Course Book

INTRODUCTION TO USER RESEARCH

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INTERNATIONAL
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LEARNING OBJECTIVES

To create high-quality products that are actually used by those for whom they are intended, it is essential to know your users, their preferences, and their behavior when interacting with your product. This course, **Introduction to User Research**, will provide insights into how to study your users.

First, the course provides an overview of important basics and definitions within the broad field of user research. Next, you will be introduced to the goals and challenges faced when conducting user research. An approach called User-Centered Design focuses on the user throughout the entire design process. Once you are familiar with this approach, User Context Analysis and its corresponding procedure will be explained.

The methods used to determine user requirements are a central part of user research. The introduction to various methods will help you to understand their differences and enable you to select methods specific to each project. You will learn how to plan, conduct, and evaluate the results of these methods, examples of which include questionnaire design, interview methods, and observation techniques. Additionally, you will learn the meaning of the term “user requirements” and why it is central to user research.

Finally, the course presents information and explanations about service design methods and tools for determining and consolidating user research results. That section considers services as a special kind of product, with particular requirements regarding user research.

UNIT 1

BASICS AND DEFINITIONS OF TERMS

STUDY GOALS

On completion of this unit, you will be able to …

- define user research and recognize its importance.
- identify the challenges and goals of user research.
- understand the concept of user requirements.
- discuss the relationship between user requirements and context of use.

1. BASICS AND DEFINITIONS OF TERMS

Introduction

Have you ever turned on the wrong light switch or the wrong burner? Have you made a wrong turn because of misleading signs, or no longer understand an app after an update? And who needs a refrigerator that is also an alarm clock? These examples all point to a lack of user involvement in the product development process, demonstrating that knowing your users and their needs is essential.

What are the main reasons why products fail or are not used as intended? Uselessness and incomprehensibility. Either people do not really need them or they are too difficult to operate and not worth trying to figure out. In short, the products fail because they were not tailored to the user needs.

The toy manufacturer LEGO experienced this in the 1980s and 1990s, when the company wanted to expand in different directions and create new toys and designs (Goodman et al., 2020). However, their sales dropped, and they realized they had to find out why. They sent user researchers to observe children at home playing not only with LEGO, but with other toys as well. They learned that they should return to their old product, the building blocks, for children. At the same time, they found out they should also focus in other directions, such as the Star Wars models now sold as special products for adults.

1.1 Definitions of User Research and User Requirements

User research
This discipline focuses on the user for system and product development, which also includes scientific methods investigating who the users are, how they think, what they need, and in which context they (will) use the system.

User research is “the study of peoples’ (users’) behavior, motivations, and needs in a particular context, which affect how people understand and use things in their daily lives” (Marsh, 2018, p. 1). In addition to user needs and context factors in general, the evaluation of designs is an important aspect of user research (Savarit, 2020). User research can be used for different kind of products, systems, and services, for example, websites, consumer electronics, medical equipment, and banking services.

Different related disciplines, such as human factors and ergonomics, human computer interaction, psychology, usability, and anthropology influenced the emergence of user research (Savarit, 2020). That is why aspects of these fields can be found in user research methods and processes. Additionally, user research is closely related to user experience (UX) design and market research. Nevertheless, these fields should not be confused. In contrast to UX design, user research is more scientific, whereas the former is more creative. Both user research and market research are needed in product development and bear similarities. However, the terms are not interchangeable or synonymous. The two areas have different objectives and outcomes (Norman, 2013).

Market research focuses on peoples' purchasing decisions, i.e., it concentrates on customers and describes the product from the market environment. Often quantitative methods (e.g., surveys with tens of thousands of participants) are used. For example, the goal may be to find out who would buy the product. Market research thus supports marketing decisions.

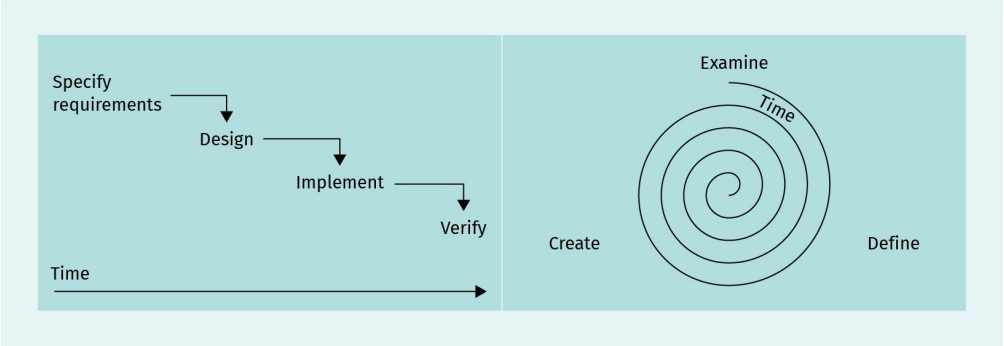
User research focuses on what people really need and how they use a product or service (user characteristics and behavior), i.e., it concentrates on users. User research describes the product from its context of use and influencing factors. Here qualitative methods are used (e.g., observation of a few users) to study user behavior in depth. User research thus supports design decisions.

User Research in the Product Development Phases

User research can be used across the entire product development process; it is not limited to a single phase. It is best applied iteratively throughout the design process (Marsh, 2018). This is particularly true for a new product or service, but also when systems, products, or services need improvement or errors occur. A survey among 525 user researchers in 44 countries about their work showed that more than half (54%) include user research at every stage of the product life cycle, from prior to the design process to after-market introduction (Balboni, 2021). User research can be added to linear product development (**waterfall**), but is even more effective in iterative development (Marsh, 2018).

Waterfall
When using the traditional waterfall methodology for system development, all phases are rigidly carried out one after the other.

Figure 1: System Development Methodologies: Waterfall versus Iteration



Source: Lina Kluy (2022), based on Goodman (2020).

Although user research can be carried out within the waterfall methodology, the more modern and flexible variant for system development is human-centered design for interactive systems (International Organization for Standardization [ISO], 2019a). The main characteristic of this approach is the strong user focus: Both user needs and requirements are considered in order to make the to-be-developed system or product usable and to achieve an optimal fit with the user and the purpose of use. This optimal fit is based on increasing the effectiveness and efficiency of systems. It should also increase system accessibility and sustainability, as well as user well-being and satisfaction. In addition to increasing positive effects, negative effects that could arise from the use of systems should

be reduced as well. These include unwanted effects on health, safety, and performance. For this purpose, techniques from the closely related fields of human factors, ergonomics, and usability are applied, all characterized by a strong user focus.

To achieve these positive effects, the following basic characteristics should be followed (ISO, 2019a):

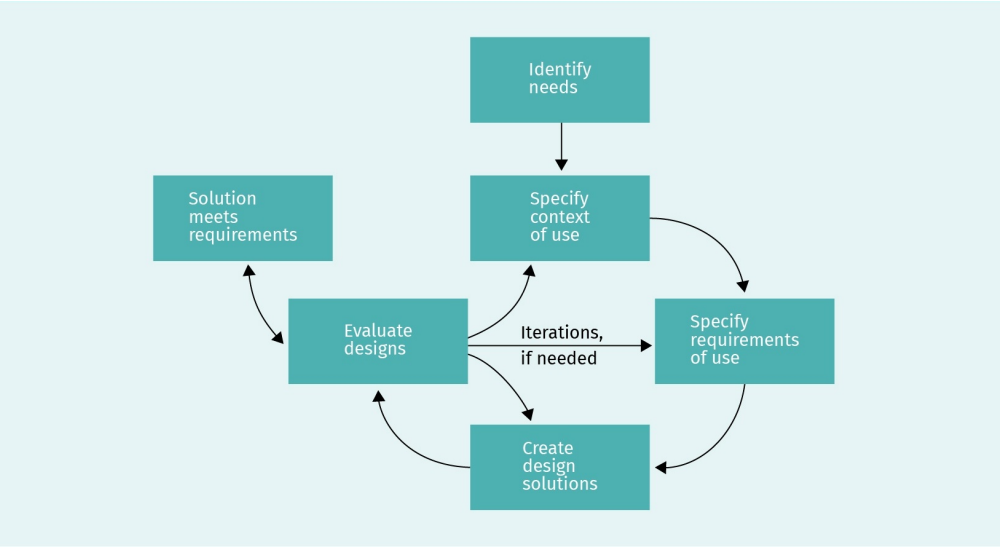
- a system or product design based on a comprehensive understanding of users, tasks, and environments/contexts
- user involvement during design and development of interactive systems
- continuous refinement and adaptation of design solutions based on user-centered evaluation
- iterations within the development process
- the consideration of **user experience**
- the interdisciplinary competence of the design team

User experience
The user experience is the behavior, attitude, and emotion when a user interacts with a system.

If user research is considered on the basis of the human-centered design process according to ISO (2019a), user research supports two phases in particular. First there is the "understanding and defining the context of use" (analysis) phase, before concrete design ideas are developed. Second is the "evaluating design solutions based on the requirements" (evaluation) phase. These phases form the basis for successful products that offer users added value.

However, some weaknesses only become apparent when the product is already on the market. To be truly successful in the long term, the product's trajectory should be continuously monitored and optimized through user research even after it has entered the market.

Figure 2: Human-Centered Design Process



Source: Lina Kluy (2022), based on EN ISO 9241-210:2019 (2019a).

Analysis of the context of use and specification of user requirements

In the "understanding and defining the context of use" phase (ISO, 2019a), user research about how a particular context or system is experienced by users is carried out empirically in direct contact with (potential) users. User research is thus structured to gain deep insights into behavior and context at a very early stage of the development process. In particular, user goals, tasks, circumstances, and resources are explored and analyzed, and their needs, problems, and requirements are documented. If existing systems are revised, critical user reactions to the existing product version are also included in the investigations.

The focus of user research in this phase, known as context of use analysis, is to understand the context of use (users, goals, tasks, environments, and resources) in order to derive concrete **user requirements**.

User requirements
The features/attributes your product should have or how the product should perform from the user's perspective.

To gain these insights, different methods are used, such as observation, interview, **focus groups**, and questionnaires. The findings from these analyses are summarized in a **context of use description**. This in turn contains various work results, such as

Focus group
A focus group is a discussion on a specific topic led by a moderator.

- user profiles. A user profile contains characteristics and skills that describe the common user.
- personas. A persona is a fictional profile exemplifying a user group and designed to bring the user profile to life during product development.
- task models. A task model is a detailed description and depiction of user tasks.
- scenarios. A scenario narratively describes how a user currently proceeds in order to achieve their goal.
- user journey maps. A user journey map visualizes all points of contact between the user and the system.

Context of use description
This describes the users, their tasks and goals, resources, and environments, resulting from the context of use analysis.

In the "specifying requirements" phase, concrete requirements for use, the user requirements, are derived from the context of use description. A catalog of requirements serves as a basis for the developers and designers to make well-informed decisions in designing new or improved interactive systems that will be successful on the market in the long term and offer tangible added value to the user.

Evaluation: Review of the design concepts

In the design phase of the user-oriented design process, initial solutions are developed based on user requirements, for example, in the form of mock-ups or paper prototypes. These design drafts are basically hypotheses, since the previously gained knowledge from the context of use analysis is mainly based on assumptions about the users and their behavior. In the evaluation phase, user research is used in forms such as expert reviews and user tests, namely when it comes to evaluating the design solutions against (user) requirements (ISO, 2019a). In this way, the preliminary results from the analysis phase are empirically validated.

Qualitative and quantitative methods

A distinction is made between qualitative and quantitative methods (Baxter et al., 2015). Quantitative methods measure data that are quantifiable, i.e., they can be expressed numerically in concrete numbers. Hence, statistical analysis can be used for further data processing. Quantitative methods can result in a broad overview of patterns and identify trends.

Qualitative methods focus more on the why, e.g., the underlying reasons driving these trends. Qualitative data cannot be measured numerically, but are descriptive. Qualitative data are about the behavior, attitudes, impressions, views, and opinions of users.

User Requirements

Design should not solely be based on technical and organizational requirements. In addition, user requirements should be derived from user needs (ISO, 2019a). Once user requirements are specified, user researchers can determine the features or attributes that should be added to the system to satisfy users. User requirements should be defined in such a way that they are consistent, and that their fulfillment can be reviewed within a design evaluation. Furthermore, relevant **stakeholders** should verify user requirements and said requirements should be further improved upon in the course of the development process.

Stakeholder
An individual or group with an interest (or stake) in the user research activity and its results is called a stakeholder. Stakeholders typically influence the direction of the system (e.g., managers, developers, business analysts).

Context of use

The context of use describes the users, their goals and tasks, the environments in which the interactive system is used, and the resources that are needed to perform the tasks (ISO, 2018). The results of the context of use analysis are summarized in a context of use description.

User
A user is defined as a person who uses or will use a system to fulfill an objective, or who uses the results it produces.

Users are individuals who interact with a system, for example, by making a selection on the interactive system, creating entries, or obtaining information. Users with similar or identical characteristics and contexts of use are described collectively and referred to as a user group. A further distinction is made between primary, secondary, and tertiary users (Baxter et al., 2015):

- Primary users use the interactive system for its intended purpose, to perform the tasks for which the interactive system was designed. They use it regularly and/or directly.
- Secondary users perform support tasks with the interactive system and do not use the product regularly. Their actions may include care and maintenance tasks on the system, training primary users, or configuring the system for a specific context of use.
- Tertiary users do not use the interactive system directly, but work with or use the results produced by the interactive system.

Primary users are the most relevant user group in user research. However, it is important to create a separate analysis of user requirements for each user group (Baxter et al., 2015). In addition to the users, there are also other internal and external stakeholders. Stakeholders have an active interest in the interactive system. The term stakeholder includes,

for example, managers, directors, shareholders, marketing representatives, developers, and designers. Users also fall under stakeholders, but stakeholders are not always users; for instance, they might not use the interactive system or the results it produces. Stakeholders who are not users, however, have additional or different requirements for the interactive system, such as organizational or market requirements.

Users pursue one or more **goals** when using an interactive system (ISO, 2018). The description of goals serves to express basic user needs so that no solutions are excluded in the subsequent design. These can be both factual (also referred to as pragmatic) and emotional (also called hedonic) goals (Hassenzahl, 2007). In the context of use, goals are formulated as states or conditions, i.e., as the result of use or what the user wants to achieve by using the interactive system. The goals can be relevant during or after use.

Goal
This is the work result sought by the user through the use of a system.

In contrast to goals, **tasks** are described as activities (ISO, 2018). There is always a connection between goals and tasks. While the goal is the intended work result, tasks are completed with the interactive system. Tasks usually consist of individual subtasks (activities) necessary to achieve the goal. The individual activities are not sufficient to reach the desired goal, but they are an important step toward it. A subtask is, for example, a decision that has to be made or an action that has to be taken to get closer to the goal. Often these are input or output options. For example, the decision on a departure time or for a certain route are both individual subtasks in the purchase of a train ticket.

Task
A task is what users do (the activity) to achieve their intended goals.

The **environments** include all physical, social, technical, cultural, and organizational conditions under which a user interacts with the system (ISO, 2018). They serve as a further source for deriving user requirements. The physical environment is the place where interaction occurs. When describing the environment, all factors that could influence the interaction must be taken into account (e.g., noise level, temperature, lighting). The social environment refers to the people who are present during the interaction with the system. These can be, for example, family members, friends, work colleagues, or complete strangers. The technical environment includes other tangible and intangible factors that surround the user during the completion of the task and potentially influence the interaction. In particular, this includes access to energy (electricity) and internet. In addition, furniture, such as a desk or an office chair, can also be part of the technical environment. The cultural environment under which the system is used includes languages, the legal situation, and values. The organizational environment is formed by concepts such as the organizational structures, working practices, processes, and codes of conduct.

Environment
The environment includes different external factors possibly influencing the interaction with the system directly or indirectly.

To complete tasks with an interactive system, reusable and depletable resources are needed. Reusable resources are resources that can be used multiple times and/or permanently. Depletable resources are used up after a defined and shorter period of use. Resources can be both physical and non-physical in nature. Reusable resources include, for example, hardware and software equipment (e.g., PC, smartphone, tablet, operating system), information, as well as human and technical support. Examples of depletable resources are time, money, and the ability to concentrate.

User needs

User needs are derived from the context of use information and form the basis for determining the user requirements as a helpful intermediate step (ISO, 2018). A user need is defined as a necessary condition for the user to achieve a goal specified in the context of use. The formulation of requirements makes it possible to define user requirements as precisely and completely as possible, before designing the user interface. When formulating, it is important to note that requirements are always solution-independent, and user needs consist of two parts: a necessary precondition in the form of a state (having, knowing, or being able to) and the goal to be achieved (deciding or achieving something).

EXAMPLE

1. Users of streaming platforms (user group) need to know where to enter their log-in data (information) in order to listen to music (goal).
2. User requirements can then be systematically derived from the formulation of the requirements, i.e., what the user must be able to do on the interactive system (e.g., select or enter something) in order to achieve the desired goal (e.g., select or enter something).

1.2 Goals and Challenges of User Research

The overall goal of user research is to create better and more successful systems and services by meeting users' needs (Goodman et al., 2020). To achieve this, user research relies on data-based knowledge instead of assumptions about wants and needs (Marsh, 2018). User research thus offers many advantages, both in the private and corporate environments (e.g., business software, but also machines and other means of production), and also for the companies that develop these products. Among 525 user researchers in 44 countries, a survey showed that, in practice, the three most important goals of user research are understanding user needs, validating early stage solutions such as prototypes, and having the voice of the customer (Balboni, 2021).

For companies, various sub-goals can be achieved through user research (Marsh, 2018). These include challenging implicit assumptions about users and enabling responses to changing behavior and expectations of systems. The stakeholders involved in the process can make decisions based on evidence from real users, not opinion and estimations. Improving existing and recently developed systems with the involvement of users can enhance the quality of the system and thereby increase the profitability of the company, saving money in the long run due to reduced training and support costs, and resulting in competitive advantages. Doing user research limits the risk of failure and increases chances of success and of meeting user expectations (Savarit, 2020). Additionally, improving

the system while in development is less expensive than once the system is on the market (Savarit, 2020). Interactive products that are fun and lead users to their desired goals often have a **viral effect**, as they are more likely to be recommended to other potential users.

