualitative with quantitative data. Use qualitative and quantitative data collection methods to evaluate UX. Qualitative evaluations help to understand underlying user information, whereas quantitative evaluations help to understand the representativeness of results. Qualitative methods furthermore provide deep insights for new product ideas.

G-E3: Evaluate as often as possible. To support decision processes throughout the entire development process and to assure the user experience centered view, validate ideas and solutions with (possibly) future users as often as possible. This means during ideation, definition and specification of the software as well as after launch to improve as much and early as possible. Numerous evaluations with constant metrics furthermore provide a profile of the user experience over time.

G-E4: Don't listen to everything the user says. Weigh carefully the importance of a user statement and try to understand the meaning of what the person is saying. Often people express a desire or a solution to an underlying problem. However, the expert often has a better solution. So rather try to understand the problem and then come up with a solution the person has never thought of.

G-E5: Start in-house and then go out. Start with people who work in the company then move on to friends and family and then move to customers. This approach helps to quickly gather feedback regarding basic user experience issues. It limits required resources of time and costs while remaining to research sufficient user information with early ideas or prototypes.

G-E6: Observe people interacting with your product. Observe users while they interact with or talk about your product as this knowledge will help to understand user problems

[33] [DIN EN ISO 9241-210, 2010, p.10].

with the background of your expert knowledge. It makes the "voice of the consumer" concrete.

Results of evaluating UX are clear facts about how the concept, prototype or product was able to fulfill UX goals anchored in the need fingerprint as well as the overall visionary goal. Findings from UX evaluations provide indications to improve the defined UX. If findings reveal need fulfillments as planned in the original need fingerprint, UX iterations will end. In that case, the system meets the earlier set UX goals as captured in the need fingerprint.

Example measures to evaluate need fulfillment aim at determining the value of psychological needs within the need fingerprint. Saying that, need items provide applicable and useful measures to evaluate UX. The following example shows how to evaluate need fulfillment based on the need items for *Autonomy – Independence* and *Competence – Effectance*[34]:
Figure 6.12 shows an example of need items for *Autonomy – Independence* and *Competence*

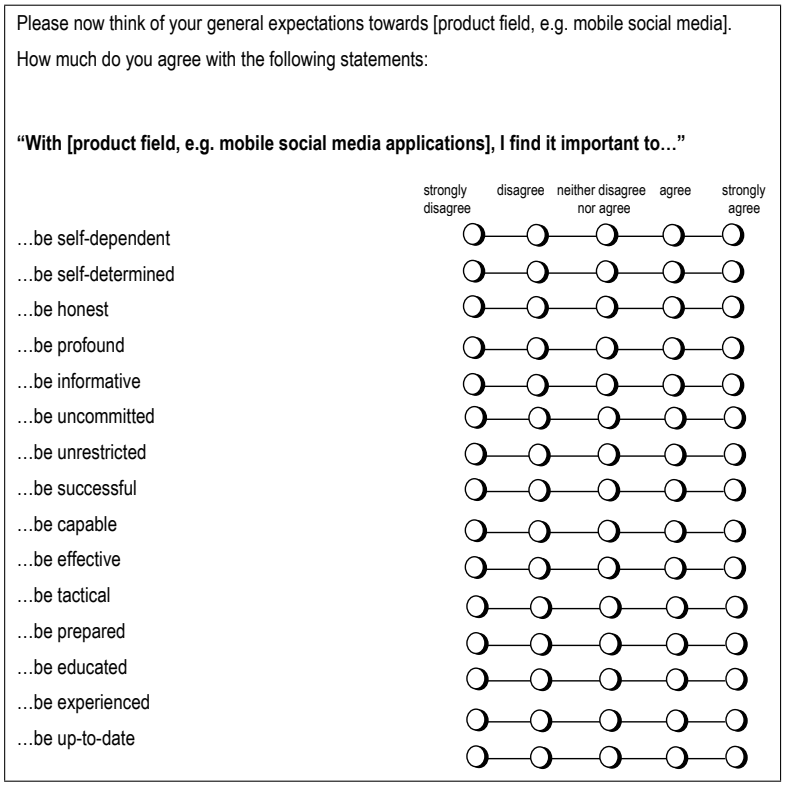


Figure 6.12: Example of How to Evaluate Psychological Need Expectations

– *Effectance* to gain insights about expected need fulfillment of a product within a specific product area. This knowledge provides indications of anticipated experienced. Results help to understand the relevance of specific need items within a defined product area. The questionnaire can also be used alone to support specifying the context of use.

[34]See need items as displayed in Table 6.8.

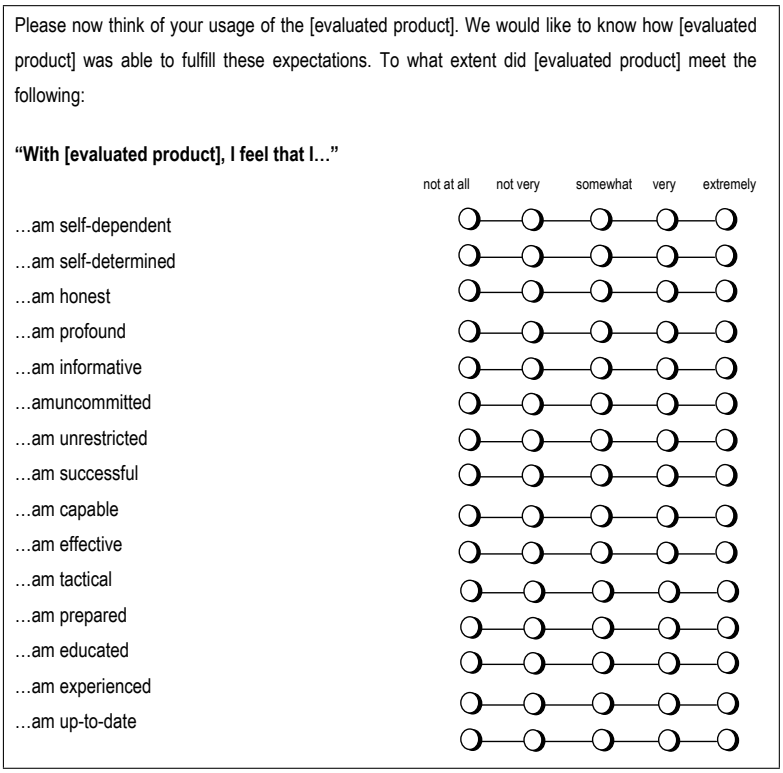


Figure 6.13: Example of How to Evaluate Psychological Need Fulfillment

Figure 6.13 on the other hand can be used to evaluate given design solutions of a product. Results provide information about reflected experiences with the product. If the evaluation is done within a one-to-one interview with a user during product interaction, more adequate information on momentary experiences can be obtained.

To add qualitative information to evaluated need fulfillment, questions can be enriched with open questions such as "Why did the product make you feel being .../ did not make you feel being ...".

6.5 Chapter Summary

The presented chapter introduced the results of the dissertation project by first presenting the general results of the user study that aimed to understand the relation between psychological needs and product features within the area of web products. The study helped to revise the existing UX Framework as presented in Figure 3.8.

Insights from humanistic psychology regarding reciprocity facilitated to record statements that were difficult to assign within the given previously categories. This knowledge helped

to complement existing psychological needs as proposed in the UX framework with the need for *self-esteem – self-respect*. The study furthermore has shown that the utility, respectively usefulness, of a product is perceived separately from usability and attractiveness as it was already determined by van der Heijden and Mahlke in earlier studies[35]. This insight lead to the decision to re-add utility as a separate perceived product quality.

The study approach was conducive to substantiate and improve the existing need categories as proposed in the earlier UX framework. User interviews helped to not only complement relevant needs in the area of web products, it furthermore helped to derive *general need items* for web products as well as *specific need items* for the web product classes Social Network, eCommerce, Search, and Information.

It became apparent that each web product exhibits specific *need fingerprints* that constitute the website's overall need fulfillment. Understanding these need fingerprints can be useful for marketing and sales activities and is worth to be examined further in future research.

The chapter consequently presented general results regarding relevant needs in the area of web products in Subsection 6.2.1, the relation between psychological needs and product features by means of evaluation results of the used test objects Facebook.de, Ebay.de, Amazon.de, Google.de and Spiegel.de in Subsection 6.2.2, extracted need categories in Subsection 6.2.3, need items for web product usage in Subsection 6.2.4 and exemplary features to fulfill psychological needs in Subsection 6.2.5

Based on these general results, section 6.3 presents the revised UX Framework including descriptions of the resulted psychological needs and product qualities.

To make the UX Framework applicable within practical software development, Section 6.4 presents the application of the framework with guidelines to conceptualize and evaluate UX. Clear UX criteria based on the UX Framework substantiate these guidelines. To make guidelines more feasible in practical software development, they were incorporated into an overall user experience centered software engineering process. Process steps are visualized in Figure 6.14 and summarized in Table 6.14.

The need categorization and resulting need items serve the purpose to support responsible actors in the development process of interactive products to develop for positive experience. Need categories and items substantiate the revised UX Framework. Guidelines to conceptualize and evaluate UX aim to support applying the UX framework within practical software

[35] See section 3.2.2 referring to [Van der Heijden, 2003] and [Mahlke, 2002].

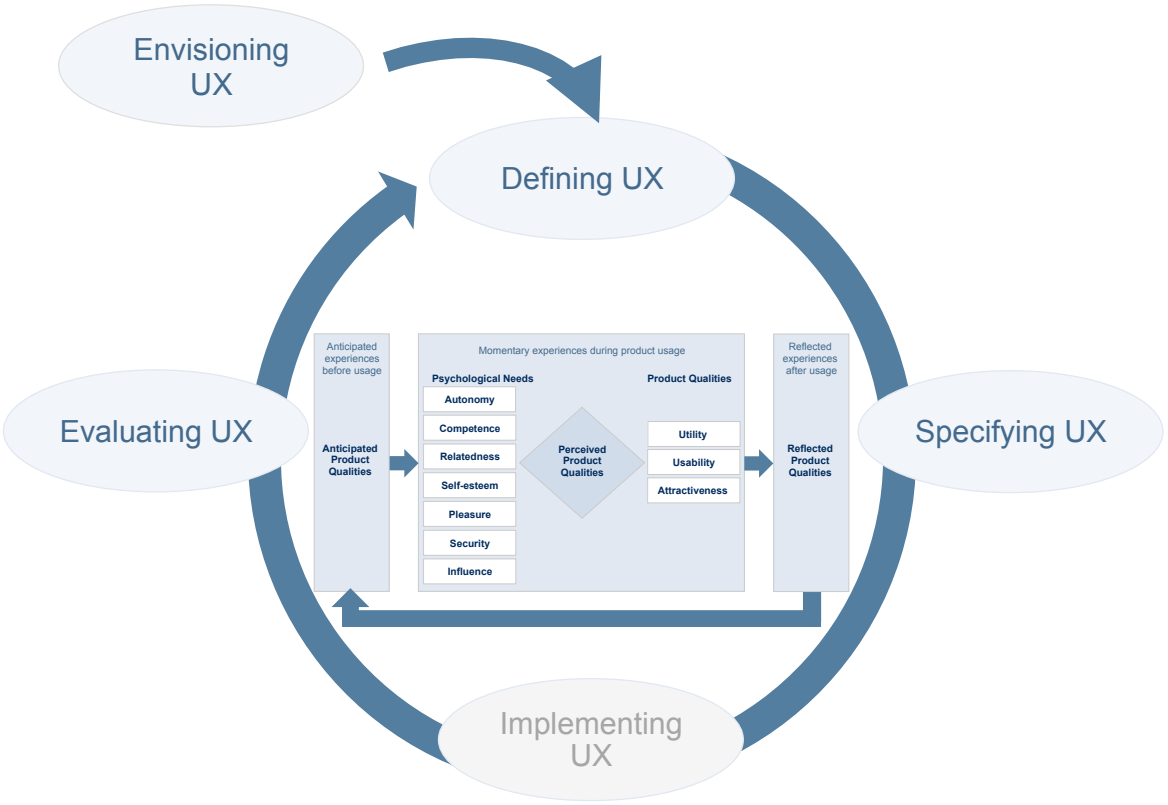


Figure 6.14: UX Framework integrated into the UXSE Process

engineering. Relating the guidelines to human centered design process steps as defined in ISO 9241-210 provides clear recommendations on when which guideline supports engineering the user experience.

UXSE Activity	Relating Guideline
Envisioning UX	G-C1: Define a visionary UX goal. G-C2: Decide on a UX strategy.
Defining UX	G-C3: Have clear criteria for greatness or great experience. G-C4: Understand user's personal goals.
Specifying UX	G-C5: Allure the user. G-C6: Reduce options.
Evaluating UX	G-E1: Work data driven from the beginning on. G-E2: Combine qualitative with quantitative data. G-E3: Evaluate as often as possible. G-E4: Don't listen to everything the user says. G-E5: Start with in-house evaluations and then go out. G-E6: Observe people interacting with your product.

Table 6.14: UXSE Activity with Relating Guidelines

7 Conclusions

7.1 Discussion

In academia and business the importance to develop human centered products that enhance human well-being is becoming more and more central. Within this context, *User eXperience (UX)* is nowadays an established component of product quality. However, as scientists and 29 expert interviews with responsible actors in product development point out, the transformation of the UX concept into practical software engineering is still in early stages. This reaffirms that a holistic view on user experience goes beyond the user-product relation and also includes the organization-product relation[1]. For that reason, it is important to understand the user-product relation (what underlying human motives influence a positive UX) *and equally* the organization-product relation (what is needed to develop for UX within an organization). Considering the latter, practitioners in software engineering emphasize the demand of a practice-driven and structured support to effectively engineer user experience within an organizational environment[2]. Targeting this demand is the overall motivation for the presented thesis.

Looking at developing for UX deeper requires to investigate desired product quality. An analysis of different existing approaches to user centered product quality of interactive products has shown that existing approaches are difficult to implement. Saying that, they do not provide a relation between perceived product quality and underlying human motives in order to understand the drivers that constitute positively perceived product quality and, correspondingly, a positive user experience. In order to understand underlying human motives,

[1] [Schulze and Krömker, 2013].
[2] See results of the expert interviews in Appendix Section B.

Hassenzahl and colleagues[3] suggest to refer to psychological needs as they are assumed to be "particular qualities of experiences that all people require to thrive"[4].

To connect both worlds – product quality and psychological needs – for understanding their influence on perceived product quality, I proposed an early UX framework. The framework included the needs for *autonomy – independence*, *competence – effectance*, *relatedness – belongingness*, *security – control*, *pleasure – stimulation* and *influence – popularity*[5] as well as the product qualities *usability* and *attractiveness* as they were shared by all product quality approaches within the context of user experience. The next logical step was to make the framework applicable. Therefore, the abstract psychological needs require to be specified according to the product context. An evaluation of the framework with the mobile social media service *LiveShare* by Cooliris has shown that the process to specify needs was only marginally applicable in practical software engineering as a result of its time- and resource consuming procedure. The framework itself was considered to be useful[6].

Consequently, applicable support to develop for UX requires a pre-specified framework for a specific product area. To transfer the specific, yet theoretic, UX framework into practical software engineering, guidelines incorporating the UX framework for conceptualizing and evaluating UX can provide a holistic UX engineering support[7].

Summarizing this analytical and empirical background, goal of the thesis was to provide an applicable support for responsible actors in product development in order to understand, conceptualize and evaluate UX within the context of web products. Therefore, the study sought to answer the following research question:
"The fulfillment of which psychological needs leads to satisfying experiences in web product usage?" by answering the following sub questions:

1. *What* need categories play a relevant role within the area of web products?
2. *How* do these need categories relate to product features?

Product features are the reference to elicit positively perceived product quality from a product point of view.

To answer the research question, a qualitative approach was chosen in order to understand underlying concepts of meaning and to inductively improve the early UX framework as well as to deductively prove the existence of the proposed psychological needs by Sheldon and colleagues (2001) within in the area of web products.

[3] [Hassenzahl et al., 2010].
[4] [Sheldon et al., 2001, p.325].
[5] Six out of Sheldon and colleague's top ten psychological needs [Sheldon et al., 2001].
[6] See detailed results in Appendix Chapter C.
[7] See results of the expert interviews in Appendix Section B.

The research was successful in inductively deriving 24 overall need categories as well as 56 need items that specify relevant psychological needs in the area of web products. Mapping these 24 need categories with the top-ten psychological needs by Sheldon and colleagues has shown that the psychologists need concept is appropriate in the area of web products and, more influential on the previous work, that the need for *self-esteem – self-respect* adds to the early proposed framework. Therefore, the thesis statement *the psychological needs for autonomy – independence, competence – effectance, relatedness – belongingness, security – control, pleasure – stimulation and influence – popularity as put forward by [Sheldon et al., 2001] build a sufficient basis to categorize needs that serve as a basis for user experience* was refuted, or better, improved. Consequently, the framework was revised based on this result.

The derived psychological need categories provide different contexts in which products can support need fulfillment. Therefore, the categories can help to create an overall product vision based on a few relevant needs the desired product aims to fulfill.

The more specified needs, the need items, provide a human centered basis to derive product requirements. Exemplary product features from the researched websites Facebook.de, eBay.de, Amazon.de, Google.de and Spiegel.de provide an indication about which existing website features are already able to fulfill psychological needs. For future products, the need item list supposedly helps to conceive new product features which are relevant within a given product context.

Summarizing this, *main contribution of this work is a specification of Sheldon and colleagues (2001) abstract psychological needs for the area of web products.* Answering the research question, specifically the needs for *autonomy – independence*, *competence – effectance*, *relatedness – belongingness*, *self-esteem – self-respect*, *security – control*, *pleasure – stimulation* and *influence – popularity* are important within the area of web products. Considering this result, the research findings provide a detailed understanding of psychological needs related to product features within the area of web products. Relating the framework to relevant human centered development steps to conceptualize and evaluate UX and substantiating these steps with analytical and empirical studies[8] provide a basic support for software engineering.

Therefore, this work can provide a basis for holistic software engineering support to create products that aim at improving human well-being. For the research area of HCI and HCD the results aim to help bridge the gap between UX theory and doing UX in practice.

There are at least four limitations of the present work:

[8] See e.g. expert interviews with product managers in Appendix Section B for results.

1. The revised UX framework was not empirically validated yet. To generalize findings, it will be necessary to validate the framework in quantitative studies with different product services in order to prove or improve the revised UX framework.
2. Applicability of the guidelines was not empirically proven and requires long-term studies to generalize the value of the guidelines in practical software engineering.
3. Although working with a small sample size is sufficient for qualitative research and to derive knowledge about complex relations, the small sample size may lead to the possibility that future studies will produce different results.
4. As the research analysis only focuses on positive experiences, future studies that include both positive and negative experiences may reveal different findings.

7.2 Transferability

The relation between psychological needs and product qualities to elicit positive user experiences as used in this thesis was limited to web products. However, resulting need categories and need items may also give indications for other consumer software developments, such as:

- Learning software: by, e.g., focusing on the needs for *competence – effectance*, *self-esteem – self-respect* and *pleasure – stimulation*.
- Games: by, e.g., focusing on the needs for *competence – effectance*, *relatedness – belongingness*, *pleasure – stimulation* and *influence – popularity*.
- Data management software: by, e.g., focusing on the needs for *competence – effectance* and *security – control*.
- Smart home software: by, e.g., focusing on the needs for *autonomy – independence*, *relatedness – belongingness*, *security – control* and *pleasure – stimulation*.

Findings may also be transferred from the context of software to the context of hardware. Adding the need for *physical thriving – bodily* for tangible and health-improving features of the hardware can provide a holistic basis to support human centered hardware development.

Furthermore, need items can be used in questionnaire development in order to determine expected need fulfillment of a product and the actual need fulfillment as exemplary shown in Section 6.4.

Introduced need fingerprints[9] may not only be interesting in analyzing the user experience of software. Need fingerprints further can provide a useful basis and visualization for marketing activities. As the need fingerprints visualize clearly the needs and their value the software is fulfilling, this information can be used to describe the Unique Selling Proposition (USP) of the product. Therefore, the USP can directly be related to the core value of the product that

[9] See Subsection 6.2.2 for more.

aims to focus on the user's well-being. Considering need fingerprints in engineering, design and marketing activities of the product, provides a holistic view on the product's ability to support people's everyday life and helps to communicate this ability accordingly.

7.3 Prospects

User experience centered software engineering as a discipline is still in its infancy. On the organizational side, helpful support, however, is required quickly. What is needed now are proven concepts to support the conceptualization and evaluation of UX while providing an understandable background about what user experience is constituted of and what implications UX centered software engineering has on an organization's revenue and image.

With the present research results, I hope to offer a step towards this goal. This is, by providing a revised UX framework that relates psychological needs with product qualities which is specified for the area of web products and related to relevant UX-engineering activities.

However, there are still many more steps to go to make this research topic more valuable in practical software engineering. The research results open up a spectrum of future research, such as:

- Reproducing the findings by conducting (1) other qualitative studies to derive need categories or (2) applying a quantitative research design that aims at proving the resulting 24 need categories.
- Conducting long-term empirical studies with the specified framework incorporated in the guidelines within the UXSE Process during development of new web products.
- Specifying needs in different product areas in order to provide a specified UX framework not only for the context of web products.
- Specifying needs for mobile products as need categorizations and need items may differ in a mobile context.
- Understanding the prioritization of presented need categories for (1) different product contexts, (2) different life areas, and if applicable, for (3) the different life stages of human's[10].
- Need fingerprints in Subsection 6.2.2 provide intuitive indications on a product's core need fulfillment and perceived utility. Future research can focus on calculating a quantitative UX scale based on psychological needs incorporating these measures.

[10]See e.g life stages by [Erikson, 1995].

8 Summary

Applying a human centered development approach is becoming more and more central in practical software engineering activities. Nowadays, a human centered development approach focusing on human's well-being is often subsumed under the concept of User eXperience (UX). Although the research field of UX is already about a decade old, the discipline is still considered to be in its infancy[1]. Considering the broad view of UX which includes the user-product relationship and the organization-product relationship, different levels of UX research open up, such as understanding the sources of positive user experiences and transferring the knowledge into practical software engineering[2].

Goal of this work was to provide an applicable support for responsible actors in product development in order to understand, conceptualize and evaluate UX. Scope of this research was web products without specifically examining emotions, mood and affect or user habit as they are often connected with the concept of UX. In order to provide an applicable support it was necessary to understand the sources of positive user experiences at first. Therefore, the thesis builds upon the theory, that "psychological needs are particular qualities of experiences that all people require to thrive"[3]. To connect this human centered theory with interactive products, I developed an early UX framework that relates psychological needs with product quality. That is, to understand the relation between psychological needs (the user) and product quality (interactive product) in order to explain the sources of positive user experiences. This early UX framework served as the research concept for this work. Therefore, the presented research sought to answer the question of *"the fulfillment of which psychological needs leads to satisfying experiences in web product usage?"* by understanding (1) what need categories play a relevant role within the area of web products and (2) how these need categories relate to product features.

Considering the overall research goal and the research question, the work presents results from four empirical studies of qualitative character that built upon each other. Results of the first three studies helped to frame the research question.

[1] [Hassenzahl et al., 2010, p.362].
[2] This thesis subsumes the human centered approach to develop and design software with focus on UX under "User Experience centered Software Engineering", short UXSE.
[3] [Sheldon et al., 2001, p.325].

The first study sought to understand main challenges to integrate UX thinking into practical product development processes at Deutsche Telekom AG Products & Innovation (DTAG) by conducting 18 semi-structured expert interviews with practitioners at DTAG. This study therefore served as a demand analysis for this work. Results have shown that main challenges are a missing uniform understanding of UX, a missing approach to include UX activities into the product development process, and a missing support to develop UX centered products. However, as the study was limited to practitioners at DTAG, a broader study with practitioners at different companies was required to substantiate these findings[4].

The second study therefore, aimed to research the current state of UX by considering the results from the first study. Saying that, this study sought to understand challenges in UX centered software engineering (UXSE) deeper and to collect best practices in UX centered software engineering. In total, 29 experts from 20 small, medium-sized and large enterprises participated in the study. Semi-standardized expert interviews with 22 product managers and 7 UX experts helped to understand the state of UX. Results indicate that besides a unified understanding, conceptualizing and evaluating UX are the most challenging activities within UX centered software engineering. Best practice examples and top three tips to create a positive UX helped to derive guidelines from experienced product managers and UX experts. Results provide basic requirements and a substantiated demand for useful support in engineering the UX[5].

The third study aimed to empirically prove the early UX framework within practical software engineering. The UX framework aimed to serve as a basis to extract product requirements based on psychological needs by means of the mobile social media service *LiveShare* by Cooliris. The study has shown that the applied approach was helpful to derive guidelines for mobile social media. Further, the UX framework in general was considered to be useful in practical software engineering. However, the process to specify needs was complex and specified needs may be argued to be arbitrary. It was not clear whether need categories and specified needs were complete for profound results. For that reason, study results suggest that it may be more valuable to understand general need categories in the field of web products[6]. Results from this study helped to frame the detailed research question.

The fourth study sought to answer the research question of this thesis: the fulfillment of which psychological needs leads to satisfying experiences in web product usage? I therefore conducted problem-centric semi-structured episodic interviews with 31 website users. The goal of the study was to deductively prove the existing theory as pro-

[4]Detailed research results presents Appendix Chapter A.
[5]Detailed research results presents Appendix Chapter B.
[6]See detailed results in Appendix Chapter C.

posed in the UX framework as well as to inductively modify and deepen the theory to understand relations between product features – that build the basis for product quality – and psychological needs. Study objects were a variety of the most frequently used websites in Germany: Facebook.de, Ebay.de, Amazon.de, Google.de and Spiegel.de.

To relate these four studies, the thesis presented main results from the first three studies in the analytical and empirical background in Chapter 3. In conjunction with a deeper understanding of *(a)* product quality by analyzing existing approaches to product quality as well as *(b)* psychological needs by comparing different need concepts from the research fields of psychology, user experience and web products, the analytical background provided (1) a grounded basis about the demand for UX centered software engineering support, (2) introduced the early UX framework and (3) its evaluation in order to frame the research question of this dissertation project.

Chapter 4 derived and introduced the research question more in detail, followed by the detailed research design in Chapter 5.

Results of the dissertation answer the research question and aim to reach the overall goal of supporting UX centered software engineering. The fourth study was targeted at answering the research question, whereas the first three studies helped to derive the demand and requirements to effectively support UXSE. Results of the dissertation, therefore, include:

Understanding which psychological needs require to be fulfilled by websites to elicit positive user experiences. The study helped to inductively extract 24 need categories which were further specified into 56 need items. The need categories relate to seven of ten needs which Sheldon and colleagues (2001) propose: *autonomy – independence*, *competence – effectance*, *relatedness – belongingness*, *self-esteem – self-respect*, *security – control*, *pleasure – stimulation* and *influence – popularity*.

A revised UX framework that relates psychological needs with product qualities to provide a holistic view on understanding and applying UX. The detected need for *self-esteem – self-respect* as well as the seperately perceived utility (core value of a product) lead to a revision of the earlier introduced UX framework. The revised framework is considered to be complete for the area of web products.

A structured UXSE process focusing on the most challenging activities conceptualizing and evaluating UX, including guidelines. Based upon the second study, I defined a structured UXSE process with the activities *(1) envisioning UX*, *(2) defining UX*, *(3) specifying UX*, *(4) implementing UX* and *(5) evaluating UX*. Each activity provides guidelines that result from the expert interviews to develop for UX, and an example on how the revised and specified UX framework supports each activity.

Introduction of need fingerprints. During the study it became apparent that each web product exhibits specific need fingerprints that constitute the website's overall need fulfillment. Understanding these need fingerprints can be useful for marketing and sales activities and is worth to be examined further in future research.

Summarizing these results, main contribution of this work is a specification of Sheldon and colleagues (2001) abstract psychological needs for the area of web products and the inclusion of this knowledge into a revised and specified UX framework which is incorporated into an overall UXSE process.

The thesis ends with a conclusion including a discussion of the work's results, transferability of results and prospective research.

Appendix

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A Study 1: Demand Analysis

A.1 Introduction

Although the importance of user centered and user experience centered product development is widely spread within the Human-Computer Interaction (HCI) community[1], practitioners still face challenges to transform this knowledge into software engineering processes. Law et al. for instance discovered a missing consensual definition of UX within academia and industry which is fundamental for communicating, researching and designing for UX[2]. Zink and Eberhard furthermore point out that a very technology-centered product development, referring to technical and economic aspects of a product but little to user orientation, in comparison to a UX-centered product development is found in companies[3]

In order to understand main challenges to integrate UX thinking into practical product development processes at large ICT enterprises, this study investigates the case of Deutsche Telekom AG Products & Innovation (DTAG P&I) by building upon the following hypotheses:

- A discrepancy between establishment (knowledge) and integration (application) of UX at DTAG P&I exists.
- A stronger integration of UX into product development activities is desired.
- Support is needed to consider UX thinking within product innovation and product development processes.

Considering the hypotheses, main goal of the study is to understand challenges of integrating UX thinking into product development processes at DTAG P&I. Understanding these challenges aims to frame the demand for support in a UX-centered software development. Sub goals of the study are to understand:

[1] [Forlizzi and Battarbee, 2004], [Arnold et al., 2010].
[2] [Law et al., 2009, p.719–720].
[3] [Zink and Eberhard, 2008, p.72].

- The general understanding of UX within DTAG P&I
- Acceptance to integrate UX thinking into product innovation and development processes
- General requirements to support UX centered software engineering within DTAG P&I

A.2 Study Method

Considering the desired study goal, I conducted 18 semi-structured problem-centered expert interviews[4] of approximately 30 – 45 minute duration at DTAG P&I in Darmstadt, Germany within the time frame from July to September 2010. Experts were individuals who are responsible for innovating and developing products at DTAG P&I.