Viral effect
The viral effect is the growing popularity of a product due to recommendations, especially in social networks.

Companies benefit in many ways from using interactive systems that have been developed on the basis of user research. Process efficiency and user productivity increase, as the systems are more accepted by the users. Another important advantage, especially for security-relevant processes, is that risks can be reduced by detecting vulnerabilities early, during the development phase.

For the user, there are advantages to improving product handling and the user experience, i.e., products should be easier to use (ISO, 2019a). This increases comfort and reduces stress stemming from interaction with the system. Another goal of user research is to increase accessibility so that people with different needs, characteristics, and abilities can use the product.

Nevertheless, there are several challenges to be faced that need to be overcome within user research. Depending on the extent of these challenges and mitigating factors, user research within a company can be classified into different levels of maturity (Savarit, 2020). The six stages range from no awareness, which means that the company outsources user research and does not focus strongly on it, to maturity. At this level, the company has recognized the value of user research in terms of strategic goals.

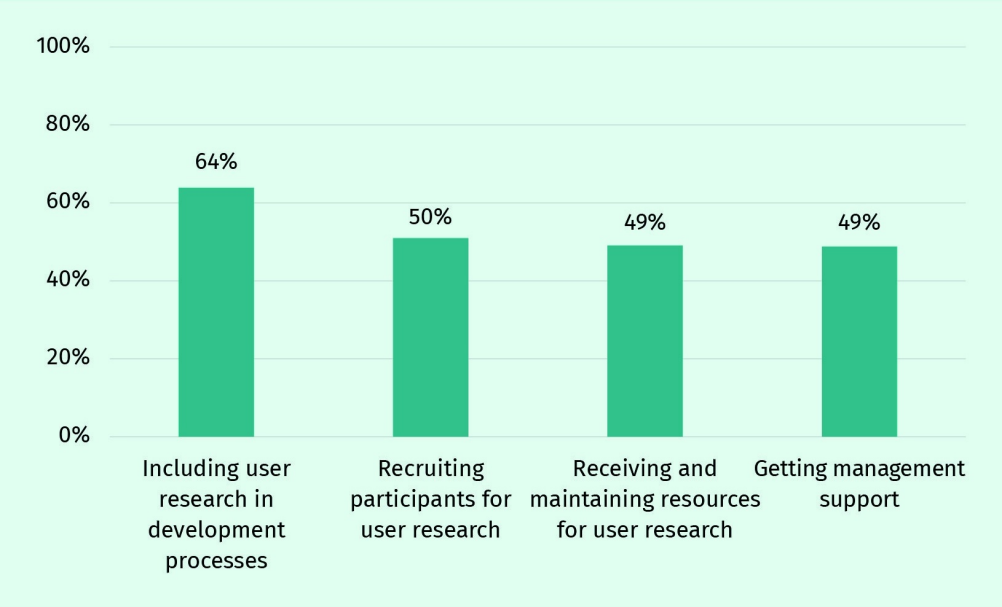
In a global survey, 222 professionals in user research at organizations with more than one thousand employees were asked about the use of user research within their companies (Duddell, 2019). The results showed that integrating user research into the development process (64%) is the number one challenge they face. This is followed by the recruitment of participants (50%), securing resources and budget (49%), and attaining executive buy-in (49%).

Additional identified challenges include (UXarmy, 2020)

- selecting an appropriate scope of the research as part of the planning process. An incorrect scope can result from factors such as inexperience and can lead to unusable findings.
- bandwidth constraints limiting the ability to maintain a holistic picture of the research. This problem can be faced by both user researchers due to being too overloaded, and by stakeholders because of a lack of contextual information.
- research often being undervalued because metrics to quantify success are missing.
- reported findings that are not always incorporated into design solutions.
- user research at times being only a formality, and not carried out because stakeholders and management want to gain real insights.

To overcome these constraints, user researchers need specific skills and capabilities (Savarit, 2020).

Figure 3: The Top Four Challenges in User Research



Source: Lina Kluy (2022), based on Duddell (2019).

Inclusion in Product Development

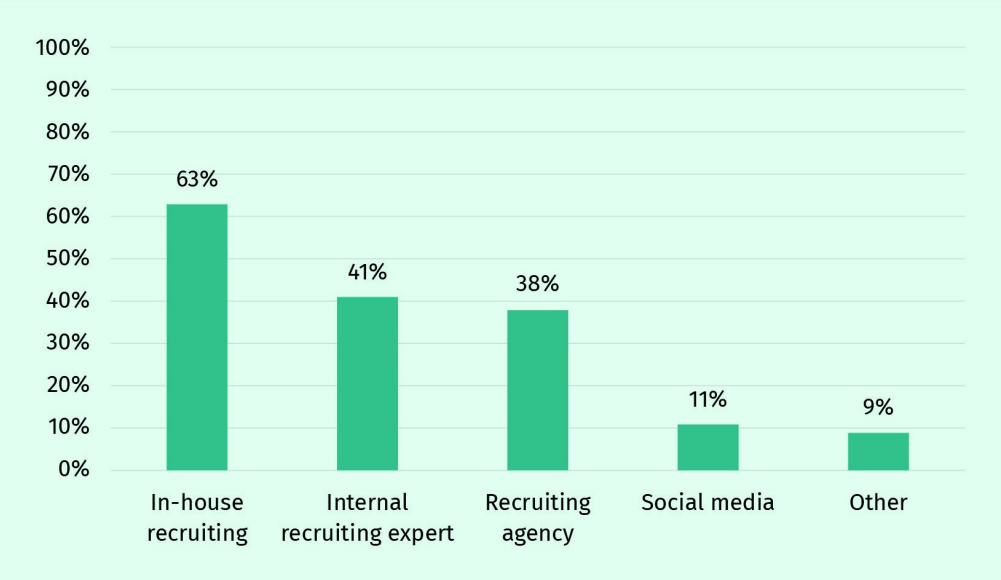
According to the study by Duddell (2019), the biggest challenge is to integrate user research into a company's development process (64% of respondents). The continuous inclusion of user research in the development process from the earliest possible moment is crucial for the success of a product. It is the only way to manage the process from the user's point of view, thus avoiding costly wrong decisions and saving the company money, time, and resources in the end. Often, the integration of user research fails because several challenges occur in combination: Problems in the recruitment of participants can lead to insufficient relevant research results being presented, which then leads to management providing no or minimal resources. This in turn makes it difficult to conduct good user research. Therefore, user researchers often have to find a cheap and fast way to interactive user feedback. Even with a limited budget and a small group of test users, interactive systems can be designed to meet user needs.

Recruitment of Participants

Recruiting the right participants is essential to user research. Recruitment is time-intensive and requires a concentrated effort. According to Duddell (2019), recruiting suitable participants was considered a challenge by 49 percent of those surveyed. However, in order to obtain the most valuable, useful, and objective findings, it is important to recruit the "right" participants and overcome the numerous hurdles in doing so (Marsh, 2018). For example, the "wrong" people may be recruited because the company does not know who the potential users are in the first place. If the wrong people are researched, the findings may be unusable. The right test persons can already be customers and users of a product, as well as people expected to use the product. However, there may be users who are diffi-

cult to reach, such as lawyers or CEOs of large companies. Similarly, specific target groups are more difficult to recruit, such as specialized care workers with limited time. If the target group is very diverse, it can be extremely expensive to include all potential user groups. This challenge may originate from carrying out an internal recruiting process (63%) and retaining from consulting recruiting agencies or services (Duddell, 2019).

Figure 4: Methods of User Recruitment



Source: Lina Kluy (2022), based on Duddell (2019).

Resources and Budgets

Many companies are reluctant to allocate resources to user research (Duddell, 2019). For example, they are afraid that the research will be costly and take several months. In the worst case, project managers or budget managers think, “Why should we spend so much time and money on user research? We have (UX) designers, they already know what our customers want.” Skeptical managers are therefore reluctant when it comes to allocating extensive resources to user research. Accordingly, user researchers have to convince and be pragmatic in order to get the best out of scarce resources. Equally important is that they are able to communicate findings in a way that is appropriate for the target group (e.g., to developers, designers, and other stakeholders). However, good user research does not necessarily require extensive resources; simpler measures are often sufficient to obtain valuable insights. Fortunately, this challenge is seeing improvement (Duddell, 2019): In 2018, 60 percent of respondents saw securing resources and budget as the biggest hurdle. This figure dropped to 49 percent within a year.

Support by Management

Although 70 percent of CEOs have recognized that products that are developed on the basis of user research offer a competitive advantage, management support remains a challenge (Duddell, 2019). It was also noted as one of the most challenging phases within the research process.

User Researchers and Their Skills

User researchers require strong research backgrounds (Savarit, 2020). They must have a wide range of professional qualifications and skill sets. Some examples of the essential skills a user researcher should possess are the following:

- mastering research methods. User researchers must be experts in research methods to collect the right data from the users. They need to understand how to assess behavior and expressions of opinions and when to use which method.
- analytical thinking and attention to detail. User researchers must be able to summarize and extract findings from the data and interpret the results of the analyses, e.g., to prepare reports.
- critical thinking. To challenge design as well as non-reflected assumptions about users and their needs, critical thinking is one core skill of user researchers.
- planning and scheduling. To organize the entire user research process and have a broad overview of it, skills in planning and scheduling are needed. Therefore, a good understanding of the development cycle is necessary.
- interviewing. User researchers interview and observe users. They need specific skills to conduct research sessions, and soft skills like empathy during interactions with participants.
- communication. A user researcher has to communicate regularly, e.g., during identification and recruitment of participants, when moderating and dealing with users, as well as when convincing other stakeholders by presenting findings in project meetings.

SUMMARY

User research is the study of people in connection with the product to be developed; hence, it is an essential part of the development of interactive systems, products, services, etc. Studying users should be integrated throughout the entire development process, but it is especially important in two phases of development: when specifying design solutions and when evaluating designs. When specifying the context of use and user requirements for the product in early phases of the product cycle, user requirements consider user needs when specifying the design solutions (e.g., through observations and interviews). Additionally, user research is important when evaluating design solutions. An important characteristic of involving users is to create an iterative process, so that results and ideas can be tested against one another to continuously refine the design.

The goal of user research is to include users and their needs into development and ultimately have a satisfying, usable, and needed product with the right features. Nevertheless, user researchers face several challenges that are difficult to overcome, such as including users in the process and obtaining support from management. That is why user researchers require particular skills and capabilities for planning, conducting, and presenting user research.

UNIT 2

BASIC IDEA OF USER-CENTERED DESIGN

STUDY GOALS

On completion of this unit, you will be able to…

- understand the concept of user-centered design.
- identify the activities carried out in user-centered design.
- recognize the importance of iterative design in user-centered design.
- appreciate how design solutions are communicated in practice.

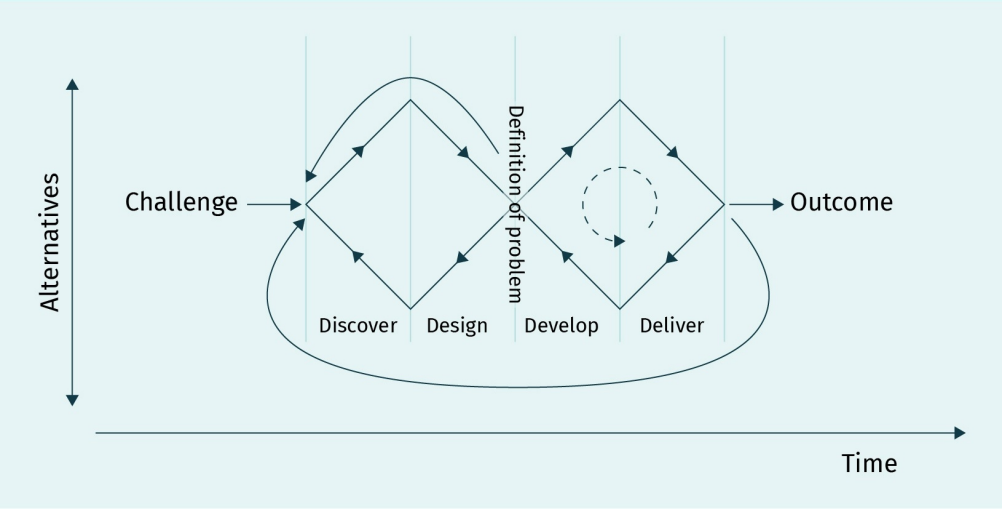
2. BASIC IDEA OF USER-CENTERED DESIGN

Introduction

User-centered design (UCD) is a design philosophy (Norman, 2013): Users are involved throughout product development and even after the product enters the market. By taking human needs, skills, and behavior into account, the purpose is to create usable, functional, efficient, and desirable systems. In employing methods throughout the product life cycle, user-centered design is a holistic and iterative product development approach focusing on and involving the users of systems.

To find the right solution within design, different solutions must be tried. However, the first goal is to identify the right problem among many. This approach is captured in the double-diamond design process model, which describes the general approach of design (British Design Council, 2019; Norman, 2013). The model is among the most used to organize design projects. Starting from a challenge, the process then consists of two main phases: finding the right problem and finding the right solution, before ending in an outcome. Both phases are again divided into a phase of divergence (broadening the scope) and then convergence (narrowing the scope) of ideas. For "finding the right problem," these phases are called discover and define. The discovery phase includes a thorough search for a deeper understanding of the challenge designers are trying to solve before narrowing the possibilities down again into the clear definition of the problem. The two phases of "solving the problem" are develop and deliver. The development phase enables designers to create different solutions before narrowing through testing. Together, these four phases look like two diamonds next to each other. It is not a linear process, rather an iterative one. Additionally, influencing components such as design principles, a methods bank, and factors like leadership and engagement surround the diamond.

Figure 5: Double-Diamond Design Process Model



Source: Lina Kluy (2022), based on British Design Council (2019).

User-centered design in this model takes place by iteratively going through the activities of understanding, designing, visualizing, and evaluating until the right solution for the right problem is found. To better understand this complex process, this unit will explain these four essential core activities of user-centered design.

Finally, the topics of **iterative design** and implementation are presented in depth. Within iterative design, changes are incorporated into the product over time based on user needs and feedback to continually improve the system from the users' perspective.

2.1 Understanding

The goal of the understanding phase is mainly to understand the existing problem. This corresponds to the first phase, "discover" in the double-diamond design process model (British Design Council, 2019; Norman, 2013). The purpose is the identification of (Savarit, 2020):

- (potential) users, their specific characteristics, and profile.
- needs of the (potential) users that should be incorporated into the development process.
- existing products and procedures that are currently in place and used.
- advantages and well-working functions of the current products.
- disadvantages and non-functional features of the current products.
- business needs (the organizational reasons for developing the system).
- the market gap that should be closed by the system.
- important legislative aspects that need to be applied.

Therefore, the user researcher observes (potential) users to generate knowledge about their behavior, characteristics, needs, problems, environments, interests, and motivations. This understanding or the subsequent steps have a great influence on the success of the interactive system (International Organization for Standardization [ISO], 2019b).

Understanding and specifying the context of use is the foundation of user-centered design and the central task of the user researcher. It should help to understand the problems that concern potential users and is thus considered a key source of information for defining the user requirements for an interactive system. Understanding the context of use is therefore of central importance for the entire design process.

This applies to both the new development and the revision of interactive systems. In the case of existing interactive systems, it is partly possible to draw on existing data, for example, from previous evaluation or user studies. In the case of new development, on the other hand, the context of use must be fully investigated. In both cases, existing data, such as competitor analyses, market research reports, documentation, customer service center reports, workplace descriptions, and information on technical, organizational, and formal boundary conditions, are used.

However, these data are not sufficient to gain an accurate understanding of user needs and requirements and their ways of working. A deep understanding of users, their actions, skills, experiences, difficulties, and conditions of use thus require empirical investigations of the context of use.

Methods for the Empirical Collection of Context of Use Information

Methods for the empirical collection of context of use information, i.e., user goals, their actions to achieve their goals, and the obstacles they face in doing so, are the starting point for design. In order to understand the context of use, one must establish contact with users and observe or interview them. Some typical methods for collecting context of use information are observations, interviews, focus groups, and cultural probes.

Observation

Observation
In this method, the researcher watches the user performing tasks connected to the system in order to draw conclusions.

The design process should start with the **observation** of potential users in the natural setting where use of the system would occur. It is one of the most important methods for understanding the context of use (Norman, 2013). The focus should be on users' actions and environmental and situational factors that bear influence. To draw meaningful conclusions from observation, the observed people should be similar to the intended users. Observation helps to understand the conditions under which users interact with the system, their activities, interests, motives, and underlying needs. In this way, workarounds and difficulties that are not mentioned can be identified, e.g., in an interview, because users may take them for granted or follow them without being aware of it. In addition, people often tend to do things differently than what they state or claim. Observations are therefore particularly well-suited when very little is known about the context of use.

Interview

Interview
In an interview, users are asked questions about their experiences, needs, and problems related to the system.

The **interview** is among the most frequently used user research methods. Interviews are individually guided conversations and effective for collecting information about what users want and what problems they are currently facing (Baxter et al., 2015). Interviews with users and other stakeholders are thus a valuable source of information. It is important that the focus of the interview be on the context of use and not on the interactive system itself.

Focus group

In a focus group, a moderator leads a group discussion on a specific topic (Baxter et al., 2015; Goodman et al., 2020). Focus groups are thus similar to an interview in some respects. Since several participants are interviewed together or discuss a topic, group reactions can be studied. The purpose of this method is to obtain information about the users' priorities, desires, ideas, and problems.