Study participants were product managers (n=9), designers (n=4), UX consultants (n=3) and managers in high strategic positions (n=2). All are responsible to develop software at DTAG P&I. Product managers and designers are directly involved in conceptualizing and managing the overall product. UX consultants often support product managers with activities such as workshops to conceptualize UX or evaluating UX with users. Strategically involved managers provide a general guidance of the product strategy and are responsible for resource allocations. Designers and strategically involved managers are therefore not directly involved in the product development process.
Interview questions subdivide into:

1. Personal information
2. Expert background knowledge
3. Theoretical knowledge about UX
4. UX integration within DTAG P&I

Interviews were transcribed according to Flick[5]. The generic analysis process therefore contains the steps of methodological commentation and summarizing information based on the hypotheses and goals of the interviews.

A.3 Empirical Findings

In summary, the interviews revealed that UX is seen as an important aspect of product development. This becomes apparent within the perception of interviewees as well as ongoing activities during the field phase. All study participants have a basic understanding of the term UX and consider the integration of UX into daily product development and innovation activities to be important and useful.

[4] [Witzel, 1989].
[5] [Flick, 1995].

At that point, a discrepancy arises: interviewees recognize the importance of UX but an integration into daily activities is still low. Main challenges are a missing unified understanding of the term UX, few meaningful measures to evaluate UX, only punctual UX activities within the software engineering process, an insufficient transfer of evaluation results back into the product development process as well as a missing overall UX vision.
Interviewees expressed their desire to receive support before, during and after product development. During the conception phase at the beginning of product development, a better understanding of the user regarding needs and contexts helps to define the product. During product development, guidelines based on studies and experience as well as best practice examples are perceived to be supportive. After product development, a meaningful overall UX measurement as well as a continuous transfer of user opinions to further develop the UX is of significance.

Considering a broader view, building a user experience-centered culture is the greatest demand. Such a UX culture contains human, organizational/ process-related and product development supporting aspects. Specifically demanded is an experience exchange between departments, a mentality to learn from and talk about flaws or negative experiences. Important is a flexible development process.

As a unified understanding of UX is a fundamental challenge that relates to UX culture aspects as stated above, the following provides a background on empirical findings with regard to the general understanding of UX and challenges to integrate UX into daily activities at DTAG P&I.

A.3.1 Understanding of the UX concept

Overall, a shared understanding of UX according to an experience with a product exists. However, terms and meanings of the related concepts usability and customer experience are often mixed with the concept of user experience. This ambiguity in confining related concepts leads to different understandings of UX.
Product managers, designers, UX consultants and strategically involved managers define UX with different foci. Designers and product managers who are directly involved in product development activities include the spatio-temporality and the overall product impression of a person into their understanding. However, product managers also include elements of customer experiences such as brand and brand perception, whereas designers speak of expectations. UX consultants and strategically involved managers define UX more vaguely with terms such as ideals, fun and simplicity. Figure A.1 shows different understandings based on expressed core terms to describe UX.

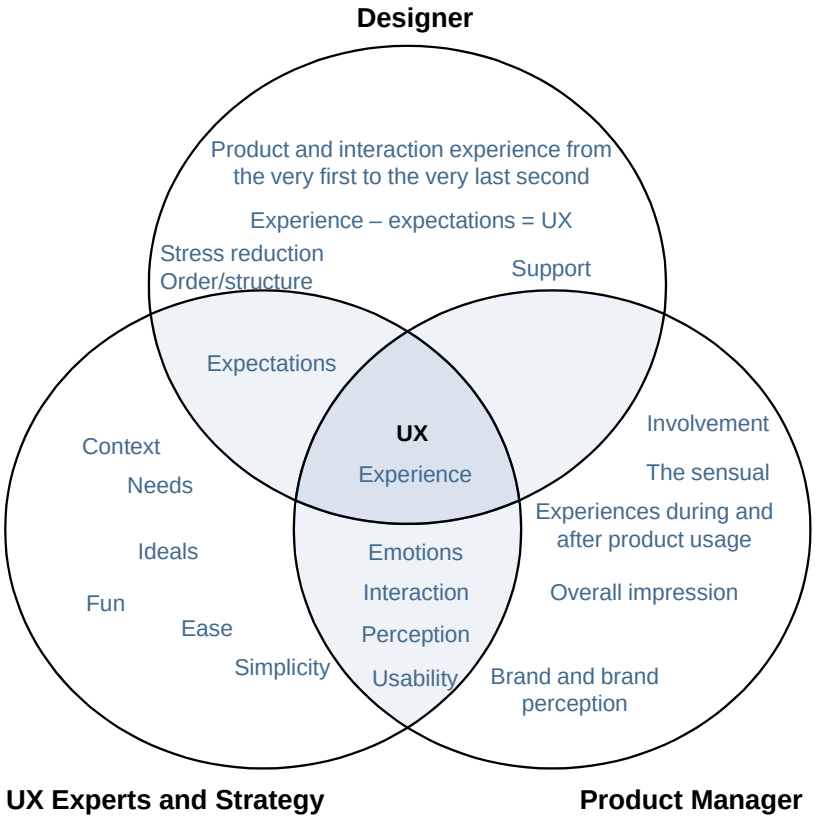

Figure A.1: Heterogenous Understandings of UX From Designers, Product Managers and UX Consultants

A.3.2 Challenges to Integrate UX into Product Development

Expressed challenges to integrate UX into product development touch various aspects of a corporate culture. They can be categorized into: organizational, humane, process-related and support challenges.

Overall organizational challenges are challenges concerning the integration of UX thinking into all aspects of a company's behaviour and decision making. Challenges may include communication aspects between departments, an overall user-centered product portfolio view, a missing UX vision as well as prioritization of UX in decision making and regulation of responsibilities.

Humane challenges relate to all responsible persons in product development to develop for UX. A main challenge here is the missing unified understanding and therefore communication of UX ideas and concepts. Participants stated that "UX has not yet arrived in the people's heads". Furthermore, a high fluctuation of responsible actors leads to loss of knowledge and experiences. Competition within departments and people as well as a missing mentality to "learn from mistakes and talk about it" make it difficult to develop for UX.

Process-related challenges include the applied software engineering process as well as resource allocation challenges. Main challenges are inactive and inflexible processes, no committed budget for UX and no time for UX – "being fast in the market vs. high-quality products". Furthermore, the lacking transfer of user evaluation results into product conceptualization as well as a chasm between conceptualizing and evaluating UX lead to unsatisfying product development results, according to the participants.

Support challenges derive from a perceived missing support to develop for UX. This includes support to have a unified understanding of UX within the company, assistance in conceptualizing UX to understand the user's perspective better in order to define mandatory functions and interaction algorithms as well as assistance in evaluating UX, such as meaningful measurements.

A.4 Conclusion

Semi-structured interviews with 18 practitioners who are responsible for products in the software industry helped to understand indications of challenges to integrate UX thinking into practical software engineering activities. The study has shown that main challenges are (1) a missing uniform understanding of UX, (2) a missing approach to include UX activities into the product development process as well as (3) missing support to develop UX centered products.

Furthermore, the interviews have shown that, for effective UX centered software engineering, the establishment of a UX culture within the company is the most important challenge and solution. According to the interviews, establishing a UX culture contains process-related, humane and support elements. Process-related elements subsume a defined UX process, a flexible/agile process, creative/open product development methods as well as obligatory UX evaluations. Humane elements subsume aspects of UX communication, an overall UX vision and experience exchange. Support elements subsume any assistance to focus on UX centered software development such as guidelines, a unified defined understanding of UX, UX criteria definitions, allocation of time and budget, meaningful measures, defined UX contact persons and best practice examples.

However, the present interviews were limited to practitioners within Deutsche Telekom AG Products & Innovation. A broader study with responsible actors in product development from different companies helps to reveal more substantial results.

Future research should focus on identifying a consensual understanding of user experience that is easily comprehensible within academics and industry as well as on developing easy-to-apply frameworks or guidelines that provide comprehensive knowledge about the user to successfully conceptualize the user experience.

B Study 2: The State of UX

B.1 Introduction

For the past few years, companies realize the raising importance of user-centered product development. With stronger market competitions, technological improvements, changing product usage behaviors and societal changes to an experience economy, companies aim to focus on a user experience centered product development. Within this transformation from a technology-driven product development to a user centered and now user experience centered product development, practitioners face challenges to engineer the user experience. In order to understand the current state of UX within the software industry, I conducted interviews within the time frame from March 2011 until August 2011. The study aims to understand user experience in practice within the software industry including practitioner's challenges and best practice examples to integrate UX into software engineering activities. Results aim to reveal indications to support UX centered software engineering by providing key aspects to consider in practice and advises for successful UX engineering. Indications to support UX centered software engineering aim to help developing a conceptual framework that is a basis to support responsible actors in product development. Such responsible actors are product managers, designers, software engineers and user researchers to engineer great user experiences.

B.1.1 State of Research

Responsible actors in product development at Deutsche Telekom AG stated earlier that challenges to develop for UX include (1) a missing uniform understanding of UX, (2) a missing approach to include UX activities into the product development process as well as (3) missing support to develop UX centered products[1]. Considering these results, this study builds upon the following assumptions:

1. No uniform understanding of UX in Software Engineering exists
2. No uniform approach to include UX activities into software development exists
3. No continuous UX Engineering process exists
4. Support is required to conceptualize and evaluate UX

[1] See results from the demand analysis in Appendix Chapter A.

B.1.2 Study Goals

Considering the earlier specified assumptions, main goal of the study is to understand the current state of user experience within practical software engineering that contains the integration of UX in current and earlier practical development projects as well as advises to develop for UX. Sub goals, therefore, are to research challenges and best practices in UX centered software engineering.

B.2 Study Method

As the study aims to understand a current state of UX, this research is mostly interested in patterns of interpretation and action that contain a collective liability derived from a process-related extract of reproduction and construction of a social reality[2]. For that reason, the *qualitative interview method* is mostly suitable. As I build upon a theoretical concept with hypotheses, I decided to conduct problem-centered semi-structured expert interviews according to Witzel[3]. Advantages of this approach is its openness, goal-oriented questions while assuring a relatively high flexibility, explication and the possibility to generate and prove hypotheses[4].

I conducted the interviews at the interviewees natural environment; with participants from UK, Italy, Sweden and Austria, via Skype video calls.

B.2.1 Interview Guideline

Building upon standard software engineering and design processes, I previously structured the interview guideline according to the three development steps conceptualization, implementation and evaluation. Pre-interviews have shown that implementation is mostly influenced by specifications coming from the conceptualization step. Evaluation focuses on assessing implemented product functions. For that reason, I extracted conceptualization and evaluation as most important process steps to be analyzed more in detail. Consequently, the interview guideline continues along the following structure frame with semi-structured questions:

1. Personal information that aim to help interpreting results by understanding the individual's background
2. Background Questions
3. Experiences and challenges in conceptualizing UX
4. Experiences and challenges in evaluating UX
5. Subjective advises to develop for UX

[2] [Lamnek, 1995, p.24–25].
[3] [Witzel, 1989].
[4] See a good summary in e.g. [Keuneke, 2005, p.255ff] based on theories by [Lamnek, 1995, p.75].

The detailed interview guideline in German and English language containing interview questions is available in section B.5.

B.2.2 Interview Process

The interview process starts with a short introduction into the research topic containing the goals and concerns of the interview. Introducing the interviewer (in all cases myself) and talking about the overall research topic helps to create a positive atmosphere that is beneficial for extensive responses and narrative interview passages. A standardized short-questionnaire regarding personal information helps to understand the interviewee's background better and to better respond to his or her statements. The interview begins with general probing, containing open questions that stimulate narration and follows with specific probing containing reflection of statements and questions of comprehension in order to receive more detailed answers. Furthermore, ad-hoc questions from the semi-structured interview guideline help to directly touch topics that have not yet been addressed by the interviewee.

B.2.3 Study Participants

In total, 29 experts from 20 small and medium-sized enterprises (such as KaufDA, Wahwah.fm, Yovisto, Cooliris and XING) as well as large enterprises (such as Software AG, Deutsche Telekom AG, BBC, Alcatel Lucent, Ericsson, Tom Tom, SAP AG) participated in the interviews. Participants were English- and German-speaking.

An expert is an individual who is responsible for designing, implementing or controlling a problem solution or who has privileged access to information or decision processes [5]. I interviewed individuals who are involved in decision processes related to product development within the software industry and who, therefore, have expert experiential knowledge. Two different type of expertise distinguishes within the expert group:

1. Product managers (n=22), decision makers regarding designing and controlling interactive products
2. UX experts (n=7), individuals with access and experiences to information regarding UX

Professional backgrounds range from computer scientists to designers and psychologists. 26 participants were male and 3 were female with a mean age of 33, ranging from 23 to 60.

B.2.4 Data Analysis

Data analysis followed the proposed transcription process by Meuser and Nagel[6]. The approach bases upon the philosophy that the transcription of the entire audio recording is not

[5] [Meuser and Nagel, 2010, p.443].
[6] [Meuser and Nagel, 2010, p.455].

necessary for most qualitative research projects and which is therefore not the normal case. I therefore transcribe audio files according to a pre-defined transcriptions rule-set. The rule-set intentionally leaves out transcription of passages that are not relevant for the research question.

Meuser and Nagel furthermore promote a process to (1) condense the interview material by paraphrasing interview passages, (2) to find titles for paraphrases and to (3) close with a topical comparison[7]. This data analysis approach leads to a summary of information according to the hypotheses and goals of the interviews.

B.3 Empirical Findings

The study was able to prove previous assumptions. *First*, no uniform understanding of UX in Software Engineering exists and *second*, as a result of a missing continuous UX engineering process, no uniform approaches exist to include UX activities in practical software engineering. Practitioners furthermore demand support to engineer user experience with a strong focus on conceptualizing UX. The following specifies empirical findings of the study by describing the current role of user experience in practice in section B.3.1, actual challenges in UX engineering in section B.3.2, advises to develop for UX in section B.3.3 and requirements for demanded support to engineer UX in section B.3.4. The chapter concludes with a summary of main findings and future work in section B.3.5.

B.3.1 The Role of User Experience in Practice

The role of UX in practice derives from answers regarding the understanding of UX, the relevance of UX as well as the actual process to conceptualize and evaluate UX.

The Understanding of UX

In general, UX is still described vaguely with a variety of different terms, perspectives and influences. Different terms and descriptions are used to describe a similar concept of user experience. The main differences appeared when confining influencing concepts such as usability, user experience and customer experience leading to unclear classifications of such concepts.

Similar to all concepts is an overall **philosophy** understanding of UX centered product development: to make people's life better by making them more engaged with the product and focusing on positive experiences.

The CTO of the internet start-up Cooliris summarizes the UX philosophy adequately:

[7] [Meuser and Nagel, 2010, p.456].