Cultural probes

Cultural probes are a collection of working materials for self-documentation. The participants usually receive a package with several materials and creative tasks, such as disposable cameras, audio recorders, postcards, and diaries. They are then asked to use these materials to create items such as stories, drawings, and sculptures. With the help of these materials, they independently document certain aspects of their everyday life, thoughts, feelings, and environments (Gaver et al., 2004).

Cultural probes make use of some of the more traditional survey methods, such as diaries and open-ended questions, but are deliberately much more experimental. It is this experimental character that makes cultural probes a valuable method because they often serve as a source of inspiration in the design process by providing information about the lives, thoughts, and values of the participants.

Above all, they help in better understanding the target group emotionally and create access to everyday situations and contexts that are otherwise rather elusive, or thoughts and feelings that are difficult for the participants to articulate consciously.

Methods for Documenting Context of Use Information

In order for the findings from data collection to be systematically processed in the development process, the collected data must be analyzed and documented in a context of use description. There is no fixed format for such a description, rather it is a collection of different forms of documentation of context of use information.

Examples of typical forms of documentation are

- user group profile (who are the users?),
- persona (who are the users?),
- current situation (how do users currently perform their tasks?),
- task model (what do these tasks look like in detail?), and
- user journey map (how do users interact with the interactive system?).

User group profile

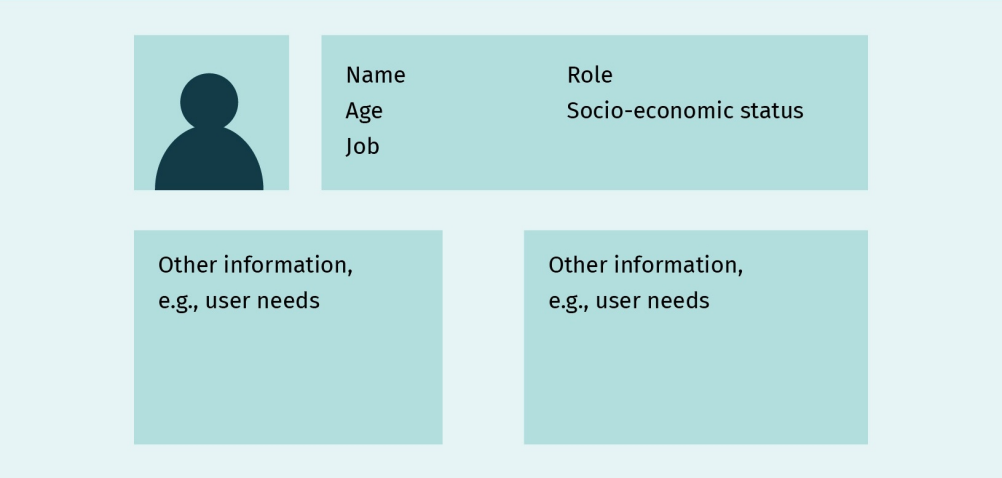
A user group profile describes characteristics of the users based on, e.g., demographics, job role, and socio-economical background (Savarit, 2020). It should provide the range of and the most common characteristics or skill levels that typical users may have. Users are generally classified into different user groups based on their activities or experience. The description usually takes the form of a table describing various aspects of each user group that are relevant to the planned interactive system.

Persona

Similar to user group profiles, personas describe the characteristics, skills, experiences, and context of a user group (Goodman et al., 2020; Marsh, 2018). Personas are fictional profiles representing a specific example of the user group. A persona contains socio-dem-

ographic characteristics (name, age, education, etc.), a picture, as well as the users' motivation, needs, and wants. The information they contain is based on empirical data. By giving the user group a face and a name, it should become more tangible for the design process. This helps designers and others involved in the project empathize with the target group, put themselves in their shoes, and sensitize them to the concerns of the users.

Figure 6: Persona Visualization Example



Source: Lina Kluy (2022).

Scenario

Scenarios are hypothetical or actual stories or descriptions of how users currently proceed to achieve goals (Marsh, 2018). Scenarios need to be detailed enough to understand and reasonably explore an aspect of a system. To do this, it is important to describe the story and the context. Scenarios are presented from the users' point of view and include information about who the users are, what motivates them, their expectations, and their goals. Scenarios are tailored to specific user groups and are represented by text, videos, or a storyboard consisting of a series of images.

User journey map

The visualization (e.g., diagram or table) of touchpoints between users and the system is called a user journey map (Marsh, 2018). It shows a general overview of factors that influence the user experience and is presented from the user's perspective. In addition to objective information, such maps can also contain emotions, expectations, motivations, and questions, and show these for a specific time segment. There are separate maps for each user group.

2.2 Design

Understanding the user and the context of use is a central task of user research. The results help designers develop an awareness of user requirements and generate ideas that best meet user needs. This means the result from the understanding phase serves as the basis for the designing phase, where creativity is essential. In the double-diamond design process model this corresponds to the second phase (British Design Council, 2019; Norman, 2013). For the development of ideas, there are numerous methods. In all of them, following the following three rules are critical (Norman, 2013):

1. Alternative solutions. Multiple ideas should be generated.
2. Unrestricted creativity. Unrealistic and seemingly crazy ideas should not be criticized, because they could be helpful and provide creative insights.
3. Unlimited questioning. Obvious things should be questioned and tested. Often a solution is only found when the supposedly obvious is questioned.

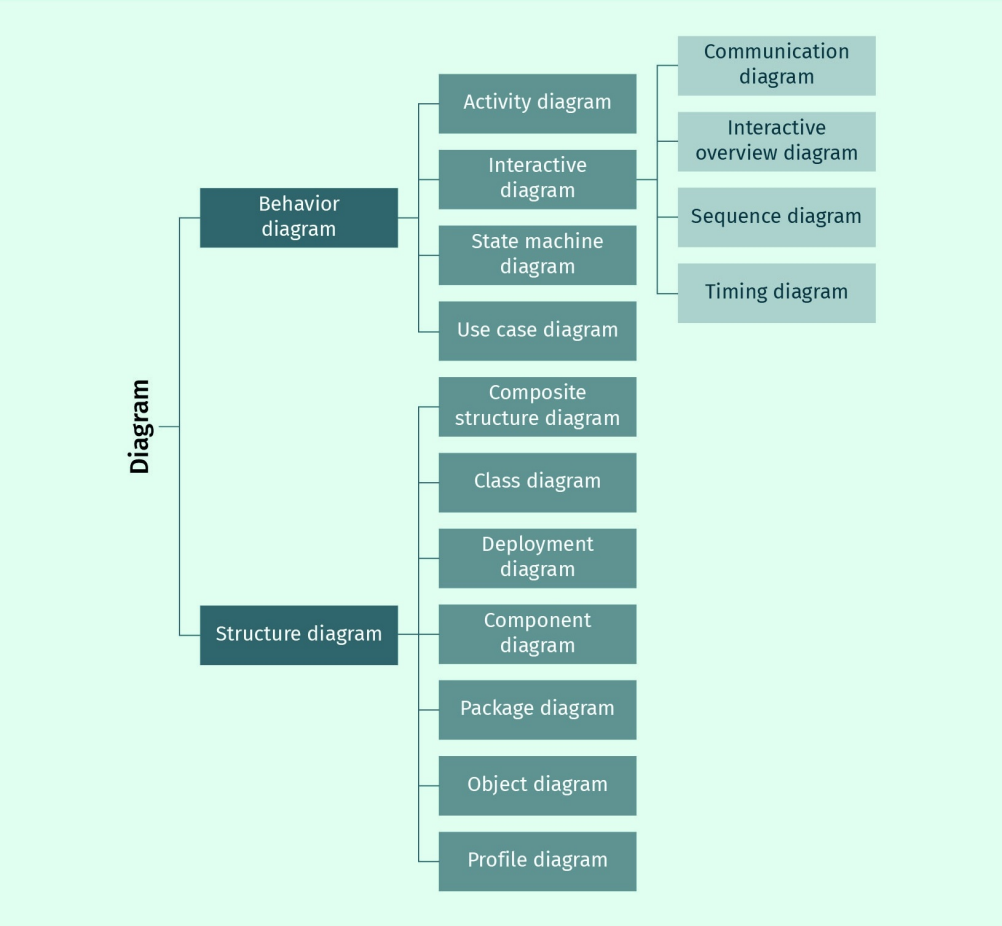
Conceptual Design

A clear conceptual design is of central importance for the development of understandable and easy-to-use interactive systems. Conceptual design is about how things should be structured, classified, and organized so that the interactive system meets the expectations and needs of the user. The conceptual design builds on the findings of user research and is checked against these findings as well. Different modeling techniques such as structural, interaction, and behavioral models are used. The use of metaphors can also help users to develop a clear mental model of the interactive system.

Modeling techniques

The structure of an interactive system is usually represented by diagrams. For example, in software engineering, Unified Modeling Language (UML) is the most frequently used graphical object-oriented modeling language (Seidl et al., 2015). It is used to visualize structures, interactions, and behavior on the basis of various diagrams. There are 14 different types of diagrams in UML (Seidl et al., 2015).

Figure 7: Types of Diagrams in UML

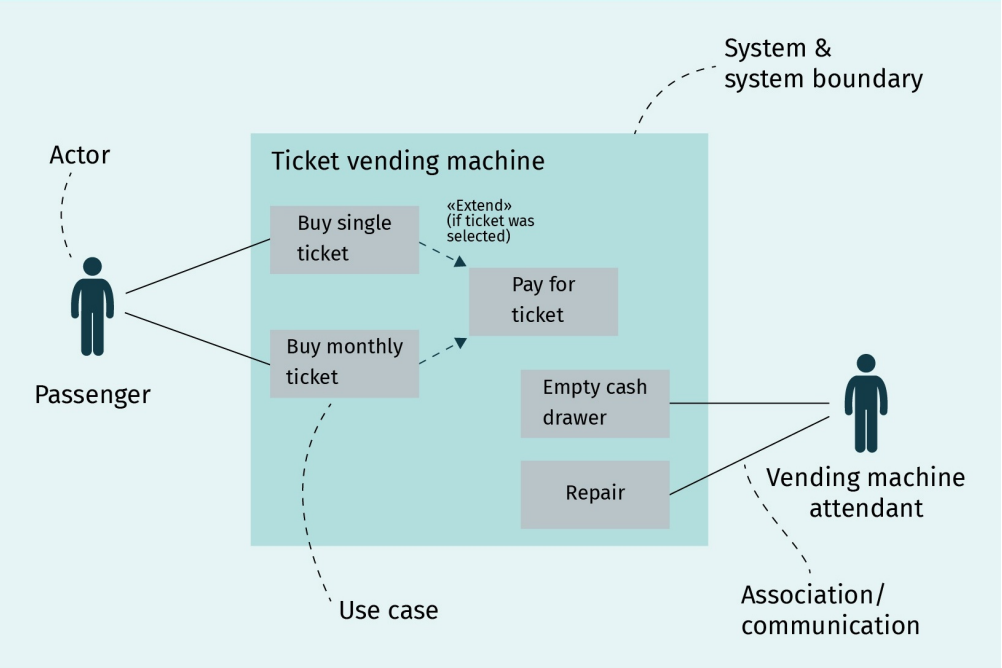


Source: Lina Kluy (2022).

Designers need not know all the details of each different diagram type, but it is important to know that they exist, as they are powerful tools that help designers to reflect on the details of a design and see more clearly whether its logic works. Some examples are

- class diagrams. These diagrams are often used to represent navigation structures of websites (as sitemaps), for example. The class diagram belongs to the structure diagram category.
- use case diagrams. These diagrams shows which use cases the interactive system can be used for and by which actors (e.g., the users, but also other systems). It thus depicts the use cases and actors with their relationships and dependencies. In user research, they are used to better understand which (groups of) users perform which tasks with the interactive system. The use case diagram belongs to the behavior diagrams category.

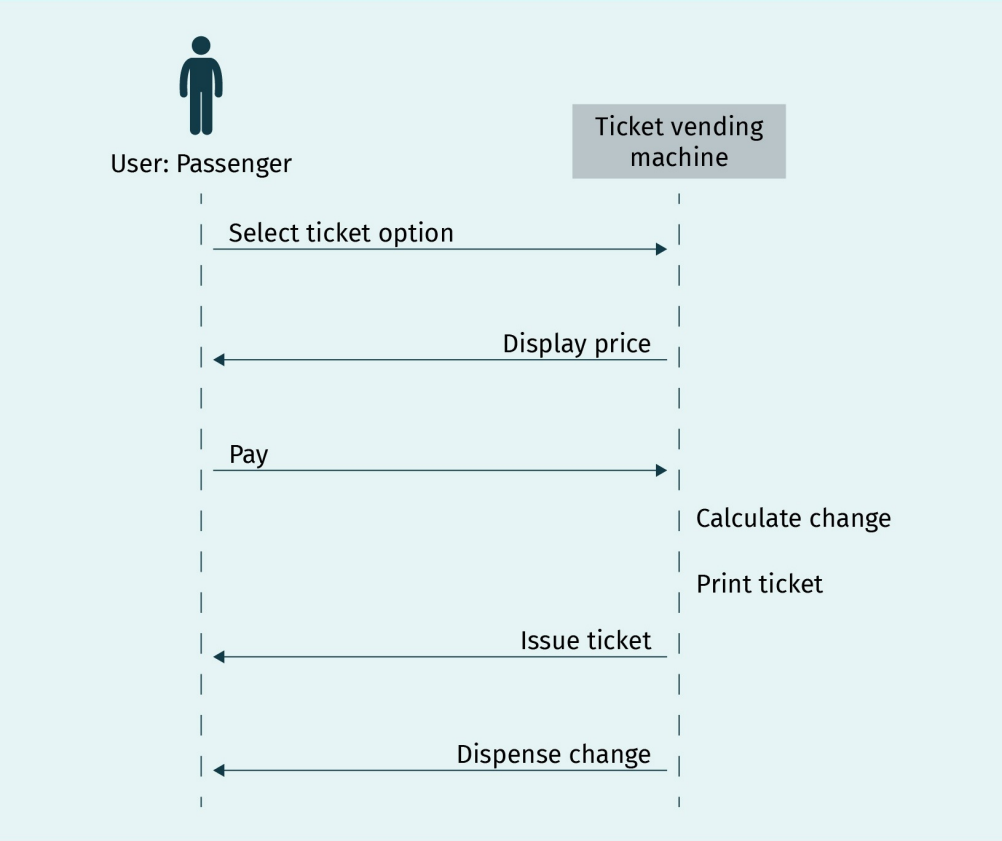
Figure 8: Use Case Diagram Example



Source: Niels, 2019. Used with permission.

- sequence diagrams. These diagrams describe a path within a system using a decision tree. Sequence diagrams help to understand and design interactions between users and the system. For overviews of all possible decisions, activity or state diagrams are used. The sequence diagram belongs to the interaction diagram category.

Figure 9: Sequence Diagram Example



Source: Niels, 2019. Used with permission.

Metaphors and mental models

A metaphor is a word or expression that is transferred from its original context into another. The design of a computer's user interface, for example, incorporates many familiar terms (e.g., desk, window) and icons (e.g., recycle bin, folder, magnifying glass) that have been transferred from everyday life (source domain) to the system (target domain). Metaphors can therefore be both textual and pictorial. Metaphors help users to intuitively perceive the meaning and purpose of certain features. By analyzing users and the context of the use of an interactive system, user research provides the basis for the design of metaphors.

The use of metaphors can help users understand the interactive system and develop an appropriate mental model. A mental model is an idea or set of assumptions about how a system works (Norman, 2013). It is formed through perceptions of the system, understanding how it works, previous experiences, and instructions. Essentially, it exists in the minds of the people. Individuals have varying mental models which may differ from the conceptual model held by the designer, or the system image built by the physical appearance of the system.

Based on the mental model, users make predictions about how a system will behave. A mental model is not stable, as it changes, for example, through use and the increasing experiences that come with it.

Physical Design

Since people can only interact with a system through their senses, the abstract conceptual design must be spatially translated, i.e., become a physical object, so that it can be grasped by the user's senses. The physical design gives the interactive system its shape. It is therefore concerned with the functioning and appearance of the interactive system, in other words, how the interactive system should function, look, and feel. It is about translating the abstract representation of the conceptual design into concrete drafts or design proposals. In physical design, a distinction is made between graphic design and interaction design.

Graphic design

Graphic design is concerned in particular with questions of style and aesthetic aspects, such as the definition of colors, shapes, icons, sizes, fonts, and layout. It is about the feelings the interactive system should evoke in the user, but also about ensuring that information can be retrieved efficiently. It therefore also includes the dialogue design and operational topics. Graphic design has a particular influence on the user experience of the interactive system. Style issues concern the general appearance, the look and feel of the system. For example, should the system appear rather simple, cool and modern, or colorful and playful? What moods and feelings should the design convey?

For example, bank websites should convey a serious impression and are therefore usually designed in rather plain colors and with a clear structure. Other interactive systems aim at making the interaction exciting or entertaining (e.g., computer games). It is important that the appearance fits user ideas and expectations.

To visualize the look and feel, a mood board is often created. Mood boards are collages of different things such as graphics, photos, shapes, color tiles, typographic elements, and icons. A mood board helps to visualize the aesthetics and mood and serves as a basis for discussion to set the basic tone of the design. It is also used as a communication tool, for example, to illustrate to other stakeholders what impression the interactive system should convey.

Interaction design

While graphic design refers primarily to the design of the user interface, interaction design is concerned with the interactions between the user and the interactive system. The relationship between the user and the interactive system should be designed as sensibly as possible, so that users reach their goal as easily and effortlessly as possible. This only works if the design of the interaction is based on the findings of user research. Interaction design therefore has a considerable influence on the usability of an interactive system.

2.3 Envision

In the design phase, abstract solutions are developed that need to be visualized. A cheap and quick solution for this is prototyping (Knight, 2019). Prototypes show how the design might look and/or feel without significant effort. Additionally, they can be changed rapidly, which enables iteration, and hence are a relevant step before implementing the system technically. This corresponds to the third phase, "develop," in the double-diamond design process model (British Design Council, 2019; Norman, 2013).