> *"We really try to build a product that makes people's lives better. We want to become a* ***natural extension of their daily life*** *rather than being a tool that they have to really think about when they use it. I think the best products end up becoming* ***second nature****."*[8]

Into their understanding of UX, practitioners include aspects of **usefulness, usability and attractiveness/joy** of an interaction with a product. A product manager stretches the importance of the product's usefulness and usability by stating

> *"There is a specific media usage need which is supposed to be fulfilled easy, fast and comfortable. Very important is the actual purpose, the* ***core use****."*[9]

Other participants add aesthetics to usefulness and usability:

> *"Two things: the functional and the aesthetic. The functionality is based on again what is the intend why I am coming in, what do I try to want to accomplish and what is the easiest way to get it done. And the second is the aesthetic, which is if it is a utility app, what is the quickest way and how can I have some fun in doing it."*[10].

and

> *"User Experience, da gibt es so zwei Dimensionen, das eine ist das emotionale, es muss Spaß machen, es muss zu mir passen, es muss attraktiv sein, es muss einladen, es muss spielerisch sein wenn es eher so Richtung emotional geht und das andere ist so der rationale Teil, es muss funktionieren, es muss effizient sein, es darf nicht abstürzen, es muss mich unterstützen und das zusammengenommen ergibt eine gute User Experience. Oft wird nur der rationale Teil betrachtet, da sind auch die ganzen Usability Richtlinien, und die beziehen sich sehr stark auf diesen rationalen Teil und spätestens mit den Smartphone kommt auch dieser emotionale Teil mehr zur Geltung. Das iPad ist ein gutes Beispiel."*[11].

A stronger focus on **life improvement** states the following:

> *"I think it is the experience a user has trying to apply an application to their life. So if you open an application, it's how do you feel, how do your expectations map on to the layout and design of the products and are you delighted or are you frustrated by your effort to use the product to enhance your life. When you think about user experience the first thing you think about are pixels, the way they look like on a screen. But then the very next thing is, how does it respond to you when*

[8] [027_Interview, p.4].
[9] [003_Interview, p.1].
[10] [028_Interview, p.1].
[11] [025_Interview, p.1].

> *you interact with it and that goes all the way from the application itself to the back end. And so the user experience is the performance and efficiency of the app, it's the visual design of the app; it's the interactivity of the app with its animations, its transitions and its information architecture, it's what the application actually accomplishes for you. Even through the side effect of sending a message to another person having them receive it, that's an indirect part of User Experience. So really the User Experience is the effect of a particular product on your life directly or indirectly."*[12].

Other product managers integrate all above aspects when defining UX, including the **right combination of content, functions and design**:

> *"User experience is the way the system makes me feel when I am using it and that is combining every aspect of it. Performance, usability, attractiveness and the content and amount of functionality"*[13].

and

> *"I think it's a right combination of having the right content, so the right features and the right movies and right channels. The users want to feel that they bought something special for the money, actually a fun filling graphic comes before a responsive UI, which is kind of strange, they want something kind of looking fancy. It can't be too slow but it is not so important."*[14].

Furthermore, product managers understand that their product must **create a particular experience**. For instance for photo browsing, a great UX is

> *"Delightful, engaging, immersive, visually rich. It maps on some people's special memory, it feels like it's a 3D space and people can intuitively understand they are moving through a space of pictures. It feels natural because instead of flipping between different modes you just zoom in and out of the content so you are in one space just moving around. And that is really natural for people."*[15].

For more task-oriented software, however, UX has a stronger focus on the usability – an effective, efficient and satisfying usage of a product:

> *"I think it's getting work done easier. Software is mostly used for getting this done. It can also be used for gaming but if you are looking at software, it is really business-side, Word, Excel. So the user has a lot of tasks to do and user experience for software design is making that task a little easier. A little more*

[12] [027_Interview, p.3–4].
[13] [024_Interview, p.1].
[14] [024_Interview, p.3.]
[15] [027_Interview, p.9.]

> *flexible. An optimal user experience is the nice feeling when you are done and you get a little smile on your face."*[16].

Other practitioners see UX as an even broader concept, they include the entire **customer experience** including marketing, sales and customer support into their understanding of UX. Customer experience is related to the product but does not necessarily require the actual interaction with it:

> *"Im Endeffekt kümmern wir uns darum dass der Nutzer ein besonderes Nutzungserlebnis auf der Webseite hat, da gehören ja unendlich viele Schichten dazu. Das fängt letztendlich vom Customer Support an, das ist letztendlich auch ein Benutzererlebnis, wenn ich mich irgendwie telefonisch an den XING Support wende und hört bei der Usability vom Registrierungsprozess auf. Unser Aufgabenbereich ist zwar schon das Produkt, eine positive UX bei einer Software ist ja noch was viel größeres. Es sind alle Berührungspunkte die der Nutzer jemals mit dem Produkt oder der Software haben kann. Jede Interaktion beeinflusst die User Experience."*[17].

Table B.1 shows a collection of user experience key terms categorized by the two product quality foci usability and attractiveness. In summary, different foci of UX provide different

Focus	UX Core Terms
Usability	Seamless, Consistent, Stable, Functional, High-performance, Self-explanatory, Thought-through, Logical, Effective, Works as expected, Competent, Usable, Easy/simple, Intuitive, Understandable, Repeatable, Useful - it fulfills a goal, Smooth, Fast, Available (online and offline), Powerful, Findability of content.
Attractiveness	Fun, Fascinating, Cool, Harmonic, Emotional, Inspiring, Informative, Exciting, Identification, Pride, Aesthetic, Stimulating, Surprising, Socially integrating, Tasteful, Inspiring, Innovative, Sexy, Familiar, Trustworthy, Realistic, Holistic, Varied (variety of content), Natural, Immersive, Friendly.

Table B.1: UX Key Terms Derived from Expert Interviews in Industry

point of views of the concept, which still remains ambiguous. Into their understanding of UX, practitioners include aspects of usefulness, usability and attractiveness/joy of an interaction with a product as well as the product's ability to improve people's lives. Some product managers state that a great experience can be achieved by a good combination of **content, functions and design**.

Different foci of UX definitions mainly separate in either **usability** (aspects such as functionality and performance) and **attractiveness** (aspects such as aesthetics, pleasure, joy) or

[16] [029_Interview, p.1].
[17] [012_Interview, p.1].

they include both. The differentiation of these product quality foci derives from the type of product interviewees' were responsible for, as some products aim to fulfill user needs in a task-oriented environment and some products aim to fulfill user needs in a stimulation-oriented environment.

The Relevance of UX in Software Engineering

All interviewed practitioners share the opinion that user experience is important within practical software engineering. The focus of UX is seen as the differentiating factor that sells the product:

> *"In a market where products are pretty similar, UX can be the USP of the product"*[18].

With a stronger product perspective, the following quote from a UX expert at the Ericsson UX research lab in Stockholm demonstrates the relevance of UX with a descriptive example:

> *"One of my last studies I did was called 'the devices that suit you'. Devices like the smart phone, devices like the iPad, devices like the desktop computer, the netbook, all kind of different mobile devices and how those integrate into your life and how you use them and how they compete to each other. And what we found was iPhone and Android users, those who used app-based smart phones, we compared the usage of those persons to other smart phone users in sort of timing, let's say, previous types of smart phones didn't have apps, they more or less have the same thing that the iPhone and the Android does today, but a lot of people weren't using the internet to the same extend. And that's one way to say how important it is. Because the phone had all those capabilities, even five years back, internet, mailing etc. But not that many people were using it. Why not, it was too slow, it wasn't instant, but now when apps came it was super simple and really instant, people used them. How long did it take to log into facebook using the app? 4 seconds! Then you're there! If you are not using the app, if you are using the internet browsing on the phone to log in to facebook, that is a different type of story. Only this fact,* ***making the service more user friendly or giving it a better user experience****, so the difference between the old smart phones and the new app phone,* ***that made a whole lot of difference. People are even using twenty times as much as they used before the apps.*** *That is one typical example on how important it is to have a good user experience. It's everything. Especially, when it comes to TV. Why do we watch TV? We don't watch TV because of the technology, we watch TV because we want the experience.*

[18] [025_Interview, p.1].

> *And everything that interrupts that experience destroys the TV experience, so it has to be good user experience."*[19]

The same UX expert furthermore adds an example within the mobile TV sector why User Experience thinking is important **before launching a product**:

> *"Firstly, when that was designed and it got launched, I would say, it wasn't that good of a user experience, the quality was soso, there was a lot of interruption, long loading time, and the concept was pretty dull and not so good as well to mobile phone TV. But everyone, the operators, ah it's a tested service, its perfect, its super great. And then the early adopters started using it and they discovered that this is crab. So they stopped using it and we got a lot of feedback that this is not good enough. So then we took it back and redesigned it and then took it back to the market for a second time and we said now, seriously, the service is really really good and people would say, ah you actually managed to fool me once but you will not manage to fool me twice. That's also a typical example. So it says, when the service is not good enough you shouldn't launch it, because you destroy the market by launching a bad service. And what happened, when we actually improved the service, I wouldn't say it's really really good now, then when we tried to launch it again they said well, no we don't force it a second time. And this also shows how important it is to include the consumers in stage one."*[20].

A great UX of an innovative product can even **limit the importance of usability problems**:

> *"Apple ist natürlich das Paradebeispiel. Die haben das so gut gestaltet, die haben so sexy Features drin, dass sie Bedienschwächen von dem Ding überdecken. Es gibt bei den Geräten durchaus Bedienschwächen, die werden alle nicht wahrgenommen weil das Ding einfach sexy aussieht und den Leut Spaß macht. Bei einem anderen Produkt hätten sie längst auf diese Bedienschwächen eingedroschen. Also wenn einer wirklich was will und es mag, dann guckt er über die Mängel hinweg. Das macht man bei Apple ganz oft. Man muss sich mal überlegen, dass das erste iPhone keine Copy-Paste-Funktion hatte. Das ist ein dramatischer Fehler. Trotzdem haben die Leute es alle klasse gefunden. Man hat gesagt, es kann das halt nicht aber trotzdem hat sich's verkauft wie Brot obwohl eklatante Fehler waren. Das ist ein eklatanter Fehler, was sie auch in der nächsten Version gleich korrigiert haben. Aber das ist ein richtiger strategischer Fehler eigentlich. Das Ding war flach, hat einen hochauflösenden Bildschirm gehabt, eine geniale User Experience gehabt mit dieser Touchoberfläche, mit dem Schieben, hat alles überdeckt."*[21].

[19] [026_Interview, p.2.]
[20] [026_Interview, p.5.]
[21] [005_Interview, p.5].

UX Evaluations are necessary as they provide the mandatory insights. After a very first user evaluation, BBC's CTO responsible for the iPlayer recognized the **importance of UX evaluations** with the following experience:

> *"And initially, it was a disaster, they couldn't use the product at all. The developers were sitting around and the developers were shocked because all the things they thought were easy and intuitive were difficult. And they initially were going "ah, this is only this person" and then I brought a second person who had the same problem. So and then, I said "hey guys, here is what we gonna do. Every week we gonna pick the top five things that are really difficult and gonna make them easier." And some of the things were expected by me, and some of them were very technical, like the video quality was problematic or something. But sometimes they were unexpected, so there was a chat show and my assistant, she eventually managed to find the chat show and then she said, she is not gonna download it. And I was like "Why, you were so successful, you found it!" And she said, "Ya, but it didn't say what the guest was, I am not gonna waste my time if I don't know what the guest was." And I would never have guessed that but it's only then the mandatory things. So slowly, every week I said to pick the top three or five major issues and once I've done that six times, actually the product, it wasn't as terrible and then we launched it."*[22].

Summarizing these experiences, UX thinking within software engineering is important as UX is a success factor in order to:

- Sell the product
- Make people use the product more frequently
- Build a quality image for anticipated experience
- Limit the perceived importance of usability problems
- Provide important insights from users in order to understand mandatory functions from a user point of view

The Process of UX-Centered Software Engineering

Overall, participants work within agile software development environments and often promote the agile product management method Scrum. At Cooliris, an ideal process is described as follows:

> *"You get in a room, you think about how it should be, you do really quick mock ups in terms of features and the look and feel. And then the engineer goes and develops it. Hopefully a day later or even on the same day, you have that quick feature that you want to try and see what it looks like and you will be able to say,*

[22] [016_interview, p.5].

> *you know what, that is a light correction to go in, lets now give it to design and think about how to get the flow optimized and then give it back to engineering, or you know what, that does not make sense, let's go back to reengineering and thinking about what the product is actually be like."* [23].

Considering all interviews as well as existing software engineering processes, the overall process structures into:

- Vision phase
- Definition phase
- Specification phase
- Implementation phase
- Evaluation phase

Considering the earlier classification of conceptualizing and evaluation UX, we further look into the vision, definition and specification of UX (summarized under conceptualizing) and evaluation of UX. Table B.2 shows a structure of relevant phases for UX engineering that build a frame for subsequent UX principles derived from advises and experiences of the interviewed practitioners. The linear appearing structure is a circular process within agile software development.

Conceptualizing UX			Evaluating UX
Envision	Define	Specify	Evaluate

Table B.2: Structure of Relevant Phases in UX Engineering

Depending on the size of the company and the size of the product to be delivered, user experience evaluations are either done pre-launch or post-launch. Specifically, medium to large sized enterprises understand the necessity to get user feedback early in product development. Interestingly, small companies such as start-ups currently focus on user feedback after launch. This may be a result of fearing time-consuming and expensive UX evaluations that start-ups cannot afford yet. An example presents the following:

> *"So we try to understand, we launched this feature and this is what we thought it would do, the expected impact was to boost retention by n percent, there wasn't an expected impact at all or that is not what really happened, so how do we go back and retune that. And we do a bunch of testing for words using Mechanical Turk from Amazon, which is an automated program. Mechanical Turk allows you to say, I want a thousand users to test out this concept and tell me the results."* [24].

[23] [028_Interview, p.1].
[24] [028_Interview, p.4].

The post-launch evaluation – a recognized not desirable – approach may work in small companies within the communication/entertainment industry as they can iterate fast in refining the product and quickly release new features. A medium sized or large enterprise however, with more responsibility (often for the product and the employees) and more effort in refining a product, integrates pre-launch evaluations.