Prototypes can be used for the designers themselves, to rapidly visualize for communication and finding orientation in the development cycle (ISO, 2019b). Prototypes also stimulate thought, and designers use them to narrow down, refine, and discover possibilities in a design space. The prototypical realization of design solutions also serves as a means of communication between designers and other project participants, such as marketing and project or product management. Furthermore, prototypes are used to gather feedback from users.

There are different ways to visualize design solutions (Lim et al., 2008). The fidelity and the range of functions are oriented in particular to the following circumstances:

- development phase. In which phase of development is the prototype created? At the beginning of the development or at the end?
- objective. What is the purpose of the prototype? Does it serve internal purposes, e.g., to present ideas to other project members, or for user tests, e.g., to get user feedback?
- resources. Which and how many resources (time, money, staff) are available to implement the prototype?

Sketches

A sketch is a simple graphical representation of an idea or concept. Sketches are virtually disposable, as they can be created quickly and cheaply with no effort. They are cheap because they only require a pencil and paper, and quick because of the minimal level of detail. Sketches are not made to last, but they are nevertheless very valuable. They encourage creativity and are a suitable tool for quickly visualizing a wealth of ideas without having to worry about quality. Sketches are different from prototypes because they only hint at something and do not solve anything.

Prototypes

In contrast to sketches, prototypes provide a more detailed version of a design or draft. In a prototype, parts or functionalities of an interactive system are implemented to such an extent that they can be tested. There are various ways in which prototypes can be categorized. In practice, the following distinctions or types of prototypes are common:

- exploratory, experimental, and evolutionary prototyping (differentiation with regard to the objective).
- low-fidelity and high-fidelity prototypes (differentiation with regard to the degree of representational detail).

- horizontal and vertical prototypes (differentiation with regard to the level of interaction).

Exploratory, experimental, and evolutionary prototyping

With regard to the objective, prototypes can be divided into three categories (Floyd, 1984): exploratory, experimental, and evolutionary.

Exploratory prototyping is often used in early development phases, especially in user research to explore user requirements or when the problem is still unclear. It serves as a basis for teams to try out different approaches to a solution and to assess the possible realization. The focus is on the functionalities and not on the visual quality.

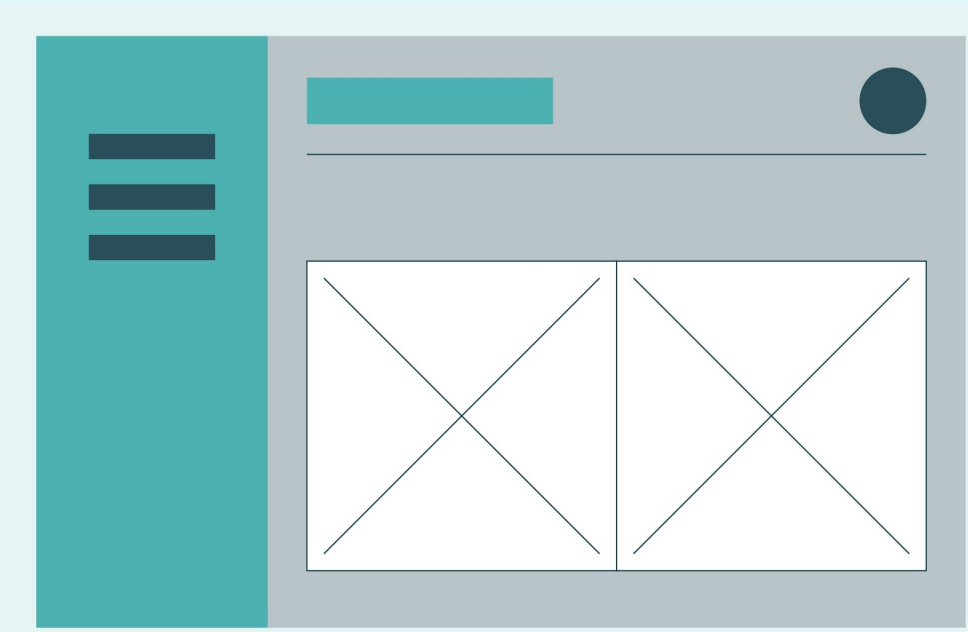
Experimental prototyping is used in particular when there are doubts about the intended use or possible implementation. Within this framework, different implementation options are then tried out, tested, and compared with one another.

In evolutionary prototyping, the functionalities of the interactive system are built up and expanded step by step. The development of prototypes and the real system runs in parallel, or the prototype itself is more or less the system. The prototype is not discarded, but rather built up. In each intermediate step, the prototype is evaluated and refined on the basis of the results.

Low- and high-fidelity prototypes

Prototypes can be distinguished according to their level of detail (Knight, 2019; Rudd, Stern, Isensee, 1996): low-fidelity and high-fidelity. Low-fidelity prototypes (rapid prototypes) are not as detailed and can be created quickly. They are mostly non-interactive and paper-based. High-fidelity prototypes, on the other hand, are more detailed, often computer-based and interactive. They should represent a system or an interface as truthfully as possible so that users and other stakeholders can gain a holistic impression (Floyd, 1984).

Figure 10: Low Fidelity Prototype



Source: Lina Kluy (2022).

Table 1: Characteristics of and Differences between Low- and High-Fidelity Prototypes

	Low-fidelity prototypes	High-fidelity prototypes
Look and feel	• Are mostly made of paper • Can be changed quickly and easily • Can be designed very flexibly, e.g., with sticky notes, which can then be moved, changed, replaced, or added to during the evaluation process • Focus on basic design ideas such as content, form and structure of the design, main functional requirements, and navigation structure • Have only limited interaction and navigation possibilities, which is why test persons must have a good imagination	• Are technically implemented, e.g., with the help of special tools • Are similar in appearance and behavior, possibly even in functionality, to the final version of the interactive system • Cannot be easily changed • Represent a realistic situation with a realistic look and feel • Often cover the entire functionality of an interactive system
Project phase and deployment	• Are used in early project phases • Often, several prototypes are implemented to evaluate design alternatives or to conduct feasibility studies • System reactions cannot be tested	• Are used in later project phases (if the prototypes are used in too early a design phase, this can lead to a premature design decision) • Are suitable for extensive evaluations, e.g., of content, graphics, interactivity, functionality, and media

	Low-fidelity prototypes	High-fidelity prototypes
Creation	• Fast and cheap to produce, therefore require only a few resources (development time and costs) • Users can participate directly in the creation (participatory design)	• Production consumes many resources (time and money) • Created by skilled personnel

Source: Niels, 2019. Used with permission.

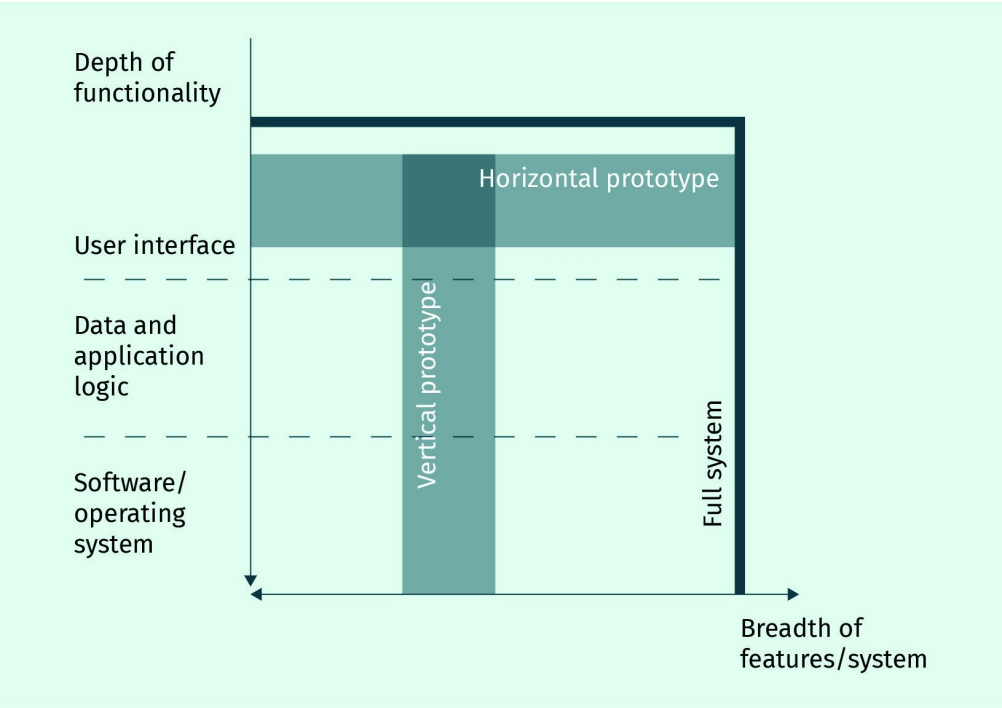
Horizontal and vertical prototypes

In terms of their interaction level, prototypes can be divided into horizontal and vertical prototypes (Floyd, 1984). In a horizontal prototype, the components of only one software architecture layer are implemented, e.g., only the elements of the user interface or only the components of the application logic, and so on. In a vertical prototype, individual and selected functionalities are implemented across all software architecture layers.

Horizontal prototypes can be implemented as both low-fidelity and high-fidelity prototypes. In early project phases, as a low-fidelity prototype, they are used for tasks such as defining the set of features to be integrated. In later project phases, they are used, for tasks such as evaluating the navigation concept.

Vertical prototypes can also be implemented as both low and high-fidelity prototypes. In early project phases they can be used, for example, to test different variants of a specific functionality against one another, and in later development stages, to improve the usability of a specific function.

Figure 11: Horizontal and Vertical Prototypes



Source: Lina Kluy (2022), based on Nielsen (1993b).

2.4 Evaluate

The Evaluate activity is closely linked to the Understand, Design, and Visualize activities, as the products (prototypes) are used to verify that the design solution meets user requirements. Evaluation is of central importance in user-centered design, as each step should be validated by an evaluation. In the double-diamond design process model, evaluation takes place in the last phase, “deliver” (British Design Council, 2019; Norman, 2013).

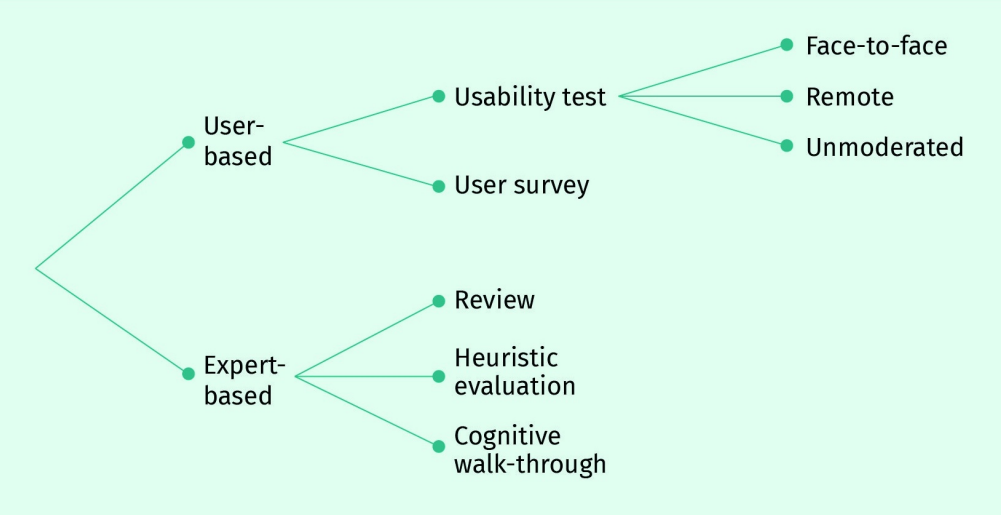
Depending on whether the evaluation takes place with or without the user, a distinction is made between two main types:

1. User-based evaluation. The design is tested by representative users. The aim is to find errors.
2. Expert-based evaluation. The design is inspected by usability experts. The aim is to predict errors.

In the case of user-based evaluations, a distinction is made between usability tests and surveys. Usability tests can be conducted face-to-face (with a moderator, e.g., in a usability lab), remotely (via a medium, e.g., by telephone or the Internet as a chat or video conference), or completely unmoderated (the user tests alone and then fills out a questionnaire, for example). In addition, qualitative (e.g., open questions in a questionnaire) or quantita-

tive (e.g., scale questions in a questionnaire) evaluations can take place. For expert-based evaluations, a distinction is made between review (inspection by an expert or layperson) and heuristic evaluation (predictive evaluation based on predefined criteria).

Figure 12: Types of Usability Evaluations



Source: Lina Kluy (2022).

An evaluation is used to gather information about the usability of an interactive system during development, so that it can be improved (formative) (Baxter et al., 2015). Formative evaluations are mainly carried out using qualitative methods in early development phases using prototypes. However, evaluation can also be used to assess the value or quality of an interactive system and whether it meets the requirements and standards once it is finalized (summative). Summative evaluations take place primarily using quantitative methods in late development phases on the basis of high-fidelity prototypes or a functioning system.

Table 2: Formative and Summative Evaluation

	Formative	Summative
Development phase	Early	Late
Evaluation object	Prototype	Functioning system
Method	Qualitative	Quantitative

Source: Niels, 2019. Used with permission

In the course of developing interactive systems, it is advantageous to use and combine several methods. The appropriate method choice depends on various criteria:

- purpose. If, for example, the effectiveness of an interactive system is to be evaluated (formative), then qualitative usability tests or inspections are the right choice. If the efficiency or the degree of usability is to be measured (summative), quantitative usability tests are suitable. If it is a matter of satisfaction, then user surveys can be carried out, for example.
- project phase. In early project phases, when only low-fidelity prototypes are available and it is still a matter of shaping the system, formative, qualitative usability tests or inspections are mainly used. In later project phases, when high-fidelity prototypes or a functional system are already available, summative, quantitative (but also qualitative) usability tests are used.
- resources. If only few resources (e.g., time and/or money) are available, then remote or unmoderated usability tests are suitable methods.

User-Based Evaluation

It is always better to involve real users in the evaluation instead of experts. If sufficient resources are available, then mainly qualitative or quantitative face-to-face usability tests are conducted.

User surveys can reach a lot of potential users and they are inexpensive to conduct (Marsh, 2018). In a survey, users are asked about their subjective experiences with the interactive system or about the context of use. The answers are written down in a questionnaire either by the user or by an interviewer. Questionnaires are mainly used to obtain information on satisfaction. A survey can include both qualitative and quantitative questions. Depending on the purpose and context of the survey, the number of participants can vary greatly. For (qualitative) usability tests there are usually only a few, while for (quantitative) online surveys there are possibly a few thousand participants. A survey is also a component of a usability test.

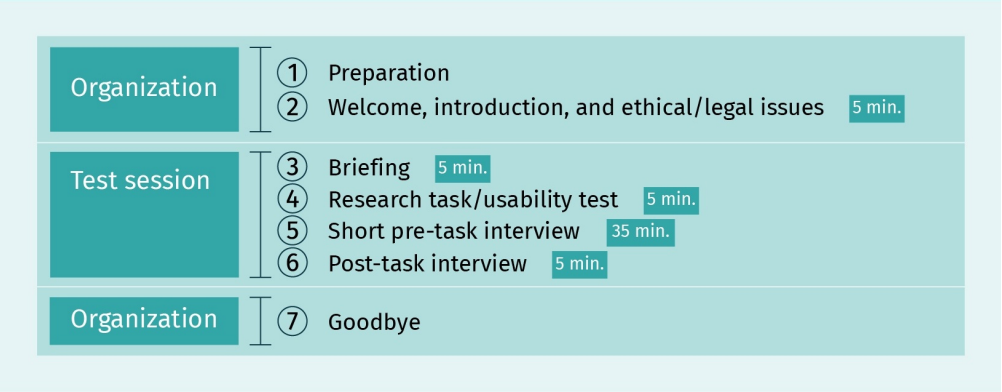
Usability testing
The systematic observation of users attempting to complete a task or set of tasks with the system based on representative scenarios is called usability testing.

Usability testing is a common method for design evaluation (Marsh, 2018). It is used to evaluate whether the solution meets user requirements and which problems persist. Usability testing can be executed in different ways: moderated or unmoderated, and quantitatively or qualitatively. However, five characteristics apply equally to all of them (Dumas & Redish, 1999):

1. Goal. The core goal of a usability test is always to improve the usability of the interactive system.
2. Representative test persons. Test subjects who represent real users of the interactive system are used to conduct a usability test.
3. Clearly defined test tasks. The test items are clearly defined prior to the usability test and are defined before the usability test and are close to reality or practice.
4. Analysis of data. The collected data from a usability test are analyzed by experts to uncover usability problems.
5. Suggestions for improvement. On the basis of the identified usability problems, suggestions for improvement are constructed.

Furthermore, the overall structure of usability testing sessions is often similar, as in the following protocol, for example (Marsh, 2018).

Figure 13: Usability Test Session Protocol



Source: Lina Kluy (2022), based on Marsh (2018).

Before a usability test, the execution of a pilot test (a dummy run session) is advisable (Marsh, 2018). The plan for the session can be tested and problems or inconsistencies in the test script can be identified and resolved.

Expert-Based Evaluation

Expert-based evaluations are based on subject matter experts' judgements of usability. If possible, these evaluations should always be conducted independently by several evaluators, and then the results can be compared and assessed. Expert-based evaluations are distinguished between reviews, heuristic evaluation, and cognitive walkthrough.

In reviews, the evaluation is based solely on the experience of the experts, which may be about (known) usability problems experienced by users. However, the assessment is also based on existing knowledge, for example, about design rules. Furthermore, reviews can be carried out by non-experts. The assessment is then based only on opinions, personal experience, and common sense.

In heuristic evaluations, judgement is based on established criteria, such as heuristics, design rules, and user requirements. The method can be used as early as the beginning of the development process. Early system versions (prototypes, mock-ups, paper and pencil versions) are analyzed and problems that could arise during the use of the system are predicted. The evaluators do not have to perform real tasks, but rather explore the system (freely or systematically).

The implementation is simple, quick, effective, and (cost-) efficient. However, the objectivity of this method must be critically questioned, results are dependent on expertise, detailed suggestions for change are unlikely, and the context of use is usually ignored. Important aspects can therefore be unintentionally neglected. Those criteria are general rules that describe, on an abstract level, properties that user-friendly systems should have.

An example of such rules are the ten heuristics by Nielsen (1993a):

1. Visibility of system status. The system informs the user about the status of the system through appropriate and timely feedback.
2. Congruence of system and reality. The system speaks the language of the user, i.e., uses words, phrases, and concepts familiar to the user. The conventions of the real world are followed, and information appears in a natural and logical order.
3. User control and freedom. Users often perform unintended actions. Functions such as undo and redo are therefore always clearly visible options.
4. Consistency. Users do not have to consider whether different words, situations, and actions mean the same thing. Platform conventions are followed.
5. Error prevention. Better than a good error message is careful design that prevents a problem from occurring in the first place. Error-prone operating options are avoided, or the user is informed about them and given the additional option of whether or not they really want to perform the action.
6. Minimizing of memory load. Objects, actions, and options are visible, so that the user has less to remember. Instructions for use are visible or easily accessible.
7. Flexibility and efficiency. Shortcuts are possible-invisible to inexperienced users—and speed up the process for experienced users. Frequent actions are customizable.
8. Aesthetic and minimalist design. Dialogues do not contain irrelevant or rarely needed information. Any additional information in a dialogue competes with the relevant information and reduces its relative visibility.
9. Error handling. Error messages are expressed in clear language (no code, no technical terms). The problem is described precisely and a constructive solution is proposed.
10. Help and documentation. At best, the system works without documentation. However, users should be provided with documentation. The information needed is easy to find and relates to the user's task. The documentation contains concrete steps and is not too extensive.

In contrast to heuristic evaluation, in a Cognitive Walkthrough, a usability expert examines the system from the user's perspective. The approach is task-oriented, i.e., the expert has to carry out predefined tasks. The evaluator then performs the tasks from a user's perspective and tries to find a justification for each step as to why the user would choose these exact actions. Evaluators receive little or no information about the characteristics of the system, i.e., the question of how intuitively understandable the system is against the background of concrete task accomplishment is examined.

A Cognitive Walkthrough consists of two phases: definition and analysis. In the definition phase, the task scenarios to be tested are selected as are the users (including their experience and prior knowledge of the system and tasks). In the analysis phase, the task scenarios are evaluated by an expert. The cognitive effort required to solve the task and critical points are documented.

2.5 Iterative Design

The purpose of iterations is to further refine and improve the system (Norman, 2013). As even well-trained user researchers and usability experts cannot determine and foresee which design is the best, the concept of iteration should be included in any development process (Nielsen, 1993b).

The process of building a successful interactive system that is useful, intuitive, efficient, and entertaining for users also entails failure, because we know we learn from our mistakes. But it is important to fail early to save resources. The design needs to be prototyped and tested with real users to uncover unforeseen design problems or inaccurate assumptions. These problems can then be fixed in the next iteration of the prototype, which should then be tested again to ensure the problems are fixed. Each new prototype is more detailed than its predecessor and gets closer and closer to the final system. The user-centered design activities of designing, visualizing, and evaluating are carried out until the interactive system or the intermediate results produced meet the requirements for use.

Research has shown that the more iterations in the development process, the better an interactive system in general (Nielsen, 1993b). Case studies have shown a total median improvement in usability of 165 percent, which is a median improvement of 38 percent per iteration, showing that iteration considerably improves usability.

But how many iterations are needed, and when can the iteration process be completed? It is likely that the first few iterations will lead to significant improvements, as this is where the biggest problems are found and fixed (Nielsen, 1993b). Later iterations have progressively less potential for improvement, as the main problems are ideally eliminated and there may be very little potential left for further improvement. It is not known with certainty after how many iterations the threshold is exceeded, beyond which further iterations are no longer economical. In practice, the decision on how many iterations are carried out in a development process, or are at all possible, lies with management. The framing conditions and resources (time and money) influence how many iterations can be undertaken (Norman, 2013).

2.6 Implementation

Once the evaluations have been completed and the design solution meets user requirements, the interactive system still has to be technically implemented. The implementation is not actually a direct part of the user-centered design process, but the results of the design process must be documented in detail so that the developers can implement the interactive system in such a way that it meets user requirements.

The handover process between designers and developers is a critical part of the development process. Designers need to communicate how each part of the design looks, functions, and feels, clearly and understandably . To ensure a smooth handover process, communication takes the form of design specifications and style guides.

Design Specification

The design specification is usually part of a comprehensive specification of all requirements for the interactive system. In addition to the design requirements, this also includes, for example, the technical and internal requirements, as well as the underlying legal conditions. In practice, this specification is referred to as a requirements specification, or less commonly, as a technical concept or system description.

All requirements for the interactive system are summarized in the requirements specification and form the basis for implementation. Since the specifications are usually very extensive, they need a clear structure. As an aid, templates can provide a specification framework as a structure. The best-known templates or standards include ISO 29148 (ISO, 2018) and IEEE 1233 (Institute of Electrical and Electronics Engineers [IEEE], 1998a).

The design requirements are integrated into this specification at the appropriate points (units). Basically, these are the exact results produced in the understanding, designing, envisioning, and evaluating phases. Functions are represented, for example, as use case diagrams, task models, or user journey maps. Users are represented in the form of user group profiles or personas. Navigation structures are depicted as class diagrams (site-maps). The physical design or details of the user interface design are conveyed via prototypes and illustrations of individual screens. In parallel to the requirements specification, another document is often produced, a style guide, which contains precise specifications of the design.

Style guide

In addition to general design principles and standards, there are style guides. A style guide is a set of concrete guidelines or specifications with the aim of standardizing systems of a certain type or manufacturer. It describes a basic layout framework model into which the content is inserted. It is more or less a design template or a design manual for the developers, but also for other project participants such as photographers and copywriters. For example, “main headings are always to be laid out in Arial, point 16, bold; their distance from the left edge of the screen is 120 pixels.”

Style guides should contain design specifications for all elements directed at the user, such as design specifications for

- structure (navigation concept, page layout, grid and layouts);
- interaction design (interaction style and patterns, use of animation);
- visual design (colors, typography, icons, graphics, interaction elements in each status and displayed with pixel accuracy, logo use);
- texts (guidance on communication style and choice of words, slogans); and
- multimedia (guidelines for style and use of images, audio, and video elements).

Especially when several developers and other project participants are creating the interactive system, a style guide ensures that the style is consistent. However, this guide also enables an efficient way of working, as it provides defined, validated, and ready-designed

interface components, which only need to be combined and assembled. Some companies, such as MailChimp, publish their style guides online so that they are free for everyone to access (Mailchimp, 2021).

User interface guidelines

Creating a style guide can be difficult and time-consuming. Fortunately, a designer can build on existing models for each element. People have certain expectations (mental models) when they use an interactive system. There are common conventions and standards that should be followed. For example, a website is expected to have the navigation at the top and the logo to the left. Many well-known interactive systems have user interface guidelines that describe these conventions and serve as an aid or template when creating specifications and style guides. The three most important and best-known user interface guidelines are the Microsoft Universal Platform Design, the Apple iOS Human Interface Guidelines, and the Google Material Design.

SUMMARY

The idea of the user-centered design process is to involve users throughout the entire product development process and beyond. User-centered design consists of four phases: the discover and define phases are concerned with finding the right problem, while the develop and deliver phases involve solving this problem. Iterative design can be implemented in activities that need to be performed. First, the problem and the context should be understood (understanding phases). Methods such as observations and personas for surveying and documentation are suitable to obtain context of use information in this phase. Then, solutions are designed (design phase) and prototyped (envision phase). One technique of conceptual design is the Unified Modeling Language, which expresses visualizations through diagrams. A more physical and less abstract expression of the solutions and design follows through prototyping. There are many different ways to create (physical) prototypes, ranging from mere sketches to high-fidelity prototypes. Subsequently, users or experts evaluate these prototypes (evaluate phase). Usability tests and user surveys are user-based methods. Reviews, heuristic evaluations, and cognitive walkthroughs are expert-based methods. After several iterations, the design solutions should be implemented (implement phase). During implementation, the importance of uniform style guides becomes apparent as the user has already become accustomed to them.

UNIT 3

PLANNING USER CONTEXT ANALYSIS

STUDY GOALS

On completion of this unit, you will be able to …

- evaluate when context of use analyses should be carried out.
- formulate, define, and apply user-centered quality objectives in user research.
- carry out a context of use analysis.
- select and recruit users for data collection based on specific criteria.
- carry out desk research and assess why it is a good basis for context of use analysis.
- differentiate the roles and work products of user requirements engineering.

3. PLANNING USER CONTEXT ANALYSIS

Introduction

The context of use analysis is a central task in user research and the basis for all downstream activities in the user-centered design process. The context of use includes the characteristics of the users, the goals and tasks they pursue, the resources available, and the organizational, social, technical, and physical environments in which the interactive system is used. Depending on the interactive system or product, the context of use can be very specific. Furthermore, the individual user groups can also differ greatly in their characteristics and goals and should therefore also be considered separately. The context of use is a broad area that needs to be researched. In practice, however, user researchers usually have only limited resources at their disposal. In order for context of use analysis to be carried out with a reasonable amount of effort, careful planning and preparation are needed.

3.1 Reason, Goals, and Procedure of the User Context Analysis

Each context of use analysis is carried out for a specific reason and pursues a specific goal. Depending on the occasion and the goal, different approaches are suitable. There are any number of reasons for performing a user context analysis (Chung & do Prado Leite, 2009). However, it serves as method to understand the characteristics of the domain, identify relevant sources of information, identify and analyze stakeholders, select appropriate research methods techniques, and finally, obtain the user requirements necessary for the development process.

User-Centered Quality Objectives

User-centered quality objectives are to be achieved in the development of an interactive system from the perspective of a user group. However, since they are merely assumptions, these goals do not correspond to any concrete user requirements. Rather, they assist in gaining an overview of what is known about the context of use and what remains to be analyzed. The definition of user-centered quality goals thus serves to plan the context of use analysis in a meaningful way and to estimate the effort required. The difference between user-centered quality objectives and usage requirements is that the user-centered quality objectives are defined at the very beginning of planning a context of use analysis or a development project. The user requirements are then the result of the context of use analyses and are formulated after the latter.

User-centered quality objectives refer to the following components (International Organization for Standardization [ISO], 2018): usability, user experience, accessibility, and avoidance of use-related damage. It is not a matter of assigning each user-centered quality

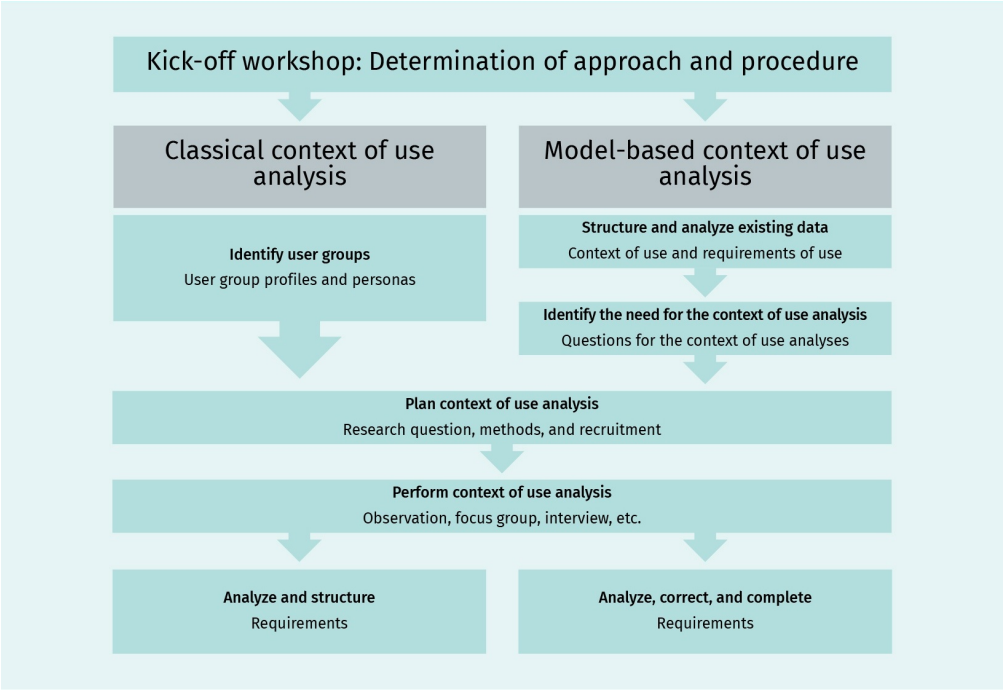
objective to one of these four components. They merely serve as a guide for defining the user-centered quality objectives. The following are examples of user-centered quality objectives:

- usability. At the new ticket vending machine, customers must be able to buy a railway ticket twice as quickly as before (efficiency).
- user experience. While using the ticket vending machine, customers must feel that their privacy is protected.
- accessibility. Customers with a visual impairment must be able to buy a ticket.
- avoidance of unexpected use-related expenses. Rail customers must be informed of additional costs, e.g., for bulky luggage, taking along a bicycle, or taking a dog on the train.

Procedure

An efficient and targeted approach is essential for a context of use analysis. It needs to be planned carefully; otherwise there is risk of wasting limited resources. Furthermore, an ill-considered approach may result in selecting the incorrect methods or participants for user testing, distorting the results. There are two basic approaches to context of use analysis: classical and model-based.

Figure 14: Comparison of Classical and Model-based Context of Use Analyses



Source: Lina Kluy (2022), based on Geis & Polkehn (2018).

If little or no information or assumptions about the context of use are available, said information must first be collected by means of classical context of use analysis.

If initial information, e.g., on the context of use or usage requirements, is already available, apply a model-based context of use analysis (Geis & Poehlken, 2018; Constantine, 2009). Since existing information is used, this can save resources and money. This is often the proper approach because it is rare that information or assumptions are not available at all.

On the whole, both context of use analyses proceed in the same way. Initially, a workshop is held with relevant stakeholders to gather all available knowledge and determine the downstream procedure. In the classic analysis, user groups are then identified, whereas in the model-based analysis, the existing data are prepared. Then, in both processes, the analysis is planned and carried out, and the data are then analyzed and prepared in a structured manner using requirements. In the model-based procedure, the existing data are augmented.

3.2 Select and Recruit Users for Data Collection

Once the resources (time and budget) for conducting the context of use analysis and course of action have been determined, suitable participants must be found and recruited. For the empirically obtained data, insights, and information about the context of use to be valid and representative, it is essential to identify and recruit the right users for the surveys. In practice, however, user surrogates (e.g., customer service staff or user supervisors) are sometimes used when there is a lack of resources or for target groups that are very difficult to access (Marsh, 2018). As has been noted previously though, the selection of unsuitable test persons leads to distorted, invalid results. Since all other steps within the development process build on the context of use analysis, faulty recruitment means everything that follows may be faulty as well.

Select the Right Participants

Sample
Since it is typically unfeasible to collect data from the entire population of users, a smaller subset must be selected; these are representative of the population as a whole.

When selecting users for data collection, two criteria are crucial: the validity of the **sample** and the accessibility and willingness of the targeted users.

Validity of the sample

In the context of use analysis, a few users (sample) are selected to be able to draw conclusions about entire groups of users (population). It is rare that all people are users, so a selection has to be made.

When selecting the sample, it is critical that the participants match with the intended users (Marsh, 2018). Therefore, always ask which person really needs to be understood. Even if the interactive system or product has a large user group, it must be divided into smaller target groups. Different types of users also behave differently and have different opinions. As a first step, who the users actually are has to be determined and defined to establish and create a profile for each identified user group. To generate useful results

from the analyses, it is more important to research a few suitable participants than many unsuitable ones. The sample must be **valid** and representative. Choosing the wrong users in the sample can lead to **sampling bias**. Reasons why incorrect participants are selected include ignorance about real users and difficult or expensive accessibility to users (e.g., special target groups with few users and lack of time).

Validity
Validity is defined as the degree to which a selection, a question, or a task actually depicts or measures the desired traits.

Sampling bias
The tendency to exclude some members of the sampling population and overrepresent others or incorrect members is called sampling bias.

Accessibility and willingness to participate

When it comes to the accessibility of participants and their willingness to participate, the key questions are (Marsh, 2018)

- How easy or difficult is it to find the right participants for the study?
- How can they best be recruited and how can they be persuaded to give their time to the research?

Problems arise especially with limited or very specific target groups, e.g., if the target group consists of commuters who only take a certain train connection on Fridays between 11:30 and 12:00. A target group consisting exclusively of people who have shopped online before is much easier and quicker to find. Depending on the characteristics and composition of the sample, it is advisable to recruit at least two weeks before the survey and at least one person more than needed should be recruited in case another drops out on short notice.

An effective way to get potential users to participate is through payment (**incentive**). The form and amount depend on various factors. These include the type of research (length, difficulty, online), the sample characterization, but also cultural, country-specific, and economic differences. The incentive can also be given away as a raffle, but should never be connected to the company conducting the research or the product or interactive system, as this could distort the results.

Incentive
A payment or gift provided to participants in appreciation for their time and resources during a research project is an incentive.

Create user group profiles

User group profiles are usually presented in the form of tables. Preparatory **desk research** and stakeholder interviews can be conducted to fill the table with data. Furthermore, it is advantageous if the practical aspects (accessibility and willingness to participate) are considered here. A very efficient method is to hold a workshop at the beginning of the project with the project participants and other stakeholders to jointly develop the user group profiles.