Specifically large enterprises such as Ericsson (Ericsson consumer lab) or Deutsche Telekom AG (T-Labs) aim to research future trends and consumer behavior as a starting point to create visionary goals that are user experience centered. For instance, Ericsson's Consumer Lab combines three different ingredients to research the consumer knowledge[25] : a fundamental module, the intercom module and qualitative interviews. Within the *fundamental module*, the quantity is data based coming from once a year carried out online interviews. Results tell Ericsson basic and general behavior and basic concerns, what opinions, values and attitudes people have. The *intercom module* is as well of quantitative character reaching 6000 users from 40 countries each year. This module focuses on technology behavior, e.g. how many users have mobile broadband, connected home habits or computer habits. These two modules provide statistics. However, as Ericsson realizes: *"We do know how it looks but we don't understand why it looks in a specific way. That's the downside of quantitative. In order to understand why it looks like this we also do a lot of qualitative interviews that can be at-home interviews, focus groups. And that's to understand why do people behave in a specific way."* For that reason, the consumer labs at Ericsson add a qualitative module to the two quantitative ones. *"Combining the what with the why gives us a pretty good idea of where it is heading and that tells us data about the future. So we can find out, that this is probably a path what this service or what people may request in the future. It's some sort of prediction. And we try to use different ways at the user experience lab to provide some early insight into projects."* This knowledge allows Ericsson to add the user perspective before product development providing the starting point for UX centered software engineering.

B.3.2 Challenges in Engineering the UX

The overall challenge in practical UX engineering is the question of *how to align user goals with business goals* while still developing a comprehensible product.

Within this overall challenge, practitioners face four main challenges according to the current role of UX in practice:

1. Understanding user experience
2. Conceptualizing the user experience
3. Communicating the user experience within the organization and

[25] [026_Interview, p.3].

4. Evaluating the user experience

Communicating UX is a challenge that builds upon a company-wide unified understanding of UX and affects both conceptualizing and evaluating UX. For that reason, appropriate communication challenges subsume under conceptualizing and evaluating UX. Other communication challenges, such as the general internal communication between departments or the communication of requirement definitions, address cultural and organizational aspects. Considering the scope of this study, I will not specify the latter communication challenges closer.

Additionally, resource allocations of time, budget and people play an important role that challenge UX centered software engineering. I will not look at resource aspects further as they, as well, need to be integrated into the organization's culture and strategic management decisions. These aspects are not focus of this study.

A Unified Understanding of UX

One main challenge in effective UX centered development is a unified understanding of UX. A unified understanding helps to create a common and deep understanding of UX visions and ideas throughout the engineering process. A company, therefore, has to define which components contribute to its own desired user experience and to communicate this clearly in the company's product philosophy. An own clear definition of UX is necessary to limit communication problems that lead to conceptualization and implementation errors.
Main challenges in understanding UX include:

- **Understanding relevant criteria that constitutes UX:** It was partly unclear, which criteria constitute the UX and need to be assessed within user evaluations. Furthermore, unclarities appeared when not understanding the broadness of the UX concept. Understanding differences and interrelations of the concept of usability and the concept of customer experience with the concept of user experience complicate all aspects of UX engineering.
- **Prioritization of relevant UX aspects:** It is a challenge to understand whether the future product has to focus on either the usability or the attractiveness aspect or both.

Conceptualizing the UX

- **Defining the *core use* – the usefulness of the product:** The challenge to define the usefulness of a product includes an early understanding of user requirements and trends in order to develop an innovative product that meets the market at the right time. Specifically, the recognition that current market research does not help to understand underlying user requirements, make it difficult for practitioners to anticipate the

UX. One interviewee stated: *"The point of view of a radical innovation must not be represented by product management who are asking with market research what is wished. My assumption is that people don't know what they want."*[26]. For that reason, it is often not clear how to define the core use, understanding and defining core functions and core scenarios of the product to anticipate the user's experience with the product. Another critical point stated by an interviewee here is to understand who will use the device and what needs this person has[27].

- **Specifying core functions:** The main challenge in specifying core functions is finding the compromise between order/structure and complexity by matching technology with design and knowledge about the user's requirements[28].

Evaluating the UX

- **Finding the right analytics/metrics**
- **Feeding evaluation results back into the development cycle for sustainable UX engineering**
- **Starting evaluations early enough in product development**

B.3.3 Advises to Develop for UX

Summarizing the experiential knowledge from these 29 interviews with practitioners in the field of UX-centered software engineering, this section provides advices to develop for UX. They aim to provide indications and directions to engineer UX.

Advises classify into the following areas:

- Overall process-oriented
- Overall behavioral
- Organizational
- Communication
- Conceptualizing UX
- Evaluating UX

[26] Translated from the German original: "Die Sichtweise einer radikalen Innovation darf man nicht vom Produktmanagement vertreten, die sozusagen mit Mafos und alles abfragen, was so alles gewünscht ist. Auch meine These ist, viele Leute wissen gar nicht was sie wollen." [001_Interview, p.2].

[27] [005_Interview, p.3].

[28] Original quote: "Der gelungene Kompromiss zwischen Ordnung und Komplexität, weil meistens die Betreiber und Techniker wollen viel mehr Funktionen gleichzeitig sichtbar haben und machbar machen und als Usability Experte muss man immer mahnen und sagen, langsam, mit Maß vorgehen, was braucht er wirklich. Das ist die eigentliche Herausforderung. Denn heute können alle Geräte wahnsinnig viel und es geht darum das auf das notwendige Maß herunterzustressen und da einen gelungen Kompromiss zu finden - nichts wichtiges weglassen aber auch keine überflüssigen Dinge auf die Oberfläche machen oder Dinge auf die Oberfläche packen, die man selten braucht und da den guten Kompromiss zu finden, das ist die Herausforderung. Das ist immer ein Priorisierungsthema. Also dass man überlegt, was ist wie wichtig, wie oft wird es gebraucht und wie tun wir es hin. Das ist ein wichtiger Prozess." [005_Interview, p.3].

To stay within the limit of the research goal, the following advises focus on conceptualizing and evaluating UX that furthermore contain advises for communicating UX. Advises form principles from experiential knowledge to develop for UX. Quotes substantiate the principle with experiences from product managers and UX experts.

Conceptualizing the UX

Define a visionary goal Define a long-term vision including a time-frame that explains why the product is supporting people in the future. Defining this visionary goal helps to communicate the product conceptual idea and provides the starting point for building a roadmap for product development. This guideline bases upon the following quotes:

> *"If it means inventing a floating car, let's think about that ideally and then let's think about the reality and the situation, and you know what, a floating car does not exist today, so that is what we can do for today. And the same thing applies to technology"*[29].

> *"There is always a conflict in planning discussions between short term and long term. Discussing the vision and kind of describing what will the product be like eventually. Like what is our ultimate goal, what would be the best product we can possibly build assuming time and resources weren't an issue and then mapping that down to what can we do in the next time box. You don't want to go too far with the vision definition because it won't really be used. You have to strip it down significantly and that's kind of disheartening. So figuring out what the right horizon line is to define here is kind of a clear picture of what the product will be like within a reasonable time frame. And then we can come up with features meeting up to that point. So figuring out where is the focal point for the vision, like how far out do you think and then making sure that the discussion context is clear."*[30].

> *"You just have to remember why your software exists and why people want to use it. It can be entertainment, utility, activity, communication. Whatever it is, it is there to help people accomplish something. And the other one technology is too complex for people to process. They don't want to deal with that. The purpose of software is to simplify it because life is complicated enough. I think like, absolutely essential. The best software has great user experience. It's clear, even for enterprise. Because the more that you can offload from your mind to the software, the more productive you can be personal."*[31].

[29] [028_Interview, p.3].
[30] [027_Interview, p.6].
[31] [027_Interview, p.3-4].

> *"Because misunderstanding commonly arises from thinking of different time horizons in terms of what the product is going to be."*[32].

Decide on a UX strategy Based on the understanding of the market place and human needs, decide on a UX strategy that is either market-driven or market-driving[33]. A market-driven strategy (or *demand-pull*[34]) orientates on existing products in the market. Typical tasks refer to learning, understanding, and responding to stakeholder perceptions and behaviors within a given market structure. A market-driving (or *technology-push*) strategy on the other hand aims at waking latent existing human needs and is characterized by changing the composition and/or roles, and/or the behaviors of players in the market[35]. Typical tasks include the proactive change of user needs by identifying latent needs and behaviour and/or a market structure[36].

> *"For a new product it is a lot about understanding what the current products are in the market place, what needs they satisfy, then either have a red sky strategy – or red ocean, which means I am going to go in there and beat them in what they do and be better than them. Or there is a blue ocean strategy, in which you do something unique that is separate from anything else that others are doing. But either way you really focus on user needs and try to think about what is the best way to do that today and how can I do this better?"*[37].

Have clear criteria for greatness or great experience Define clearly what makes a good user experience in order to check throughout product development if these criteria are met. UX criteria furthermore provide metrics for UX evaluations.

> *"It must be clear what are the criteria and why did I decide to do it this way"*[38].

> *"Clean and simple navigation, not too crowded pages, leave the user in charge what he or she sees"*[39].

Understand user's personal goals Understanding user's personal goals helps to fulfill underlying needs and therefore to create demand in market. It furthermore helps to define use cases and to prioritize functions as the user's goals provide the indication whether a product is useful.

[32] [027_Interview, p.6].
[33] [Jaworski et al., 2000].
[34] [Specht et al., 2002, p.32].
[35] [Specht et al., 2002, p.32].
[36] [Jaworski et al., 2000] and [Carrillat et al., 2004].
[37] [028_Interview, p.1].
[38] [013_Interview, p.2].
[39] [029_Interview, p.2].

> *"Try to emphasize the best you can with the people you are building that product for. The product isn't just for you, it's for your target market. So, once you personally understand why the product is going to change the world, figure out how you can change the world for as many people as possible. So that's the part when you have to think about other people."*[40].

Allure the user Guide the user and provide a way to navigate through the product. This builds upon the theory that people often not clearly know what they want. To reach the (often underlying) goal of the user, the product should allure the person to reach that goal - to fulfill his or her needs. Guiding the user helps her or him to navigate through the product with the least effort.

> *"Always think of 'Where is the banana'. Imagine that you are a scientist and you are experimenting on the monkeys. And the monkeys could push the new green light - when to come on, they have to push the green button. And when they do it right, they get a banana. And the side effect is that you think the monkey is really clever, it is analyzing the situation. But from the monkeys perspective it is just about what is the least amount of effort I need to go through, to get to a banana. I am not saying that users are monkeys. But when a user gets to a website, the user is going to be thinking what is the least effort I need to go through to get a reward. And if you give them hundreds of items to go through, they are going to get seriously unhappy. And therefore, what you need to do is, if they don't know what they want to do, to have a single thing that jumps out of the page and they just go out for that."*[41].

> *"Allure users through your product world, don't push them, just allure them"*[42].

Reduce options Reducing options for users to interact with the product helps to make the product more understandable and usable. It can help to assure a minimal entry threshold. Saying this, goal of reducing options is to minimize complexity by offering fewer functions.

> *"If you ask people they always want more choice, but if you give them more than about three choices, the level on unhappiness increases. They are overloaded and its more mental work to find something."*[43].

> *"Simplicity - for me a product is good when you cannot miss it anymore, so you only have what you need"*[44].

[40] [027_Interview, p.11].
[41] [016_Interview, p.3].
[42] [018_Interview, p.3].
[43] [016_Interview, p.3].
[44] [019_Interview, p.6].

"We have a desktop software and we have an online software. And the type you gonna get depends on the device that you have. If you have an old device you have to download the desktop version, if you have a new device you need to have the online environment. And it was always really hard to communicate, so with this device so I need to download this and this thing. And what I did was group it all together in one list, because we were really focusing towards the online environment - "join now, get this and this and this, if you have these devices, download this now." And there was this really small sentence. So what I did was first force the user to select the device and you can do this by looking up in a list, or typing in the first characters of a serial number, and once you have done that, we have shown him all the information he needs. So no longer he has the feeling to be less appreciated as he no longer sees the features he can't get and now he could see all the advantages he can get. I think that was a nice improvement, and its really small but UX is in the small things."[45].

Evaluating the UX

Work data driven from the beginning on Start early with knowledge about the user in order to understand user trends, stay up-to date with things in order to be truly user-centered. Early user experience research guide the developing process from the beginning on. Late evaluations only limit options to improve the product that aims to be user experience centered[46].

"We try to do it as early as possible, we try to start out at a concept level. If you have some idea of some service or a function within the service, you can take this idea and get feedback from users. If you have a sketchy type of description of the concept you can start an discussion with focus groups to get an idea if this is the right way to go or not. At this time of work you are mostly targeting the utility of the concept, is it basically something that will be used, is it something they ask for. Later on in the process, when we decide this is something we should do then how should we define the user experience, and how is the interaction design to be done and in this case you can add different types of user relations from user experience specialist who evaluate the user interface or the concept or you can bring the end user from the target segment you are creating the product for and let them perform traditional evaluation of the product. And we do all of them. (...) Results directly go into the implementation work. But there has to be an assessment about the impact of different things and if you are late in the process and

[45] [029_Interview, p.2].
[46] [019_Interview, p.6].

> *then it can be difficult to make some kind of changes. Most of the time the results from the evaluations is pin-pointed to different types of areas where improvement is needed."*[47].
>
> *"If you want to make the worst product look as nice as possible, no one will use it, if it's not useful"*[48].
>
> *"More usability-testing, understanding of market, the earlier that data comes in the more often it comes in the better for us to plan our features"*[49].

Combine qualitative with quantitative data Use qualitative and quantitative data collection methods to evaluate UX. Qualitative evaluations help to understand underlying user information, whereas quantitative evaluations help to understand the representativeness of results. Qualitative methods furthermore provide deep insights for new product ideas.

> *"Combining the what with the why gives us a pretty good idea of where it is heading and that tells us data about the future. So we can find out, that this is probably a path what this service or what people may request in the future. It's some sort of prediction. And we try to use different ways at the user experience lab to provide some early insight into projects."*[50].

Evaluate as often as possible To support decision processes throughout the entire development process and to assure the user experience centered view, validate ideas and solutions with (possibly) future users as often as possible. This means during ideation, definition and specification of the software as well as after launch to improve as much and early as possible. Numerous evaluations with constant metrics furthermore provide a profile of the user experience over time.

> *"Wir machen hier auch einmal die Woche User Lab im Haus, wir haben einen Testingday eingeführt. Jeden Donnerstag sind hier Nutzer da. Weil wir auch agil entwickeln, damit wir den Leuten ein niederschwelliges Angebot bieten können, auf das sie zugreifen können. Weil man beim Testen oftmals das Problem hat, dass es zwei bis drei Wochen in der Planung dauert und dann nochmal zwei Wochen in der Auswertung. Und bis dann das Researchprojekt abgeschlossen ist, ist die Software schon längst fertig entwickelt oder umgesetzt und life-gestellt. Das ist ein sehr frustrierendes Erlebnis, weil man da schon nichts mehr machen kann. Und deswegen machen wir hier einmal pro Woche einen Testing-Tag, dass man auch so den Produktmanagern und Interaktionsdesigners es möglichst einfach macht, ihre Ideen und*

[47] [023_Interview, p.2].
[48] [026_Interview, p.3].
[49] [027_Interview, p.7].
[50] [026_Interview, p.3].

> *Konzepte mit dem Nutzer zu besprechen. Wir machen das mittlerweile sogar so, dass die Produktmanager oder die Interaktionsdesigner mit in den Tip-Raum hereinkommen und dass das nicht länger nur beobachtet wird, sondern dass die dann auch mit dabei sitzen und dann direkt während des Tests Fragen stellen. Das ist schon sehr kollaborativ, wie das hier abläuft."*[51].