Desk research
Secondary research (or desk research) obtains information from existing sources of information.

To ensure that no relevant user group is forgotten, it is helpful to distinguish between the different user types (primary, secondary, and tertiary users) when developing user group profiles. For each user type, there may in turn be several specific user groups. The four dimensions of the context of use (users, tasks and goals, environments, resources) should guide the creation of user group profiles.

When describing user groups, all criteria relevant to the respective user group and that could influence the design of the interactive system should be taken into account. User groups should be clearly differentiated in terms of their characteristics (e.g., experience

and skills). However, not all criteria are equally relevant for all user groups. DIN EN ISO 25063 (ISO, 2014) contains a list of criteria that can be used to describe the user characteristics:

- psychological and social characteristics, long-term characteristics (e.g., cognitive abilities, cultural background, language(s), level of education), work task-related characteristics (e.g., knowledge and skills, motivation, expertise), social and organizational characteristics (e.g., willingness to change, willingness to take risks, depth and type of organizational structure, rule-driven versus self-determining)
- physical and sensory characteristics, e.g., body measurements, biomechanical abilities (mobility), social and organizational characteristics, haptic abilities (sense of touch), visual and auditory abilities (seeing and hearing), and handedness (dexterity)
- demographic characteristics, e.g., age and gender.

The description of user group objectives should indicate the intended outcome of the work without specifying the specific means used to achieve the objective. The goals of individual user groups can differ considerably and can lead to discrepancies. User group goals can often be derived from organizational goals or user group responsibilities. In addition, all tasks that need to be carried out to achieve the goals should be described.

The description of resources and the environment should consider physical, social, and technical characteristics. Here, too, DIN EN ISO 25063 (2014) provides a list of examples that help in the creation of user profiles:

- physical environment, e.g., lighting, temperature, noise exposure, freedom of movement, and vibrations.
- social and organizational environment, e.g., group work dynamics, time pressures and constraints, work interruptions, work supervision, and support with problems.
- technical and technological environment, e.g., tools, work equipment and supplies, hardware (input and output devices) and hardware configurations, software and software configurations (e.g., software versions), internet (e.g., wireless, network), and assistive technologies for users with impairments.

A user group profile can be depicted in a structured table. For example, one user group of a music streaming app could be students listening to a playlist with calm music while studying. They can be described by the user characteristics of age, tasks, and goals such as finding suitable tracks, as well as environment and resources. Another user group could be described in the same way.

Table 3: User Group Profile Example

Elements of the context of use	User group 1	User group 2	User group 3
Interactive system	Music streaming app		
Name of the user group	Student (primary user)		

Elements of the context of use	User group 1	User group 2	User group 3
User characteristics	• 17—27 years old • leans female (65%) • Student, university education • High educational level (minimum of high school diploma or equivalent)		
Tasks and goals	• Find suitable music as background music • Create playlists with suitable pieces (e.g., without lyrics) • Listening to music without disturbances (e.g., ads)		
Environment & resources	• No minor disturbances • Listening to focus on studying • Primary task is studying, which requires high cognitive demands • Smartphone with internet or W-LAN		

Source: Lina Kluy (2022).

It should be noted that the user group profiles at this early stage of development may still contain many assumptions about the context of use. During the context of use analysis, the descriptions are often inaccurate or users perform other or different tasks. The user group profiles should therefore be reviewed and adjusted based on the data collected through the context of use analyses.

Recruit Participants

There are different approaches to recruiting participants, with the decision often depending on budget, time, resources, and target subjects (Marsh, 2018). On the one hand, a recruitment agency could be used. Normally, they have large databases with contact information and specific data on people who agreed to be contacted for research. On the other hand, internal recruitment from existing contacts can be conducted, e.g., through databases or newsletter subscriptions, or from a wider population through ads. Regardless of which strategy is chosen, a recruitment brief and screener are fundamental parts of the recruitment process.

Recruitment brief

The recruitment brief is a document containing important information about the research itself and intended participants (Marsh, 2018). It states who should participate and how many participants are needed. Included information is often the dates of research, location of the research facility, length of the research session, characteristics and number of participants needed, times at which people are to be scheduled, and the incentive. Additional exclusion criteria, e.g., based on skills or allergies could also be mentioned.

Table 4: Recruitment Brief Example

Organization	Music streaming platform	
Date of research	11—12 January	
Place of research	User Research Lab Berliner Str. 11. 1234 Anywhere	
Number of participants needed	10	
Characteristics of participants	Student; music streaming enthusiast	• Uses the music streaming platform regularly (once a day) • Student • 17—27 years old
	Student; live concert enthusiast	• Has never used a music streaming platform • Student • 17—27 years old
Information to be recorded	• Age • Gender • Knowledge and experience in streaming music	
Length of session	60 minutes	
Research session schedule	Participant 1: 11:00—12:00 Participant 2: 12:15—13:15 Participant 3: 13:30—14:30 Participant 4: 14:45—15:45	
Incentive	30€ per participant	

Source: Lina Kluy (2022), based on Marsh (2018).

Screener

The screener is a questionnaire used before a study to learn whether a potential study participant fits the profile of participants being sought (Marsh, 2018). Not too much about the research background or purpose should be revealed because people might feign interest in participating if they can easily find out what specific types of people are being sought.

In this questionnaire, people also have to assess themselves and their behavior. This is a difficult task, and precise descriptions should be used. Neutral, unbiased questions should be used so that potential test participants can reflect freely and not have their answers steered in certain directions.

The main elements of the screener contain the following information (Lewes, 2020):

- introduction. The responsible people and the project are briefly introduced. It should be explained what the screener is used for (selection of suitable subjects) and made clear that it is possible that the person participating in the screener might not be a good fit for participation in the research.
- logistics and times. This section is about organization, especially information about location and timing, so that people can determine their availability from the beginning.
- demographics and behavior. At the heart of the screener, the previously defined inclusion and exclusion criteria should be queried.
- confidence level. This is the self-assessment of, e.g., skills related to the topic to be researched (such as digital skills).
- technology and devices. This element is about identifying which technologies and devices are used by the participants. This is especially important for research with digital products and systems. They may be used in the research (e.g., when an app is developed that is to run on different operating systems) and, in conjunction with confidence level, reduce bias.
- confidentiality and disclosure. If **non-disclosure documents** must be signed, then these should be mentioned in the screener. In particular, information should be provided on the need to sign such documents and why. Furthermore, assurances must be provided that the data will be treated confidentially and that the research sessions may be recorded.

Non-disclosure documents
In this legal agreement, the participant agrees to keep all information regarding the product and/or research confidential for a predefined time.

3.3 Preparatory Desk Research

Desk research (also called secondary research), which is closely connected to market research, includes the collection of information from previous research and documents (Savarit, 2020). This can conserve time, resources, and money, and allows for the acquisition of data that cannot be collected through internal research (Goodman et al., 2020). Desk research should be conducted even before the context of use analysis is planned. It provides an overview of the context of use information, data that are already available and what still needs to be collected through context of use analyses (primary research). In secondary research, both internal and external data sources are used.

Table 5: Internal and External Data Sources in Secondary Research

Type of data source	Data source	Examples
Internal data	Internal statistics	Statistics on products, customers, sales territories, distribution channels, complaints, and production figures
	Field service reports	Reports on customer visits, quotations, and orders
	Customer service reports	Reports on support requests and complaints for previous versions
	Market research reports	Reports on market sizes, trends, shares, and competitor analyses
	Documentation	Documentation of previous versions, descriptions of technical and economic conditions, workstation descriptions, usability test reports, and expert evaluations of previous versions
External data	Official statistics	Federal Statistical Office
	Statistics from associations	Federation of German Industries (BDI)
	Statistics from chambers of industry, commerce, and skilled trades	Chamber of Commerce (IHK)
	Publications from institutes and research facilities	Universities
	Publications from publishing houses	Specialist books, journals, and research reports
	Company publications	Annual reports, company magazines, catalogs, and company websites

Source: Lina Kluy (2022).

Often, information on target group characteristics and structures, as well as organizational, formal, and technical frameworks, are well documented. However, information about the actual work practices of users, their requirements, and the environmental conditions under which the interactive system is used is often missing. This information must then be elicited through field studies. Thus, depending on the extent to which the information from secondary research is sufficient to describe the context of use and how well the data are corroborated, supplementary empirical studies are conducted.

3.4 Work Products and Roles in User Requirements Engineering

User requirements engineering produces many work products. These are created and used by different people (roles) in the development process. The following section presents the different work products and the different roles in user requirements engineering.

Work Products

The work products correspond to the results obtained from the context of use analyses. The work products can be used either in the user requirements engineering process itself or in communication with project participants and stakeholders. Typical work products used in the requirements engineering process are the recruitment brief, screener, interview checklists, scenarios, user group profile, task models, and user requirements. Typical work products used in the communication with stakeholders and other project members are as follows (Goodman et al., 2020):

- personas, for information regarding (potential) users.
- personas or scenarios, for information about why and where the system could be used.
- scenaiors; task analysis diagrams or process maps; usability evaluations; and user journey maps, for information about tasks and activities involving the system.
- scenarios; process maps; experience models; context of use descriptions; **affinity diagrams**; and user journey maps, for contextual information.

Affinity diagrams
An affinity diagram is a fast visualization of data by clustering them based on emerging topics.

Roles

Different roles with a variety of tasks are involved in the design process, which in turn generate and use different work products (Siang, 2021).

The UX designer is a generalist. This role takes care of all tasks in the design process that relate to the user experience. This includes understanding user needs, generating ideas to solve problems, designing prototypes, and user testing.

The product designer role is relatively new and has substantial overlap with the UX designer. However, in addition to the focus on user research, a product designer focuses more on the product or system. This role supports the product design, product goals, and the product roadmap (a high-level summary of the future (6—12 months) direction of the product's design and features). The product designer considers not only today's business goals, but also those for the longer term. The role is responsible for ensuring that the design is implemented in a timely and satisfactory manner and for close collaboration with development and marketing teams.

The visual designer is more of a specialist and focuses on the successful creation of prototypes as well as satisfactory and useful interfaces. The objective of this role is primarily to implement quality goals in designs, maintain the style guide and guidelines, and apply design principles (topography, color theories, gestalt principles) to user interfaces.

The UX researcher is also a specialist. This role is especially important in the early stages of the product development process. The tasks here are to empathize with users, understand them, define problems, and validate and improve designs. For these purposes, mainly quantitative and qualitative user research methods are applied.

The content strategist is an expert in wording and copywriting. The role contributes to prototypes and mock-ups, as well as to the final product just before launch.

Other roles that can be part of system development are the system requirements engineer, the system architect, the system engineer, and the system tester.

SUMMARY

When new, interactive systems are developed or existing ones are changed, a context of use analysis becomes necessary. The definition of user-centered quality goals, as well as preparatory desk research, helps to plan the context-of-use analysis and to estimate the effort involved.

Different procedures are applied depending on how much information about the context of use is already available. If information is scarce, a classic approach of analysis is usually selected. If information is readily available, then the model-based approach is a resource-saving alternative.

Once the approach has been determined, suitable participants for the context of use analyses must be found and recruited. In the selection process, researchers must assess the validity of the sample, the accessibility of the participants, and their willingness to participate. User group profiles are created to identify the right participants and serve as recruitment criteria. Especially if the recruitment is carried out by other departments or external companies, a recruitment brief should be prepared. It contains the most important information about the research project, including the time schedule and recruitment criteria. A screener questionnaire can be used to determine whether potential participants are suitable.

The context of use analyses produce a variety of work products that are used by different people (roles) in the course of the development process. The user requirements engineer must be aware of these roles and know who uses the various work products and for which purposes.

UNIT 4

USER RESEARCH METHODS FOR THE DETERMINATION OF USER REQUIREMENTS

STUDY GOALS

On completion of this unit, you will be able to …

- define and explain methods used to collect information on the context of use.
- choose the right method for collecting information on the context of use.
- apply the respective method.

4. USER RESEARCH METHODS FOR THE DETERMINATION OF USER REQUIREMENTS

Introduction

Gaining a comprehensive understanding of (ideally) all factors that could influence the use of an existing or future interactive system or product is the core of user research. In the context of use analysis, this information is collected with the help of various methods to derive concrete user requirements.

There are three methods: interview, observation, and questionnaire. There are different versions of these methods, each of which has specific advantages and disadvantages and is suitable for different purposes. In addition, there are special forms such as focus groups, combined methods such as an observational approach taking place in the natural environment of use (contextual interviews), and methods with a strongly explorative character such as cultural probes. In this unit you will learn about these different methods and how they are used in practice.

4.1 Observation Methods

Observation is the systematic collection of observable data by watching a process (Baker, 2006). This involves observing users as they solve tasks related to the interactive system. Quality criteria, such as validity and **reliability**, must be observed. An observation can cause people to consciously or unconsciously change their behavior, which can lead to biases in the data collected and interpretation; this is called the Hawthorne effect.

Reliability
The extent to which the test or measurement yields the same approximate results when used under the same condition indicates reliability.

Types of Observations

In practice, different forms of observation are classified based on the following dimensions (Flick, 2018). It is also possible to have a mixture of the different forms.

Systematic (“structured”) versus unsystematic observation

This characterization is related to the observation scheme. In a systematic observation, a more standardized scheme is applied, whereas an unsystematic observation remains flexible with regard to the observed processes itself.

Participating versus non-participating observation

This characterization is related to the observation scheme. In a systematic observation, a more standardized scheme is applied, whereas an unsystematic observation remains flexible with regard to the observed processes itself.

Participating versus non-participating observation

These types of observation are differentiated on a spectrum. Here, the observer can take on different roles and may or may not be actively involved in what the observed participants are doing. These roles include complete participant, participant as observer, observer as participant, and complete observer (Gold, 1958).

Overt versus covert observation

An overt observation is revealed to the participants, whereas a covert observation is not (or only after the observation).

Mediated versus unmediated observation

In a mediated observation, when it is necessary to capture all behavior, technical aids such as audio or video recordings are used. The recorded material can be replayed as often as desired during the evaluation. However, technical aids do not always remain hidden from the observed persons, which may affect their behavior. In an unmediated observation, no technical aids are used. This means that the observed behavior cannot be captured completely and the data must therefore be reduced to the essentials.

Field observation versus laboratory observation

These types differ in their location or characterization of the environment. A field observation is ethnographic, meaning it takes place in the natural environment of the users or where the system would be used. An observation in a laboratory, in contrast, takes place in a neutral and, for the users, unknown laboratory room. Whereas the field observation is closer to the real-life situation, the laboratory setting offers the advantage of being able to control different factors (e.g., light, processes, heat).

External versus self-observation

In an external observation, a person takes on the role of observer in order to record the behavior of another person. The observer can take on both a participating and a non-participating role.

Observation Protocol

An observation **protocol** (also referred to as an "observation inventory or system") defines instructions on how and what to observe and how to record the information. The more information that is available about the object of study (e.g., the context of use), the more structured the observation protocol will be. Since an observer can never record all behavior at all times and in all situations, it is necessary to reduce the amount of data that are recorded during the observation. For this purpose, various observation systems (or **transcription** systems) are used, such as

Protocol
This script outlines all procedures performed within a study or session, the order in which these procedures are carried out, and can serve as a checklist.

Transcription
A transcription involves the writing down of a conversation on the basis of predefined rules.

- A sign system is used to record behavioral characteristics or behavioral expressions (signs) that occur during the observation (e.g., how often a certain action is performed)

- In a category system, behavior is assigned to a category (generic terms) under certain aspects (e.g., start of an interaction, end of an interaction).
- In a rating system, a scale is used to assess the extent of the behavior (e.g., on a scale from +2 “very strong” to —2 “very weak,” the person is assessed as to how angry they are about something).

There are no uniform guidelines for observation protocols. Rather, a specific observation protocol is designed depending on the research question and observation strategy. The individual transcription systems can be combined in an observation protocol.

Figure 15: Example of an Observation Protocol

Protocol No.	**1**		
Observer:	Name	Start:	Date, time
Participant:	ID code/name	End:	Date, time
Location:	☒ Home	User group:	◯ Pensioner
	◯ Office		☒ Solo commuter
	◯ Lab		◯ Family

Task description: Find a train ticket for commuting between Munich and Hamburg on a specific date. Purchase the cheapest train ticket using this information.	Task no.: 1

Observations		
Time	**Activity/notes**	**Code**
001	Opening the app	
	Note:	
010	Entering travel destination (Hamburg)	Dcd, Upo
	Note:	
015	Entering departure point (Munich)	Dbc
	Note: Slow response when loading the next page	
033	Entering discount code in the wrong field	Uee
	Note: Different fields for different discount codes—unsure which is correct	
...	...	

Additional observations	Code
Diversions:	
Cat coming through door Boyfriend calling	Dcd Dbc
Usage problem:	
Problems with orientation Error in entry	Upo Uee

Source: Lina Kluy (2022).

Planning Observations

A suitable observation strategy should be selected by taking into account the advantages and disadvantages of the different forms of observation, the circumstances within the project, and the research question. The observation process must be planned carefully to proceed as efficiently as possible and save resources.

The planning process includes various steps (Ross, 2018). First, the aim of the research should be defined. This is usually derived from the research question. For example, everything that is important in a certain situation or interaction with the system should first be observed in an unstructured way. Or, to save time and financial resources, there might be a more specific focus that should be pursued with the observation. The next step is to select the method to be used and the support methods (e.g., an interview). It is also necessary to decide what (i.e., which task), who (which target group), where (in which environment observers can be placed), and when (perhaps at a specific time) to observe. These decisions can be made based on previous research and background information. Depending on the type of observation method, no questions can be asked during the observation. Background research is essential, through interviews with stakeholders, previous studies, and secondary data.

Several people should be observed and, ideally, several observation sessions should be conducted. The beenfits for this are more variety in task performance (e.g., depending on time of day), more repetitions of the task/scenarios, lesser burden in the observer's attention, and more time for reflection between sessions.

Execution and Documentation of Observations

Observation involves using all senses to determine the important details of the observed situation. The observer needs to pay attention to the several significant factors that depend on the research question, such as characteristics of the users, workflows and tasks, interpersonal interactions, problems and hurdles, and sources of information (Ross, 2018). Summarized, this is called the AEIOU framework, and includes the following important factors to be recorded (Wasson, 2000):

- activities, e.g., goal-directed actions, tasks, and processes.
- environments, in terms of personal or shared spaces.
- interactions between people and between people and systems/objects.
- objects that people have in their environment and use in their activities.
- users, i.e., the people observed.

Despite the different types of observation and the corresponding different roles of the observer, the observer needs to remain objective and therefore must avoid biases. A strategy against biased data is to note the observations themselves, not the interpretation of observed matters (Ross, 2018). Because of this, observers should be trained beforehand.

The first step when performing observations is the theoretical preparation phase (background research, select a location and participants, etc.; see Neuman, 2014). After that, the next phase involves entering the locations and, depending on the role of the observer, adapting to the participants and their roles. The observation collects qualitative data by watching, listening, and taking notes, as well as collecting other artifacts, such as photographs and videos.

Qualitative data analysis aims to transform relatively unstructured data into a detailed description of the important aspects of the observed situation, task, or problem (Lazar et al., 2017). One way to analyze qualitative data comprises three major steps (Corbin &

Strauss, 2014). First, superordinate themes that describe the task, situation, or problem are identified. In the example of students streaming music, we found that both the arrangement in the app interface and the situation (e.g., learning environment) influence music listening. In the next step, the analysis is more in-depth: Related descriptions and dimensions of the overarching themes are identified, and relationships between the themes are established. For this purpose, a literature review can be used, for example, on the topic of listening to music in different learning environments. The final step is to analyze the data from the observation while accounting for the research findings. The documentation of these descriptions can take many different forms, e.g., texts, figures, and tables, and can be incorporated into the requirement engineering work products (Lazar et al., 2017).

4.2 Interview Methods

While observation is a valuable method for generating data, to thoroughly investigate a situation, users need to be questioned, e.g., in an interview (Goodman et al., 2020). The user research interview differs from journalistic interviews in that it is more formal and standardized to minimize the influence of the interviewer's perspective. In an interview, participants are asked about their experiences, needs, and problems related to the interactive system or related tasks.

Type of Interviews

Interviews vary according to their level of standardization (Baxter et al., 2015). They can be structured, semi-structured, and unstructured. The structured interview is the most standardized format as it follows a strict guide with fixed questions. In an unstructured interview, broad direction is provided, but the participant can decide how much to say about which topic. Semi-structured interviews fall in the middle. There are prefabricated questions, but their naming and structure may differ. In addition to the type of interview, other factors that can be varied. For example, the interviews can take place in person (face-to-face) or mediated via telephone or video chat. Interviews can be conducted with one person or a group.

Questioning Techniques in an Interview

To obtain as much information as possible about the context of use in an interview, the right questioning technique must be used. Questioning techniques are distinguished between the following types:

- closed-ended versus **open-ended question**. Closed-ended questions provide pre-determined options for answers. Examples for closed-ended questions are "Are you a student?", "Do you like this song?" or "On a scale from 1 to 10, how well do you feel today?" Open-ended questions such as, "Why are you studying?", "What do you think about this song?", or "What can we improve to make our product better?" allow the participants to answer in a narrative format (Baxter et al., 2015).

Open-ended question
A question in an open-ended format is designed to elicit detailed responses and that are free from structure (i.e., options for answering are not provided).

- leading versus neutral question. An interviewer needs to remain neutral (Goodman et al., 2020). Interviews should be conducted in a way that does not bias or distort responses (non-directed). This approach minimizes the impact of the interviewer's preconceived ideas in order to explore the participant's thoughts, feelings, and experiences. An example of a leading question might be, "Don't you agree that the product packaging should be green instead of yellow?" This can also be turned into a non-directed neutral question: "What color do you think the product packaging should be?"

Interview guide questions must be tested before use (Baxter et al., 2015). Important aspects in this testing are

- inclusion of all topics to be discussed;
- difficulties in understanding the questions; and
- possible interpretations of questions and how to limit these.

Pre-tests could be practiced with team members who are not directly involved in the project. Based on their responses, questions can be reformulated and restructured. After this testing, the data should be reviewed to determine whether the questions are achieving their intended goal.

Interview Structure

Almost all forms of interviews follow the same rough structure (Goodman et al., 2020). The interview begins with general information, then becomes more specific and ends again with a broader perspective and a summary, a wrap-up. Interviews can be divided into four phases:

1. Introduction. This part contains information about the aims of the study and the interview. In addition, formalities such as signing the consent form and information on data protection, are clarified. This is followed by an introduction between interviewee and interviewer.
2. Warming phase. The aim here is to create a comfortable environment for the interviewee before the interview and to make it easier for them to begin. For this purpose, simple, broad, and open questions are asked.
3. Main section. This part contains the relevant topics and interview questions. For the sake of clarity, the individual questions should be divided into different topics and sorted according to their relevance. The first questions should be about general attitudes, experiences, and expectations regarding the research topic. This can be followed by more in-depth questions about the interactive system.
4. Wrap-up. Here, the interviewee should be given the opportunity to add previously unmentioned but relevant information. Formally, this phase completes the interview.

Documentation

If possible, the interview should be audio recorded (Goodman et al., 2020). This frees the interviewer from having to take notes. An even better option is video recording, so that contradictory actions and otherwise imperceptible movements are captured.

Contextual Interview

The contextual interview (also contextual inquiry) refers to a research method that combines interviews and ethnography (Marsh, 2018). It takes place in the realistic, natural environment and consists of a semi-structured interview to elicit the context of use. In terms of quality criteria, the strength of the contextual interview is that the **ecological validity** of data is high due to the strong focus on the real world. However, this method is time-consuming and costly. It is not suitable for measuring long-term changes over time or when time constraints exist. Skills similar to those required for observation and conducting interviews are needed for implementation.

The principles for contextual interviews are (Marsh, 2018)

- good planning, based on a clear understanding of why the method should be conducted.
- contextualization, based on the natural environment and normal behavior when performing tasks.
- bonding with the participant, by having the interviewer talk to the participant and enabling them to bring up unspoken aspects.
- interpreting and developing a shared understanding with the participant about important issues.

The goals of contextual interviews are to specify concrete details about the real environment, use, and tasks, to uncover otherwise hidden information, and to test established assumptions (Goodman et al., 2020).

Plan and conduct a contextual interview

Planning a contextual interview involves selecting valid participants and user groups and well-planned time management (Marsh, 2018). Conducting the contextual interview consists of several elements in which the research question and objectives should always be considered. In the introduction, the observer, the research purpose, and other relevant information should be presented. In a semi-structured interview, an overview of the context and the tasks, as well as qualitative statements from the participant, should be obtained. The flexible structure allows different narrative strands of the participant to be followed more closely. Active observation is another important aspect, consisting of engaging the participant and interrupting from time to time with the questions.

4.3 Questionnaires

A questionnaire is a list of questions used to collect data. In a context of use survey, questionnaires are used in many ways, such as in interviews (interview checklist), where typically open-ended questions are asked by an interviewer. A questionnaire can also be answered by respondents on their own, without an interviewer present. They can be distributed in paper form or made available online. When respondents are answering independently, it is even more important that the questions be formulated clearly and care-

fully, as they will not be able to ask clarifying questions. In contrast to observations and interviews, data can be collected quickly and inexpensively. Statistical analysis is also easier using a questionnaire with closed-ended questions. However, questionnaires are less suitable for capturing important contextual information that would have stood out in a contextual interview or observation. During a context of use analysis, questionnaires without an interview should therefore only be used in exceptional cases, as a supplement or to verify findings.

Questionnaire Standardization

Questionnaires vary in their degree of standardization, from ad hoc lists of questions to standardized questionnaires. These options are described as follows:

- ad hoc lists, simple lists of questions compiled on the basis of content.
- partially standardized lists, uniformly formulated and arranged lists of questions that can be freely answered by the respondents.
- standardized lists, uniformly formulated and arranged lists of questions that are answered by the respondents on the basis of predefined answers.
- normalized lists, questionnaires for which the results can be statistically compared because comprehensive empirical data from representative surveys are already available.

Types of Questions and Answers

Typically, a questionnaire consists of brief instructions, the individual items (questions or statements), and if not open-ended questions, the corresponding answer options (categories). With closed-ended questions, there are different types of items and categories:

- yes/no, single-choice, and multiple-choice questions,
- grouping questions,
- scale questions,
- polarity profiles,
- summation and ranking questions, and
- cloze and completion questions.

Yes/no, single-choice, and multiple-choice questions

In yes/no questions (also called “dichotomous questions”) only “yes” and “no” (and sometimes additionally “don’t know”) are given as answer options. In single-choice questions, several answer options are given and the respondent can only choose one answer. With multiple-choice questions, several answers can be selected from the possible answers. The number of possible answers can be left open or stated.

EXAMPLE

- Yes/No question: Have you ever bought a train ticket?

- Yes
- No

- Single-choice question: Where do you buy train tickets most often? Please select one answer.
  - Ticket vending machines
  - Travel agency
  - Ticket app
- Multiple-choice question: By which method have you ever bought a train ticket? (select all that apply)
  - Ticket vending machines
  - Travel agency
  - Ticket app

Grouping questions

Grouping questions specify various value ranges into which the respondent is asked to group themselves.

EXAMPLE

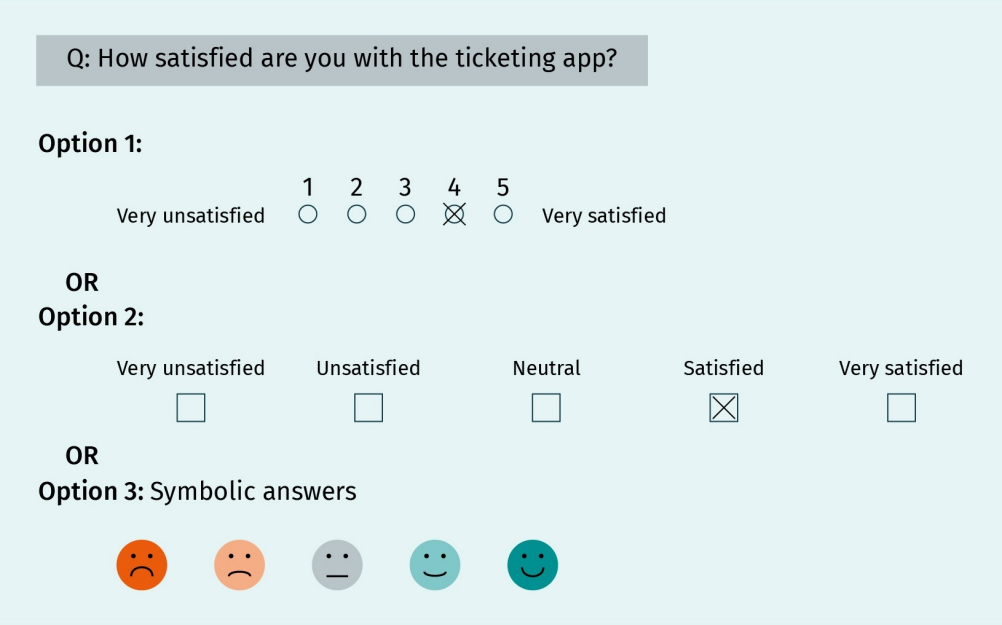
- How old are you?
  - Under 20
  - 21—30
  - 31—40
  - 41—50
  - Over 50
- How often do you travel by train (in a year)?
  - Fewer than 5 times
  - 6—10 times
  - 11—20 times
  - More than 20 times

Scale questions

Scale questions (also called “ranking scale,” “rating scale”) are characterized by closed-ended response options; normally, two extremes are given with intermediate values (e.g., from “very good” to “very bad”). Intermediate values can be provided with words (verbal scale question) or with numerical values only. Scales can also be purely numerical, for example, if they are to be evaluated on the basis of school grades. Another variant is the symbolic scale question, where instead of terms or numbers, the assessment is made using symbols such as smileys. For statistical analyses, the response options need to be converted to numbers (e.g., “very bad” = 1, “bad” = 2, etc.). Scale questions can consist of

an even or odd number of answer options (e.g., “6-point scale” or “5-point scale”). With an even number, the respondent is forced to lean one way or the other. With an odd number, it is possible to take a neutral position.

Figure 16: Examples of Scaled Questions



Source: Lina Kluy (2022).

Polarity profile

In a polarity profile (also called “semantic differential”), several terms of opposite polarity within a group of characteristics are compared in pairs.

Figure 17: Example of a Polarity Profile

Please rate the ticket app according to the following characteristics:

	1	2	3	4	5	
Creative		×				Unimaginative
Complicated				×		Simple
Clear			×			Confusing
Fast					×	Slow

Source: Lina Kluy (2022).

Sum and ranking questions

In sum questions, the respondent has to assign certain percentages to given terms. The sum must always add up to 100 percent. In ranking questions (or "hierarchy questions"), the respondent has to rank the given terms according to their importance (significance). In the case of ranking questions, however, the fact that the order given in the question can influence the answer is a problem.

EXAMPLE

- Please allocate 100 points to the following answers. My favorite way to go on vacation is
  - by train
  - by car
  - by plane
- Please rank the following answers according to "first, second, third." On vacation, I prefer to travel by
  - train
  - car
  - plane

Cloze and fill-in-the-blank questions

In cloze questions, the respondent is asked to fill in the gap in a text in a meaningful way. In multiple-choice questions, a supplementary option (e.g., "Other, namely: ___") is often added so that the respondent has the opportunity to expand on the available answers.

EXAMPLE

Which means of transport did you use last month? Select all that apply.

- Car
- Bicycle
- Train
- Other: _____

Questionnaire Design

A questionnaire usually starts with an introduction that briefly presents the questionnaire topic and provides an estimate of the time needed to complete the questions. Typically, the first questions asked are more general questions about the person and their back-

ground (age, gender, education level, profession, technical experience, etc.). This is followed by the more specific questions, which should be structured according to the following rules (Rogers et al., 2019, p. 238):

- In the case of longer questionnaires, the questions should be grouped thematically so that the questionnaire remains clear and is easier to complete. Easier questions should be asked first.
- The questionnaire should be as short as possible and only relevant questions should be asked. Whether the order of the questions influences the answers to subsequent questions should be checked. Accordingly, influencing questions should be asked at the end to give the respondents the opportunity for feedback.
- Open-ended questions should also be asked at the end, and there should be space at the end for further comments and opinions.
- Consider whether the questionnaire is suitable for all target groups being surveyed (e.g., younger and older respondents). It may be necessary to design different questionnaires for different target groups.
- Questions should be clear and unambiguous.
- In the case of closed-ended questions, respondents should always be given the option to abstain ("no opinion"). No answer is better than a forced wrong answer.
- Questionnaires should be tested before publishing them for use. This also allows the time needed to complete the questionnaire to be estimated.

4.4 Focus Groups

A focus group can be characterized as a group interview with approximately 5 to 10 participants of similar characteristics (Baxter et al., 2015). Facilitated by a moderator, participants discuss their experiences and opinions. Unlike individual sessions, focus groups can take advantage of group dynamics that elicit issues that otherwise would not have surfaced. This group interaction usually motivates participants to discuss freely. At the same time, social influence can also be a disadvantage; for example, opinions of particularly influential participants are adopted by the group and thus crowd out other opinions and ideas.

Moderation Guide

As with individual interviews, the process and content of a focus group must be well planned. For this purpose, a moderation guide is drawn up to provide the structure of the content while being conducive to discussion. The moderation guide specifies how much time to allocate for the individual elements. As a rule, one and a half to four hours should be planned for focus groups.

A moderation guide is especially important for a focus group to keep track of the session and maintain consistency between sessions (Baxter et al., 2015). The guide contains basic information such as the date and number of the session, as well as topic-specific ele-

ments. These include the structuring and the time schedule, time allocation, specific questions, and which goals are pursued with which part of the implementation. This document must be seen as a guide rather than a script from which it is permissible to deviate.

Execution

Creativity techniques such as daydreaming and personification can be used during focus groups (Baxter et al., 2015). Strategies such as probes (questions), prompts (reactions to statements), pauses, and checks (reassurances) are often used. The challenge for the moderator is to maintain the balance between different kinds of people (talkative, shy, etc.).

4.5 Cultural Probes

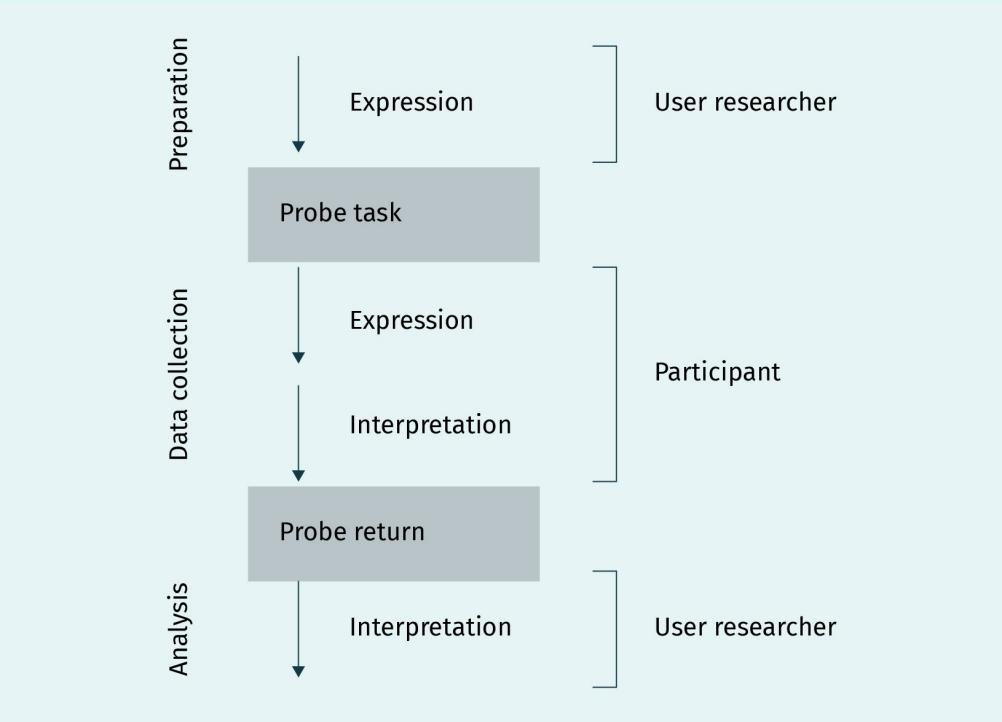
Cultural probes are used when traditional methods such as observations or contextual interviews reach their limits (Gaver et al., 2004, 1999). It is a mixed approach that combines very different survey methods and does not correspond to any scientifically derived methodology. The method originates from design research and, in contrast to observations and interviews, enables explorative access to rather difficult-to-access target groups and their everyday situations and contexts. Cultural probes provide deep insights into the feelings, dreams, and desires of the target group.