Don't listen to everything the user says Weigh carefully the importance of a user statement and try to understand the meaning of what the person is saying. Often people express a desire or a solution to an underlying problem. But the expert often has a better solution. So rather try to understand the problem and then come up with a solution the person has never thought of.

> *"Market research always relates to the past and people don't know what they want."*[52].

Start in-house and then go out Start with people who work in the company then move on to friends and family and then move to customers. This approach helps to quickly gather feedback regarding basic user experience issues. It limits required resources of time and costs while remaining to research sufficient user information with early ideas or prototypes.

> *"What I would do is instead of going for very expensive user experience testing which would take weeks and cost thousands of Pounds or Euros, I would find a big meeting room, switch off the light and put a big projector TV and then would wander around the building and would find somebody non-technical like from our legal department and would say "hello, you're our star today! What's your name? Michelle, excellent, would you come join us? I will give you some chocolates!" And then I would sit them down and say, tell me you favorite program and now please find and play your favorite program"*[53].

> *"We always knew what functionalities were important, functionalities had to be there when wanted. But as we took the product into trials in front of the consumer we found that there were functionalities that were more important and functionalities we thought were important were not so important. That changed the focus and we learned a lot."*[54].

Observe people interacting with your product Observe users while they interact with or talk about your product as this knowledge will help to understand user problems with the background of your expert knowledge. It makes the voice of the consumer concrete.

[51] [012_Interview, p.2].
[52] [009_Interview, p.3].
[53] [016_Interview, p.4-5].
[54] [014_Interview, p.2].

> *"Participate in the interviews, listen to the interviews, watch the interviews because I can stand and show what people think and say how important user experience is, but when they are standing there and they design the service and they see one of the potential consumers standing there talking to a moderator or an interviewer and saying, this is important to me and I would never buy this service because if this and this and this or this is really good because of this and this and this. Then they see and say, oops, this matters, the consumer's voice all of the sudden is very concrete."*[55].

B.3.4 Requirements to Support UX Engineering

Considering explicit and implicit statements from practitioners, the following requirements are most important to effectively support responsible actors within UX centered software engineering besides general demands for applicability and understandability:

- **Contains clear UX criteria:** Clear criteria provide a compass about what consitutes positive experiences for people who use the product. They can provide a basis for decisions at every stage of the product development cycle in order to prioritize functions with a focus on user experience. One interviewee explicitly stated *"It must be clear what are the criteria and why did I decide to do it this way"*[56].
- **Contains analytics that intertwine conceptualization and evaluation:** Although this requirement closely relates to the previous one, it further stretches the importance of clear evaluation criteria. Results of user evaluations should be able to directly flow back into conceptualizing the UX. The following quote substantiates this requirement by stating: *"I want to be able to say, here is my independent variable, here is my dependent variable and see data from real users instantly and make decisions based on that. That would be fantastic."*[57] .
- **Focuses on early development:** Most effective support provides insights already in early development as decisions in early development phases define UX with the highest impact and freedom of action. *"More usability-testing, understanding of market, the earlier that data comes in the more often it comes in the better for us to plan our features"*[58].

B.3.5 Summary of Results

Study results show that main challenges to develop for UX are a unified understanding of UX within the company, conceptualizing UX and evaluating UX. Results display different

[55] [026_Interview, p.6].
[56] [013_Interview, p.2].
[57] [027_Interview, p.7].
[58] [027_Interview, p.7].

understandings of UX including a summary of UX key terms derived from participant's experiential knowledge.

Previous experiences and advises to develop for UX helped to form principles for UX in practice. A summary of empirical findings combining both challenges and principles to develop for UX shows Table B.3. The principles can already serve as a basis to provide indications for

	Conceptualizing UX			**Evaluating UX**
	Envision	Define	Specify	Evaluate
Challenges	Understanding relevant UX criteria.	Prioritization of UX criteria. Defining the core use of the product.	Specifying core functions.	Finding the right criteria. Feeding evaluation results back into the development cycle for sustainable UX engineering. Evaluations start too late product development.
Guidelines	Define a visionary UX goal. Decide on a UX strategy.	Have clear criteria for greatness or great experience. Understand user's personal goals	Allure the user. Reduce options.	Work data driven from the beginning on. Combine qualitative with quantitative data. Evaluate as often as possible. Don't listen to everything the user says. Start with in-house evaluations and then go out. Observe people interacting with your product.

Table B.3: Summary of Challenges and Guidelines to Develop for UX

UX centered software engineering. They therefore can build an appropriate frame to classify required support to develop for UX.

Reported challenges in this study help to derive requirements to support practitioners in practical UX centered software engineering. Effective support UX-centered software engineering should meet the following requirements:

- Contains clear UX criteria
- Contains analytics that intertwine conceptualization and evaluation
- Focuses on early development

B.4 Summary and Conclusions

29 semi-standardized expert interviews with responsible actors in product development aimed at understanding the current state of UX within the software industry in order to derive requirements for effective support to engineer UX. Therefore, the study reveals experiences regarding the role of UX in practical software engineering including challenges and advises to develop for UX. Results show that the concept of UX is understood differently throughout various domains and individuals. Conceptualizing and evaluating UX are the most challenging activities within user centered product development. Consequently, the interviews have shown that support is specifically required to understand the concept of UX and for applying it during conceptualization and evaluation to create specific user experiences.

Considering this, empirical findings not only serve as a snapshot of the current state of UX, they furthermore provide indications with requirements from practice to effectively support UX centered software engineering.

Future work for that reason includes the development of an applicable and understandable framework that contains clear UX criteria which better connect UX conceptualization and UX evaluation. An important aspect is to focus on early product development.

B.5 Study Material

1. **Personal data (socio demographics)**
2. **Background – Probe questions**
    1. How do you define user experience in software development? Do you have an example?
    2. How relevant is user experience in software development to you?

3. **UX Conceptualization**
    3. If you think of your projects, how do you typically plan user experience? What information do you receive to develop for UX?
    4. How do you operationalize visionary UX goals?
    5. How do UX product requirements look like? Please name some examples.
    6. What do you find most important in order to consider UX in product planning?
    7. From your experience, what are the biggest challenges to plan for UX?
    8. What kind of support would you need that helps you to make UX planning easier?

4. **UX Evaluation**
    9. When in product planning and –development do you evaluate UX?
    10. On what basis (prototype/information) do you evaluate UX?
    11. How do you typically conduct UX Evaluation? Please describe one or more typical UX tests.
    12. From your experience, what are the biggest challenges to plan, conduct and analyze good and goal-oriented UX evaluations?
    13. What kind of support would be helpful to you to evaluate UX better?
    14. How do you use results from the test?
    15. How do you document results from the test so they will be used in product planning and evaluation?

5. **Examples**
    16. How do you describe in words a positive UX of your product? What are core terms?
    17. Did you already have positive experiences with one/some of your projects that elicited a positive UX? What was positive?
    18. Did you already have negative experiences with one/some of your projects that elicited a positive UX? What was negative?

6. **End**
    19. What are your three tips to develop for positive UX?

Figure B.1: Interview Guideline for Expert Interviews in English Language

C Study 3: Framework Evaluation Study Cooliris

C.1 Introduction

This study is a preliminary study to extract requirements for user experience based on psychological needs. Building upon the existing UX framework from Schulze and Krömker[1], I applied a structured approach to research user expectations regarding mobile social media applications. A hands-on user study with the mobile sharing service LiveShare helped to understand applicability and impact of the approach in practical software development environment. The study serves as a pre-study to understand the relation between psychological needs and product qualities. Moreover, it serves as a first step to substantiate the existing UX framework. Results were present at Mobile HCI 2012[2].

C.1.1 Related Research - User Experience in Mobile Social Media

As pointed out by Multisilta and Milrad, "Social media is a combination of people, technologies, new rich digital content and practices that enables users to share their experiences with other users, thus building a shared meaning among communities. In fact, experiences are mediated by technologies as a form of content; i.e. the real world experience is reflected as a blog note, a set of images or video clips. Mobility adds the freedom of time and place"[3]. Mobile social media is used as a main platform to both capture and share life experiences and memories[4]. Various research has been done in the area of sharing life memories[5]. However, as the mobile internet is evolving (see current developments in 4G or Long Term Evolution) and mobile services aim to feel more natural for users, sharing life experiences instantly is

[1] [Schulze and Krömker, 2010].
[2] [Schulze and Krömker, 2012].
[3] [Milrad and Multisilta, 2009, p.2].
[4] [Olsson et al., 2008, p.274].
[5] [Olsson et al., 2008, p.276].

one of the main developments in mobile social media. To create natural, engaging and immersive services for sharing experiences instantly, it is important to understand expectations and underlying needs of people to share their life moments with a sharing service.

C.1.2 Effort and Time Period

The field phase of this study was from July 27th 2011 until September 12th 2011 in California, USA. Test venues were the Cooliris headquarter in Palo Alto and the University of California in Berkeley.

C.1.3 Approach

To understand how psychological needs help to design product qualities that elicit positive user experiences in the field of mobile social media, I followed a three-step approach: In a **first step**, I specified psychological needs for the context of mobile social media based on literature research[6] and within an expert group. Experts were two product managers at Cooliris specifically experienced in mobile social media. I finalized the specification within three iterations containing five individual user interviews as well as expert evaluations from product managers. The final specification is displayed in Table C.1. Specified needs and standardized product qualities built the basis for a UX questionnaire that has been developed in a **second step** to collect qualitative and quantitative data. In a **third step** I collected user data regarding need expectation and actual need fulfillment by means of a mobile social media service. The approach aimed to understand the importance and existence of specified needs and underlying needs in order to extract product requirements.

C.1.4 Study Goals

Goal of the study was to investigate the importance and existence of psychological needs regarding mobile social media. Sub goals were to evaluate perceived product qualities of the test object and to derive general design guidelines as well as clear recommendations for optimization.

C.2 Study Method

C.2.1 Test Subject

Test subject was Cooliris' group photo sharing app LiveShare version 1.2.6 as displayed in figure C.1. LiveShare is a mobile social media application used to instantly share photos in public and private streams.

[6] [Goh et al., 2009], [Milrad and Multisilta, 2009], [Olsson et al., 2008], [Sheldon et al., 2001], [Van House and Davis, 2005] and [Van House et al., 2005].

Need	Need Specification
Autonomy – Independence	- Decide who can access my content and who cannot
Competence – Effectance	- Understand quickly how it works - Feel competent in the things I am doing
Relatedness – Belongingness	- Share experiences with people that are meaningful to me - Feel that I belong to groups of people - Feel being part of beloved ones
Pleasure – Stimulation	- Discover new things - Not feel bored - Enjoy browsing information (i.e. pictures) of others
Security – Control	- Feel that my data is safe - Have control over my personal information - Have control over the information I share with others
Influence – Popularity	- Feel respected - Feel being liked - Feel that I achieve something

Table C.1: Specification of Psychological Needs in Mobile Social Media

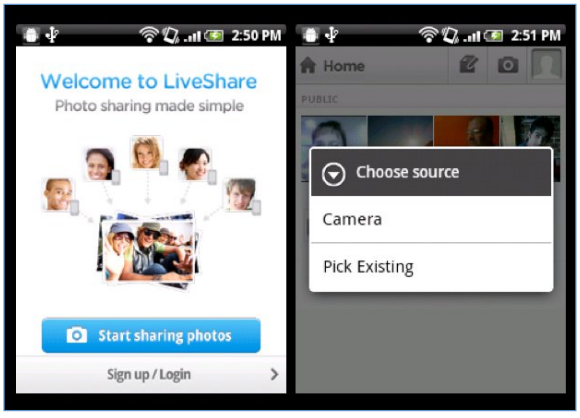

Figure C.1: Test Object LiveShare Version 1.2.6

C.2.2 Data Collection

Three different approaches helped to collect information on perceived user experience: (1) qualitative guideline supported UX interviews of 60 minute duration, (2) hand-out questionnaires during an event at which users used the product for the very first time in a very specific environment, and (3) an online survey reaching a mix of long-term and short-term users. Table C.2 shows these three data collection methods in an overview. This data triangulation

	Guideline-supported Interviews	Hand-out survey	Online Survey
No of participants	n=7	n=12	n=20
Environment	Laboratory environment	Event environment	Restrospective evaluation at a computer
Collected Data	Expectations, need fulfillment, perceived product quality, short-term experiences, detailed qualitative data in specific use cases	Expectations, need fulfillment, perceived product quality, very first experiences in a specific context	Expectations, need fulfillment, perceived product quality, overall impression, long-term experiences
User Skill Level	Novice	Novice	Casual and expert

Table C.2: Overview of Used Data Collection Methods

helped to understand experiences in specific contexts as well as short term versus long-term experiences. Common to all three approaches is the previously developed UX questionnaire to collect information about need expectations towards mobile social media, actual need fulfillment through LiveShare and perceived product quality of LiveShare. The questionnaire itself took about 15 minutes to complete.

C.2.3 Participants

In total, 50 subjects participated in the test. However, only data from 39 individuals could be used for valid UX evaluation results. Cooliris employees as well as participants who did not finish filling out the questionnaire were excluded from data collection regarding product evaluation.
Participants were novice, casual and expert users of LiveShare between 22 and 55 years old. I screened and selected exclusively smart phone users using Android, iOS and Windows7, who download mobile applications at least 1-3 times per month.

C.3 Results

Qualitative and quantitative statements from users in this study indicate that the specified needs as displayed in Table C.3 were most important to users. Participants rated specified needs on a five-staged Likert scale from 1 = “not important at all” to 5 = “very important”.

Need	Need Specification (mean rating)
Autonomy – Independence	- Decide who can access my content and who cannot (4,47)
Competence – Effectance	- Understand quickly how it works (4,47) - Feel competent in the things I am doing (4,29)
Relatedness – Belongingness	- Share experiences with people that are meaningful to me (4,15)
Pleasure – Stimulation	- Enjoy browsing information (i.e. pictures) of others (4,18)
Security –Control	- Feel that my data is safe (4,46) - Have control over my personal information (4,55) - Have control over the information I share with others (4,41)

Table C.3: Most Important User Expectations Towards Mobile Social Media Services

Most important statements are statements that were rated with a mean of higher than 4 – between "important" and "very important".
Regarding UX evaluation, practitioners found it most helpful to see the delta between need expectation and need fulfillment by the tested service. Figure C.2 shows need expectations as rated by users in this study with an exemplary profile of need fulfillment. The example does not represent actual need fulfillment results from the study with LiveShare. Results from

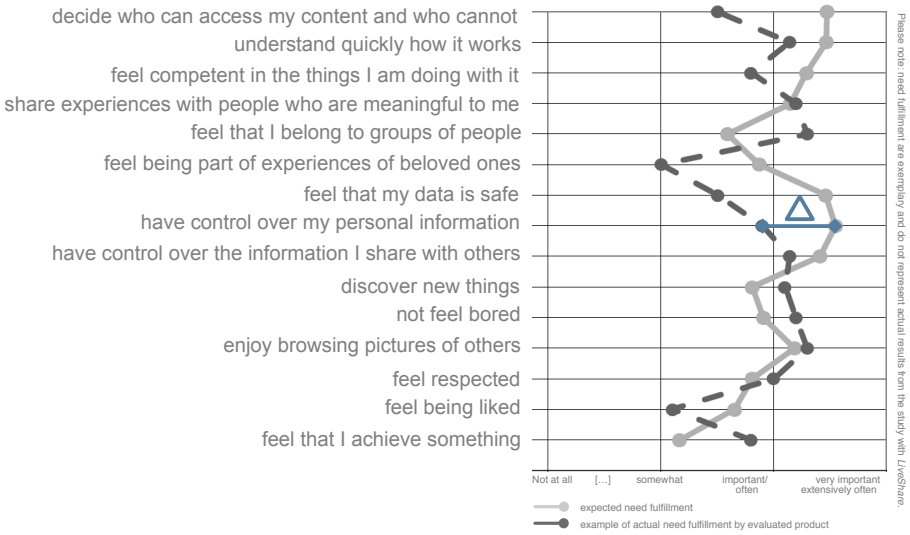

Figure C.2: Example of Deltas Between Need Expectation and Need Fulfillment

the deltas between need expectations and actual need fulfillment in combination with results from user observations and qualitative statements helped to extract product requirements for the mobile sharing service LiveShare as well as general guidelines for mobile social media services.
Clear recommendations for action furthermore helped to improve the tested version of LiveShare. I derived Recommendations for action from the results of test scenarios during lab

interviews as well as product quality evaluations stated in the hand-out and online survey. They are categorized into three steps of prioritization:

!!! High UX problem that affects the overall experience extensively – elimination of the problem should be of high priority and should be implemented as soon as possible

!! Medium UX problem that affects the overall experience – elimination of the problem should be of medium priority and should mostly be implemented before (the next) product release.

! Low UX problem that has no essential influence on the overall experience – elimination of the problem should be of low priority and should only be implemented if there is enough time and budget available.

To provide advices that focus on user's experiences over time[7], recommendations for action subdivide into user acquisition, user engagement and user retention. The concept is adapted from the Customer Relationship Lifecycle (CRL)[8] with different terms as they are commonly used at *Cooliris*[9]. Figure C.3 visualizes the classification of user acquisition, user engagement and user retention. Each phase comprises different characteristics that imply different foci

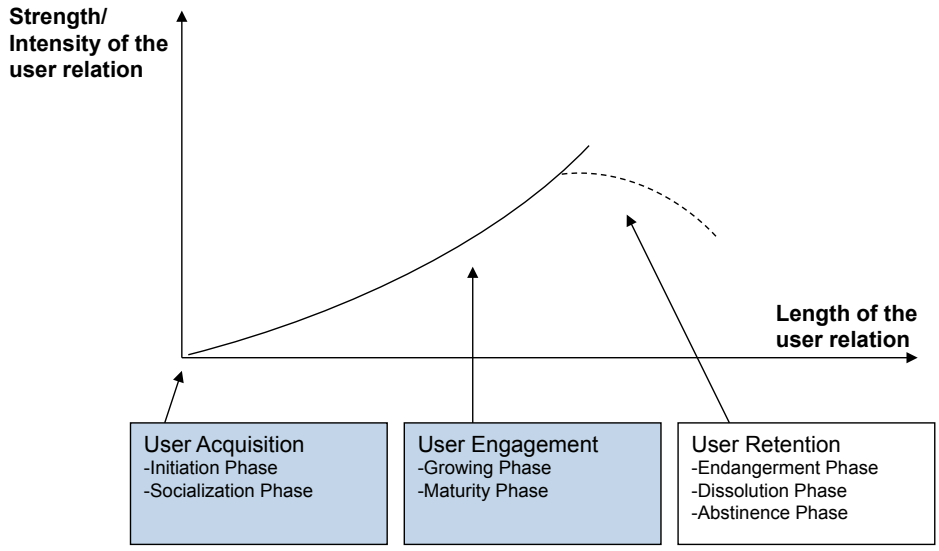

Figure C.3: Phases of the Customer Relationship Lifecycle adapted from [Bruhn, 2009, p.60]

for user experience engineering and marketing. As user experience engineering is product development related and less marketing related, recommendations for action focus on user acquisition – very first usage – and user engagement – long-term usage.

[7] Introduced by [Karapanos et al., 2009], earlier analyzed by [Forlizzi and Battarbee, 2004] as "spatio-temporal experiences".

[8] As introduced by Bruhn, aim of this strategy is to reach high customer loyalty in order to be economically successful in terms of revenue and cost [Bruhn, 2009, p.3].

[9] Bruhn's original terms: (1) Customer Acquisition, (2) Customer Retention, (3) Customer Win-Back [Bruhn, 2009, p.60].

C.4 Conclusion

The present user study with the mobile sharing service LiveShare has shown that the approach was able to derive general guidelines for mobile social media as well as clear product optimizations. Practitioners specifically appreciated the approach of detecting differences between need expectations and need fulfillment. The delta between need expectations and need fulfillment provided a helpful basis to understand product quality (usability and attractiveness) evaluations and was presented in an intuitive way (as displayed in figure 3). Qualitative information from lab studies substantiate those findings and provided comprehensive information regarding product requirements.

However, the process to specify needs was complex and specified needs may be argued to be arbitrary. It was not clear whether need categories and specified needs were complete for profound results. For that reason, it may be more valuable to understand general need categories in the field of web products and to use this basis for a more detailed specification within the field of mobile social media.

D Study 4: Need Specification Study

D.1 Interview Material

D.1.1 Interview Guideline

1. Einleitung und Hintergrundinformationen

Begrüßung

Vielen Dank für Ihre Bereitschaft, an meiner Studie teilzunehmen. Bei dieser Studie geht es mir darum, zu verstehen, warum Sie Funktionalitäten von ausgewählten Webseiten nutzen, um Implikationen für die Produktgestaltung abzuleiten.

Um von Ihnen genannte Aussagen wiederholt auswerten zu können, nehme ich das Interview mit einem Sprachrekorder auf. Hierfür möchte ich Sie um Ihr Einverständnis bitten. Bitte unterzeichnen Sie die vorliegende Einverständniserklärung zur Audioaufzeichnung.

→ *Interviewer: Einverständniserklärung zur Audioaufzeichnung ausfüllen lassen*

Vorab möchte ich Ihnen gern einige Fragen zu demographischen Daten und Ihrem Nutzungsverhalten von Internet und einer Auswahl an Webseiten stellen. Die Beantwortung der Fragen nimmt etwa 3 Minuten in Anspruch und unterstützt die Auswertung der Studie. Ihre Daten werden selbstverständlich streng vertraulich behandelt und nicht an Dritte weitergegeben.

→ *Interviewer: Vorbefragung ausfüllen lassen*

Haben Sie noch Fragen? Dann können wir jetzt anfangen.

Ich habe Sie als Nutzer/Nutzerin der zwei Webseiten [Webseite 1] und [Webseite 2] eingeladen, da Sie eine hohe Nutzungsdauer dieser Webseiten aufweisen. Wir werden uns in den nächsten 40 Minuten mit diesen Seiten sowie Ihren persönlichen Erfahrungen und Gründen beim Umgang mit den Seiten nach einander befassen. Bitte teilen Sie mir während des Interviews stets mit, was Sie denken, was Sie als nächstes tun möchten und bestenfalls, warum Sie etwas tun möchten oder getan haben. Diese Technik nennt sich Lautes Denken. Ihre Offenheit beim Beantworten der Fragen ist sehr wichtig für die Qualität des Interviews.

Figure D.1: Interview Guideline Page 1

2. Interview

1. **Bitte rufen Sie die Seite [Webseite] auf. Wenn Sie sich an Ihre bisherige Nutzung mit der Webseite erinnern, welche Funktionen haben bei Ihnen - ganz spontan - in der Vergangenheit zu positiven Erlebnissen geführt? Warum?** *Interviewer: fragen bis ein Bedürfnis abgeleitet werden kann.*

2. *Interviewer: Nutzer ggf. einloggen lassen* **Bitte nutzen Sie die Webseite für drei Minuten so, wie Sie sie zu Hause nutzen würden.** *Interviewer: etwa 3 Min beobachten und notieren welche Funktionen die Person nutzt. Im Anschluss an die zwei Minuten nachfragen, warum diese Funktionen genutzt wurden, um herauszufinden, welches Bedürfnis dadurch zufriedengestellt wurde und welches Erlebnis die Person dabei hatte:*

    a. **Sie haben soeben die Funktionalität [...] genutzt / den Link [...] geklickt. Warum?** *Interviewer: Nutzen und Motivation erfragen. Solange nachhaken, bis ein Bedürfnis abgeleitet werden kann.*
    b. **Wie <u>wichtig</u> finden Sie diese Funktion auf einer Skala von -3 (ganz unwichtig) bis +3 (ganz wichtig)? Warum?** *Interviewer: Die Wichtigkeit der Funktion <u>bei dieser speziellen Webseite</u> erfragen. Ggf. nachhaken, ob der/die Nutzer/in die Wichtigkeit generell beurteilt oder direkt auf die Webseite überträgt.*

3. *Interviewer: Funktionen aus der Funktionsliste der jeweiligen Webseite herannehmen und nacheinander durchgehen:* **Wie werden uns jetzt einzelne Funktionen genauer anschauen. Bitte nutzen Sie folgende Funktion** *(Interviewer: Funktion nennen)* **und bitte teile mir auch hier wieder mit:**

    a. **Warum nutzen Sie diese Funktion/ würden Sie diese Funktion nutzen?** *Interviewer: Nutzen und Motivation erfragen. Solange nachhaken, bis ein Bedürfnis abgeleitet werden kann.*
    b. **Wie wichtig finden Sie diese Funktion auf einer Skala von -3 (ganz unwichtig) bis +3 (ganz wichtig)? Warum?**

Figure D.2: Interview Guideline Page 2

D.1.2 Pre-Selected Product Features

Product features were pre-selected in a one-day workshop at Deutsche Telekom with two experts (heavy internet users) who analyzed the websites. We derived 5 features that are general to all websites; and 5 specific ones for each product as shown in Figure D.1. In total, 10 functionalities were pre-selected per product. The number of features is limited to 10 in order to still make the interview feasible within the given interview time and to limit exhausting the participants. Pre-selected general product features are Search (Suche), Navigation (Navigation), External Advertising (Werbung), Contact Information (Kontakt-information/Impressum) and Help (Hilfe).

Product	Product Features (German)
Facebook.de	- Status - Kommentieren - Gefällt mir - Teilen - Nachrichten
Ebay.de	- Ersteigern - Versteigern - Bewerten - Beobachten - Wunschliste
Amazon.de	- Kaufen - Verkaufen - Schenken - Empfehlungen - Rezensionen
Google.de	- Websuche - Bildersuche - Ortsuche (Maps) - Link Vorschau (Previews) - Anzeigen
Spiegel-Online.de	- Neuigkeiten lesen - Artikel empfehlen - Artikel twittern - Feedback geben - Fotostrecken

Table D.1: Pre-Selected Product Features

D.2 Additional Detailed Results

Sheldon et al. (2001)	Need Classes by Schulze	Need Statements	Action Statements	Examples for Functions
Autonomy - Independence	**Freedom of Choice**	To be self-dependent To be self-determined	To decide To limit To adjust To choose To compare To filter To select	Variety of Content Variety of Offers User Reviews (read) Buy-Now Option Search Filter Result Filter Individualization of Views
	Freedom of Opinion	To be honest To be profound To be informative	To comment To write To explain oneself To express ones opinion To inform	Comment (write) Feedback Functions
	Independency	To be uncommitted To be unrestricted	To decide	Price Comparison Product Comparison
Competence - Effectance	**Success**	To be successful To be capable To be effective	To find To win To create something To memorize To remember	Search Bid Auction Buy Auto Completion of Search Terms Highlighting of Search Terms LinkPreview Observation Lists Birthday Reminders Event Reminders
	Planning	To be tactical To be prepared	To optimize time To plan To prepare To organize To look after	Route Planner Event Planner Group Function Time Information Route Information
	Knowledge	To be educated To be experienced To be informed To be up-to-date	To inform myself To learn To educate further	Auction Location Search News-Stream Group Function
Relatedness - Belongingness	**Exchange**	To be involved To be available	To join in a conversation To exchange To discuss To get to know people To maintain contacts To stay in contact	Chat Comments Like Contact List
	Altruism	To be inspiring To be selfless To be generous To be helpful	To bring pleasure to others Andere erfreuen To make a present to someone To inspire others To help on To congratulate	Comment Like Review
	Participation	To be participating To be existent	To show To participate To reveal oneself	Share Photos Status Update (share/read) Photos (share/view) Documents (share/view) Group Chat

Figure D.3: Overall Need Classification Part 1

Sheldon et al. (2001)	Need Classes by Schulze	Need Statements	Action Statements	Examples for Functions
Self-esteem - Self respect	Approval/ Validation	To be approved/validated To be accepted To be important To be respected To be noticed	To receive attention To get comments To get agreement To receive appreciation	Comment (receive) Review (receive) Recommendation (receive) Messages (receive)
	Individuality	To be individual	To receive matching recommendations	Personalized Recommendations
Pleasure/ Stimulation	Excitement/ Fun	To be playful To be in pleasant anticipation To be flutteringly To be excited	To distract myself To relax the mind To follow up with interests To triumph To follow up with hobbies	Games Videos
	Curiosity/ Interest	To be gawping/curious To be impatient To be attentive	To explore To browse To distract myself To rubberneck To get ideas To see what is new	Image Search Satellite View in Maps Web Search Photo Streams Videos Status Updates (Read) Personalized Welcome Page Wish List Friend's Profiles
	Inspiration	To be explorative To be inspired	To discover To get incentives To get ideas	Links Contextual Additional Information Auto Completion of Search Terms Displaying Related Articles Categories Personalized Advertisement
	Creativity	To be imaginative To be artistic	To combine To design	Photo-Stream
	Distraction/ Amusement	To be entertained To be relaxed	To distract To relax To calm down	News Stream Profile Information Photos
	Surprise	To be surprised	To receive notifications	Notifcations
Security - Control	Overview	To be structured To be sorted	To orientate oneself To overlook	Navigation Categories Account Welcome Page
	Control	To be controlled To be prudent	To verify To control To observe	Shopping cart Data Protection Observe Products Profile View from Others Point of View Profile Limitations Account
	Security/ Certainty	To be secure To be certain To be protected To be safe	To get an impression To see shortcomings To estimate quality	Reviews Product Photos Pay Pal Integration Comments Product Detail Page
	Ease/ Peace	To be assured To be carefree	To mediate To calm oneself down To avoid stress To avoid anger	Help Contact
	Trust/ Reliability	To be confident To be trusting	To trust To count on something	User reviews (read)
Influence - Popularity	Reputatation	To be influential To be exemplary To be regarded	To make oneself noticable To exhibit oneself	Status Comment Recommend an article Review (write)

Figure D.4: Overall Need Classification Part 2

Sheldon et al. (2001)	Bedürfnisklassen nach Schulze	Bedürfnisaussagen	Aktionsaussagen	Funktionsbeispiele	Kernaussagen (Rohdaten)
Autonomie	**Entscheidungsfreiheit**	Selbständig sein Selbstbestimmt sein	Entscheiden Einschränken Einstellen Auswählen Vergleichen Filtern Aussuchen	Angebotsvielfalt Nutzerbewertungen Sofortkaufen-Option Suchfilter Ergebnisfilter Personalisierung von Ansichten	Selbst entscheiden können ob ich Artikel sofort kaufe oder nicht Selbst einschränken können Selbst ordnen können Vergleichen können Ansichten selbst auswählen Gefühl von Freiheit Selbst einschränken können Nach Lust und Laune entscheiden Kurzfristig entscheiden können Unverbindlichkeit Größeres Angebot Tag und Nacht kaufen können - wann ich möchte Selbst entscheiden ob ich mich an Uhrzeit binde oder nicht Selbstbestimmt suchen Selbst entscheiden was ich bestelle Filtern können Größen selbst einstellen können Selber entscheiden was von mir Preis gegeben wird Selbst eingrenzen können Vertragspartner selbst aussuchen
	Meinungsfreiheit	Ehrlich sein Hintergründig sein Informativ sein	Kommentieren Schreiben Rechtfertigen Meinung äußern Mitteilen	Kommentar Feedbackfunktion	Wahrheit weitergeben Meinung äußern Selbst miterlebte Dinge beschreiben Eigene Meinungen argumentieren Hintergrundinformationen weitergeben Meinung nach außen tragen Ansicht vertreten Ärgern herauslassen Meinung mitteilen über soziale Medien Virtuelle Kneipe Meinung mitteilen Kommentieren dürfen Stellung zu Themen nehmen Meinung kundtun Meinung teilen Standpunkt vertreten Sich rechtfertigen
	Unabhängigkeit	Ungebunden sein Uneingeschränkt sein	Entscheiden	Preisvergleiche Produktvergleiche	Mich nicht festlegen wollen Mich nicht einschränken wollen Sachen nicht aufdrücken lassen wollen Breite Basis zum entscheiden Alles kaufen können

Figure D.5: Need Classification German Part 1

Sheldon et al. (2001)	Bedürfnisklassen nach Schulze	Bedürfnisaussagen	Aktionsaussagen	Funktionsbeispiele	Kernaussagen (Rohdaten)
Kompetenz	Erfolg	Erfolgreich sein Fähig sein Effektiv sein	Finden Gewinnen Etwas schaffen Merken Erinnern	Suche Ersteigern Versteigern Kaufen Autovervollständigung von Suchbegriffen Hervorheben von Suchbegriffen Linkvorschau Beobachtungslisten Geburtstagserinnerung Veranstaltungserinnerung	Erfolgreich sein Gefühl es geschafft zu haben Gezielt Artikel finden Erfolgserlebnis haben, Gewinnen wollen Mehr Chancen Produkt zu finden Etwas finden das passt Gefühl alles zu finden Traumpreis erzielen Orte finden Mich an Dinge erinnern An Dinge erinnert werden woran ich nicht denke Sachen zurücklegen die ich später gebrauchen könnte Langfristige Liste anlegen Dinge merken
	Planung	Planvoll sein Vorbereitet sein	Zeit optimieren Planen Vorbereiten Kuemmern	Routenplaner Veranstaltungsplaner Gruppenfunktion Zeitangaben Streckenangaben	Zeit optimieren Planen können Gleich zum Ziel kommen Zeit sinnvoll verwenden/etwas Vernünftiges tun Hilft vorzubereiten Entfernung und Strecke herausfinden um etwas kümmern
	Wissen	Gebildet sein Erfahren sein Informiert sein Auf dem aktuellen Stand sein	Organisieren Lernen Weiterbilden Informieren	Produkte versteigern Ortssuche/Google Maps News-Stream Gruppenfunktion	Erfahrungswerte sammeln Wissen aneignen/mehr wissen Vorabinformationen sammeln In Materie drin stecken Dinge verstehen Kompetente Antwort finden Ein Bild von Dingen machen Bescheid wissen Dazu lernen Gegenmeinung kennen lernen Interesse nachgehen Allgemeinbildung Nicht ungebildet und dumm sein Recherchieren Zusätzliche Informationen bekommen Meinung bilden/entwickeln Dinge besser vorstellen können Besser Infos merken Mitreden können umfassend informiert sein Kenntnisse haben Auf aktuellem Stand sein Hintergrundinformationen, Herauszufinden ob ich mir Sorgen machen muss Für Wahlentscheidung verstehen was Regierung macht Beruflich und charakterlich weiterentwickeln Preise einschätzen können

Figure D.6: Need Classification German Part 2

Sheldon et al. (2001)	Bedürfnisklassen nach Schulze	Bedürfnisaussagen	Aktionsaussagen	Funktionsbeispiele	Kernaussagen (Rohdaten)
Verbundenheit	Austausch	Beteiligt sein Erreichbar sein	Mitreden Austauschen Diskutieren Menschen Kennenlernen Kontakte pflegen In Kontakt bleiben	Chat Kommentare Gefällt Mir Freundesliste/Kontakte	Menschen kennen lernen Mitreden/an Konversationen beteiligen Sich austauschen Mit anderen diskutieren Private Kommunikation Beziehungspflege/ Kontakte pflegen Mit Freunden in Kontakt bleiben Erreichbar sein Diskussion/Unterhaltung starten Kontakt halten/in Kontakt stehen
	Nächstenliebe	Inspirierend sein Selbstlos sein Großzügig sein Hilfsbereit sein	Anderen eine Freude Andere erfreuen Andere beschenken Andere inspirieren Andere weiterbringen Gratulieren	Kommentieren Gefällt Mir Bewerten	Andere erfreuen Andere beschenken Mehrwert liefern für bestimmte Personen Andere weiterbringen Menschen gratulieren Andere erfreuen Andere inspirieren Interesse zeigen Ein gutes Gefühl schenken Andere bei Entwicklung helfen An andere denken Zustimmung zeigen Warnungen weitergeben Tipps weitergeben Händlern helfen Käufern helfen
	Zugehörigkeit	Beteiligt sein Existent sein	Zeigen Teilhaben Offenbaren	Fotos teilen Statuseingabe Fotos ansehen Dokumente ansehen Gruppenchat	Dabeisein Für andere existieren Am Leben von Freunden teilhaben Zusammengehörigkeit Füreinander da sein Gleiche Interessen mit Personen teilen Was mir gefällt/mich erfreut mit anderen teilen Anderen etwas zeigen Leben offenbaren Freunde am Leben teilhaben lassen
Selbstachtung	Anerkennung	Bestätigt sein Anerkannt sein Geschätzt sein Respektiert sein Beachtet sein	Aufmerksamkeit erhalten Kommentare erhalten Zustimmung erhalten Verständnis erhalten	Kommentar erhalten Bewertung erhalten Artikel empfohlen bekommen Nachricht erhalten	Ego-Ding Rückmeldung über Zufriedenheit der Käufer Bestätigt fühlen Feedback bekommen Gefühl wichtig zu sein Respektiert fühlen Aufmerksamkeit Beachtung Auf positive Kommentare erhalten Zustimmung erhalten Geschmeichelt fühlen Verstanden werden
	Individualität	Individuell sein	Passende Empfehlungen bekommen	Empfehlungen	Individuelle Empfehlungen Auf meine Wünsche zuschneiden

Figure D.7: Need Classification German Part 3

Sheldon et al. (2001)	Bedürfnisklassen nach Schulze	Bedürfnisaussagen	Aktionsaussagen	Funktionsbeispiele	Kernaussagen (Rohdaten)
Stimulation	Spannung	Verspielt sein Gespannt sein	Zeitvertreib Gemüt auflockern Interesse nachgehen Triumphieren/Glück Hobby nachgehen	Spiele Videos	Risiko Reiz Hobby/Interesse Teil eines Freizeiterlebnisses Wie ein Spiel Glück Vorfreude Adrenalinkitzel 3-2-1-Meins Erlebnis Aufregung Ablenkung Beschäftigung bei Langeweile Lückenfüller/Zeitvertreib Spannend zu sehen wenn Preis sinkt Gemüt auflockern
	Neugier	Schaulustig sein Neugierig sein Aufmerksam sein	Explorieren Surfen Zeitvertreib Herumgucken Ideen bekommen Sehen was es neues gibt	Bildersuche Satellitenansicht in Karten Websuche Fotostrecken Videos Statusmeldungen lesen Persönliche Startseite Wunschliste Freundesprofile	Neue Ideen suche was ich noch gebrauchen kann Sehen was es Neues gibt Neugier was noch zu mir passen kann Neugierig was Leute für Meinungen haben Neugier befriedigen Neugier was andere sagen Neugier was in Welt vor sich geht Ungeduld zufriedenstellen Sehen was andere machen Neuigkeiten mitbekommen Auf dem neuestem Stand sein Sehen was anderen passiert/ Witze und Pannen anderer Nichts verpassen
	Inspiration	Explorativ sein	Entdecken/ Explorieren Anreize bekommen Ideen bekommen	Verlinkungen Kontextuelle Zusatzinformationen Autovervollständigung von Suchbegriffen Anzeige ähnlicher Artikel Kategorien Personalisierte Werbung	Weckt Aufmerksamkeit Sehen was Freunde denken Sehen was andere sagen Neue Ideen bekommen Aufmerksam gemacht werden Etwas finden woran man nicht gedacht hätte Zum Kaufen inspirierend Anreize bekommen (was ich noch gebrauchen kann) Ideen für Präsentationen bekommen
	Kreativität	Einfallsreich sein Künstlerisch sein	Verbinden Gestalten	Photo-Stream	Kreativ sein Verbinde alles mit Bildern
	Ablenkung	Unterhalten sein Vergnügt sein Entspannt sein	Ablenken Abschalten Herunterkommen	News Stream Profilinformationen Fotos	positive Ablenkung Unterhaltung durch Bilder Herunterkommen Zum Abschalten
	Überraschung	Überrascht sein	Benachrichtigungen bekommen	Benachrichtigungen	Dinge die mich Überraschen Dinge mit denen man nicht rechnet

Figure D.8: Need Classification German Part 4

Sheldon et al. (2001)	Bedürfnisklassen nach Schulze	Bedürfnisaussagen	Aktionsaussagen	Funktionsbeispiele	Kernaussagen (Rohdaten)
Sicherheit	**Übersicht**	Strukturiert sein Orientiert sein	Orientieren Überblicken	Navigation Kategorien Kundenkonto Startseite	Einen Überblick bekommen Nicht im Dschungel der Ergebnisse verlieren Geleitet werden Sofort sehen was Sache ist Nicht durchklicken müssen Auf ersten Blick/ sofort alle wichtigen Informationen sehen Ordnung haben Struktur Orientierung bekommen Überblick über alles haben Mich nicht in der großen Datenbank verlieren
	Kontrolle	Kontrolliert sein Bedacht sein	Prüfen Kontrollieren Beobachten	Warenkorb Datenschutzeinstellungen Artikel beobachten Profilansicht aus Sicht anderer Profil-Beschränkungen Kundenkonto	Preise kontrollieren Sehen wie andere Artikel bei Verkäufern weggegangen sind Produktkauf kontrollieren können Lieferumfang prüfen Sehen ob alles dabei ist Kontrolle über finanziellen Dinge haben Prüfen wer was sehen kann von mir Kontrolle darüber wer welche Informationen von mir erhält
	Gewissheit	Sicher sein Gewiss sein Geschützt sein	Eindruck bekommen Mängel sehen Qualität einschätzen	Nutzerbewertungen Produktfotos PayPal-Bezahlverfahren Kommentare zu Artikeln Produktdetailseite	Gefühl von Sicherheit alles zu haben Sicherheit nicht falsch zu suchen Keine Angst nichts zu finden Heimisch fühlen eBay-Polizei Schutz für Drumherum Ansprechpartner haben Genauen Zustand von Artikeln sehen Qualität erkennen Eindruck über Produktqualität bekommen Wissen ob gewünschtes Produkt vorhanden ist Sicher vor Fehlkauf sein Eindruck vom Produkt bekommen Mängel und Vorteile von Produkten sehen Sicherheit bei Entscheidungen bekommen Sicher sein dass Qualität angemessen ist Bewahrt mich vor Fehlkäufen Garantie
	Ruhe/Frieden	Beruhigt sein Unbekümmert sein	Schlichten Beruhigen Stress vermeiden Ärger vermeiden	Hilfe Kontaktinformationen	Unstimmigkeiten aus dem Weg gehen Ärger und Stress verringern/vermeiden Beruhigungseffekt Anstrengung sparen Zu einer neutralen Person gehen können
	Vertrauen/ Verlässlichkeit	Zuversichtlich sein Vertrauensvoll sein	Vertrauen Auf etwas verlassen	Nutzerbewertungen	Sehen wer verlässlich ist Kein böses Erwachen Vertrauen in die Marke Vertrauen können Gefühl der Seriosität Darauf verlassen können Transparente Informationen
Einfluss	**Ansehen/Ruf**	Einflussreich sein Beispielhaft sein	Bemerkbarmachen Schaustellen	Statuseingabe Öffentlich kommentieren Artikel empfehlen	Einfluss auf Geschmack nehmen Andere an mir orientieren Was zu sagen haben Zur Schau stellen
	Präsenz	Angesehen sein	Präsent sein	Bewerten	Mich bemerkbarmachen

Figure D.9: Need Classification German Part 5

Theses on the Dissertation

1. A holistic view on user experience goes beyond the user-product relation and also includes the organization-product relation.

2. A practice-driven and structured support to effectively engineer user experience within an organizational environment is needed.

3. Existing approaches to user centered product quality lack in their applicability to develop for user experience.

4. Existing approaches to user centered product quality do not provide a relation between perceived product quality and underlying human motives in order to understand the drivers that constitute a positive user experience.

5. Product Qualities that aim at fulfilling psychological needs have the potential to elicit positive user experience.

6. The psychological needs for *autonomy – independence*, *competence – effectance*, *relatedness – belongingness*, *security – control*, *pleasure – stimulation* and *influence – popularity* as put forward by [Sheldon et al., 2001] build a sufficient basis to categorize needs that serve as a basis for user experience.

Ilmenau, 20. 12. 2012 Katrin Schulze

Declaration of Originality

I hereby declare that this thesis and the work reported herein was composed by and originated entirely from me. Information derived from the published and unpublished work of others has been acknowledged in the text and references are given in the list of sources.

Ilmenau, 20. 12. 2012 Katrin Schulze