The data collected serve as a source of inspiration, especially for design (Gaver et al. 2004, 1999). Cultural probes are thus often used when other methods do not provide sufficient input for the design. The participants receive a kit with various creative materials and tasks that they work on independently during their everyday lives. The kit can contain materials such as diaries, disposable cameras, postcards, and audio recorders. The participants write stories, draw pictures, or make sculptures, which serve in particular as a source of inspiration for later design.

Plan and Conduct Cultural Probes

In contrast to observations and interviews, cultural probes are cumbersome. To use the method effectively, the kit must be designed carefully. It should contain materials with which the participants can represent their world, reflections, and dreams. Cultural probes are conducted in three phases: preparation and kit development; collection of data; and analysis and communication.

Figure 18: Phases of Cultural Probes



Source: Lina Kluy (2022), based on Gaver et al. (2004).

Preparation and kit development

Before the development of the kit can begin, the objectives need to be defined (Esser, 2020). What is the aim of the cultural probe? What subject is to be learned? What kind of kit suits the users? For example, if the user group is train passengers, then the kit should be designed so that participants can take the kit with them and work on it on the train. The kit should be designed in a way that makes it as easy as possible for the participants to get started. Therefore, it should begin with simpler tasks such as taking pictures of the surroundings. Furthermore, work should be done from the present to the future. If the participants think about events and activities that have already taken place in the past, they can better imagine future scenarios. As a final note, participants usually put notable effort into the tasks, and it takes a significant amount of time to complete them. Therefore, it is important to consider how to show appreciation to the participants for the occasionally very deep insights into their private lives. This includes, for example, collecting the materials personally if possible.

Collection of data

When the kit is completed, it is distributed to the participants (Esser, 2020). The first simple tasks serve to raise awareness of everyday contexts. For example, participants document a typical daily routine using a timeline. This is followed by tasks in which the partici-

pants generate ideas and create items such as sketches, collages, or sculptures. After the materials have been collected, the information should be verified and completed through a face-to-face discussion with the participants.

Analysis and communication

After the material from the participants has been collected, it needs to be analyzed (Esser, 2020). Sometimes patterns can be identified or clusters formed. In other cases, a single image or quote is highlighted. Regardless of what insights emerge from the material, they need to be communicated.

SUMMARY

Various methods can be used to determine user requirements, which must be derived from the context of use. A common method for obtaining information about the context of use is an interview with potential users. To gather detailed information, user research should always be conducted in the context of use, i.e., as a contextual interview. To better understand the context of the findings from the individual interviews or to gain deeper insights into opinions, trends, and patterns, additional focus groups (group discussion) can be conducted with selected stakeholders.

As an alternative or complement to the different interview methods, users can be observed performing their tasks. Questionnaires are used in interviews as an interview checklist, typically asking neutral and open-ended questions. A questionnaire can also be used to collect user data, independent of location and time. In a context of use analysis, questionnaires without interviews should only be used in exceptional cases or as a supplement to verify the findings.

When traditional methods such as observations, interviews, and questionnaires reach their limits, for example, because the target group is very difficult to access, then cultural probes are suitable. Cultural probes provide deep insights into the feelings, dreams, and desires of the users. The data collected can also be used as a source of inspiration for the design.

UNIT 5

FROM USER CONTEXT INFORMATION TO USER REQUIREMENTS

STUDY GOALS

On completion of this unit, you will be able to …

- identify requirements from context of use information.
- distinguish qualitative from quantitative user requirements.
- derive qualitative user requirements from user needs.
- structure user requirements.
- distinguish between different methods that exist to prioritize user requirements for implementation.

5. FROM USER CONTEXT INFORMATION TO USER REQUIREMENTS

Introduction

When alternative solutions or user requirements are argued about in project teams, the question often arises as to the derivation of the solutions or user requirements in the first place. These questions, in turn, trigger discussions about the requirements. The focus of the discussions is usually on the solution ideas from the point of view of those involved in the project. For example, sentences such as “As a user, I would want...” are common. These discussions cost a lot of time and stress, and usually do not lead to a fitting solution that meets the real requirements of users.

To avoid such conflicts and find suitable solutions for the real problems of users, user requirements should be identified from the context of use information as early as possible in the project. This creates the basis for a stable specification of precise and determinable user requirements that the interactive system must fulfill. The user requirements can be used to ensure that the solutions optimally meet the user requirements. Therefore, user requirements must be formulated so that usability evaluations can be used to verify whether the solution approaches that are presented, e.g., in the form of a prototype, meet the user requirements.

In this unit, you will learn what types of requirements exist and how they can be identified from context of use information. In addition, you will learn the difference between qualitative and quantitative user requirements, how concrete user requirements can be derived from the contextual information, and how to structure them in a meaningful way. Finally, you will learn methods for prioritizing the user requirements for a project.

5.1 Identify Requirements

The context of use analyses produce various work results such as scenarios, use cases, and personas (Maguire & Bevan, 2002). These contain the context of use information and are subsequently used to identify solution-independent requirements. Identifying needs is an important step in system development because every need that is not currently satisfied represents a potential for innovation in the interactive system being developed. Each satisfied need also increases the acceptance of the interactive system inasmuch as it increases the satisfaction of the users.

A (user) need is defined as a “requirement identified as necessary for a user or group of users to achieve an intended result that is implied or specified in a specific context of use” (DIN EN ISO 25064, 2014, p. 13). DIN EN ISO 25064 (2014, p. 13) highlights the following regarding user needs:

- User needs are solution-independent, i.e., they do not contain any references to the system that can satisfy the requirements.
- User needs are based on the results of context of use analyses such as interviews, observations, surveys, focus groups, and cultural probes.
- User needs often provide evidence of gaps (or discrepancies) between what is (actual situation) and what should be (target situation). Thus, they reveal the potential for innovation by revealing which user requirements are not being met.
- User needs are transformed into requirements with context of use, user priorities, system requirements, and other requirements and constraints, as well as framework conditions, all taken into account.

Types of User Needs and Their Formulation

The classification of user requirements is helpful in their analysis and consolidation. The respective type should therefore be specified when documenting requirements (DIN EN ISO 25064, 2014). Furthermore, formulation should follow specific syntax rules. The formulations always contain the respective goal, the prerequisite necessary to achieve the goal, and the type of requirement. Therefore, requirements must describe how a system can support the user in achieving the goals effectively, efficiently, and satisfactorily within the context of use (Kujala et al., 2001). Common types of requirements that can be distinguished include (DIN EN ISO 25064, 2014) informational, enjoyment, and environmental needs.

Informational needs

Informational needs refer to the information (“need to know something”) required by users to achieve a specific goal.

FORMULATION: THE <USER GROUP> NEEDS TO <KNOW INFORMATION> TO BE ABLE TO <MAKE A DECISION> OR <PERFORM AN ACTION>.

Example: When booking a rental car, the traveler (user) must know at what times the pick-up locations are open (information), so that they can check whether the pick-up location is open when they arrive at the resort (action).

Enjoyment needs

Enjoyment needs refer to a provision of a pleasant experience by the product, system, or service (e.g., appealing, challenging, and satisfying). Enjoyment needs are often found in relation to consumer goods.

Environmental need

Environmental needs refer to the physical and/or social environment in which the system, product, or service is used.

FORMULATION: THE <USER GROUP> MUST <PREREQUISITE> BE ABLE TO <MAKE A DECISION> OR <PERFORM AN ACTION>.
Example: The traveler (user) must be vacationing in a place with a car rental agency (prerequisite) to be able to rent a car (action/goal).

Additionally, user requirement expressions should include additional attributes according to the requirement statement, such as the source who/that elicited the requirement, the priority of the requirement (e.g., mandatory) and other attributes such as review and verification status (Dick et al., 2017).

Quality Criteria for Requirements

In addition to the different types of needs and requirements and their formulations, quality criteria must also be considered. These include the following (Dick et al., 2017):

- Each requirement may contain only one element so that it can be identified uniquely and must not cover several requirements simultaneously.
- Each requirement must be clearly understandable and precise.
- Each requirement must be verifiable and there must be information on how it can be verified.
- Although a requirement should be technically and legally possible within time and resource constraints, the requirement should not point to or be dependent on a specific (system or technical) solution.

Accordingly, the following criteria apply to a coherent set of requirements:

- The compiled set of requirements must be complete, i.e., all requirements are mapped.
- The requirements must not conflict with one another, i.e., they must be consistent. At the same time, they should not be redundant.
- In the documentation, thematically related requirements should be listed close together and follow a clear structure.

When establishing requirements, there are pitfalls to be avoided at all costs:

- Be direct and to the point. The statements do not have to read like an eloquent novel.
- Trying to fit several requirements into one statement should be avoided at all costs. Avoid the word “and,” for example.

- The requirements must be clearly derived from user needs or the context of use analyses; speculations and vague formulations (e.g., normally, generally, often, typically) must be avoided.
- The requirements must be tested for fulfillment at the end, which is why vague expressions such as “user-friendly” or “flexible” should not be used. In addition, the requirements should not contain wishful thinking, which can be seen in phrases like “run on all platforms,” “please all users,” or “100 percent reliable.”

Identify Requirements in Context of Use Information

Acceptance, use of, and satisfaction with a system depend not only on the features of the interface, but also on how the system fits into the context of use (Kujala et al., 2001). Therefore, user needs should be derived from the analysis of the context of use so as to inform the product development process. User needs tend to be written as informal data, whereas user requirements are more formal descriptions written from the perspective of the user.

The context of use information that emerged from the context of use analyses is usually available as narrative descriptions, for example, in the form of actual scenarios, or in the case of interviews, as lists with the answers to the questions asked. User need tables are useful representation tools and make needs understandable and usable for designers. In addition, the tables help when turning user needs into user requirements, as they provide an overview of tasks, task sequences, and more.

Table 6: Identification of Requirements from a Context of Use Description

Description of the context of use in the form of a narrative (e.g., remarks of an interviewed person)	Identified need
When I flew to Spain on vacation in May, the rental car location had already closed. We then took a cab to the hotel, and I had to go to the airport again the next day to pick up the car.	N1: A user needs to know when the pickup location is open (information) when booking a rental car, so they can check if it is open when they arrive.
I actually wanted to book the same car category as our last vacation trip. Unfortunately, when booking, I was unsure which category we had booked before. The car category we ultimately selected was much too small.	N2: Users who have already rented a car need to know which car category they selected in their last booking (information) so that they can book it again in the future.
Overall, the whole car reservation process took a lot of time because I had to enter all of my data again. For example, I had to look for my credit card, although I have reserved a car several times with the company.	N3: Users who have already rented a car must have access to their user data (resource), so that they can reuse them for a future reservation.

Source: Lina Kluy (2022).

Distinguish Requirements from Organizational Requirements

Organizational requirements are rules that apply to the system when it is placed in context (Maguire & Bevan, 2002). These must then be followed by users when interacting with the system. The rules are specified by the organization, for example, by the employer, and are thus a context of use component. Governmental or legislative requirements can also be considered organizational requirements.

EXAMPLE

A call center employee of a car rental company is not allowed to reserve a car for customers who have an outstanding bill.

The informational requirement is: The call center employee must know whether the customer has an open invoice (information) in order to decide whether to reserve a car for the customer (goal/decision making).

Distinguish Requirements from Demands

Contextual interviews
In a contextual interview, (potential) users are watched and listened to in a real life environment. Questions might be asked, which gives qualitative results.

In context of use analyses such as **contextual interviews**, the users often express wishes in the form of concrete proposals for solutions regarding the design of the interactive system. However, these rather subjective demands may or may not also represent an objective requirement of the context of use. This means that the user wishes, which are often formulated as demands, do not necessarily describe the requirement, i.e., what the users truly need in general.

For example, a user request formulated as a requirement could be all “customers who have not paid an invoice should be marked red in the system.” The demand “mark red” is subjective and such demands, based on the preferences and attitudes of the surveyed users, cannot always be generalized. Moreover, this requirement also represents a description of the system, which should be avoided. Therefore, it is important to follow up on such statements to check whether there is a genuine requirement behind the demand. For example, it could be asked for which specific task the information is required. The answer could then be, for example, “I need the information for existing customers who want to reserve a car by phone, but only for customers who have at least two outstanding invoices.”

This contextual information would then result in the following solution-independent requirement: When making a car reservation, the call center agent must know which customers have two or more outstanding invoices in order to decide whether or not to reserve a car for them. The requirement no longer contains the individually requested solution desired by the user (“mark red”), but it leads to a user requirement that leaves the solution of the problem open and allows for a more suitable solution.

5.2 Qualitative and Quantitative User Requirements

For user requirements to be clearly and appropriately distinguished from other requirements (e.g., system requirements), they must always refer to one or more user groups. Furthermore, they must be formulated from the user's perspective, i.e., as a requirement for use from the user's perspective ("The user group must be able to use the interactive system..") and not as a system solution ("The interactive system must..."). A distinction is made between qualitative and quantitative user requirements.

Qualitative Requirements

Qualitative user requirements are descriptions of what the user must be able to recognize, find, select, understand, or enter when performing a task on the interactive system (Geis & Polkehn, 2018). They are mainly used as a basis for the design of the user interface. These should not describe how the functions are to be implemented and made available to the user, but merely provide the basis for them. The descriptions contain no concrete design solutions or features.

The following quality criteria apply to qualitative user requirements (Geis & Polkehn, 2018):

- Qualitative user requirements are justified by a user need in the context of use.
- Qualitative user requirements consist of a requirement regarding the use of the interactive system (being able to recognize, find, select, understand, or enter something) and possibly other conditions resulting from the context of use (e.g., environmental conditions such as noise).

Specification of qualitative user requirements

Qualitative user requirements consist of the following components:

- a description of what the user group must be able to recognize, find, select, understand, or enter (type of use)
- a description of the object of use to which the type of use refers

For example, wheelchair-bound rail passengers (user group) must be able to select on the interactive system (type of use) that they require assistance when changing trains (subject of use) if they do not book a direct connection (specific condition).

Quantitative Requirements

Quantitative user requirements can be expressed numerically. They describe the extent to which the user-centric quality objectives must be satisfied to adequately fulfill the identified requirements in the given context of use. The numerical values thus relate to effectiveness, efficiency, satisfaction (usability), user experience, accessibility, and avoidance

of harm through use. An example of such a measurement could be whether users can complete a certain task with the interactive system within a given timeframe. Quantitative user requirements are used particularly in the evaluation of design solutions. The measures are employed to check whether a respective user-centered quality goal is met (Geis & Polkehn, 2018).

The following quality criteria apply to a quantitative user requirement (Geis & Polkehn, 2018):

- It must be justified by a stakeholder requirement.
- It must be able to serve as a clear quantitative criterion.

Specification of quantitative user requirements

When specifying quantitative user requirements, it is helpful to look at experiences with existing systems (previous versions or competing systems). Users expect the redesigned interactive system to exceed or at least meet these requirements. Quantitative user requirements can be specified through the following components:

- designation of the number or percentage of users who must meet the user requirement
- description of the goal (intended work result) that is to be achieved by the users
- specification of the quality (measured value, e.g., being able to complete a task within a certain time)

Examples of User Requirements

Usability (effectiveness)	Ninety-five percent of car rental app users must be able to be able to select a car that suits them.
Usability (efficiency)	Ninety percent of car rental app users must be able to reserve a car that suits them within five minutes.
Usability (satisfaction)	Eighty-five percent of car rental app users must rate the app with at least 4 out of 5 stars.
Accessibility	Eighty percent of blind users must be able to reserve a car in the car rental app within five minutes using voice input.
Avoiding surprise expenses	Ninety-eight percent of car rental app users need to be aware of additional costs incurred before completing a car reservation.

When specifying user requirements, each should be uniquely numbered regardless of whether they are qualitative or quantitative (e.g., “NA 1.2” for user requirement 2 of task 1). In addition, the user group must be named if the user requirement is not valid for all user groups (otherwise, just “user” can be used). If the user requirement is only valid under specific conditions of the usage context, then these must also be indicated. In development projects, both types (qualitative and quantitative) of user requirements are not necessarily specified. For example, perhaps only qualitative user requirements are stated to guide the design of the user interface. Similarly, perhaps only quantitative user requirements are specified, for example, when the user interface design is handed over to

an external service provider. In practice, however, qualitative user requirements reduce the communication difficulties and misunderstandings between the clients and service providers (Geis & Tesch, 2019).

5.3 Derive and Structure User Requirements

Once the project participants have agreed on the user groups and user needs have been determined, comprehensive and applicable user requirements for the interactive system can be derived. It is important to structure the user requirements in such a way that the task reference becomes clear and is maintained throughout the entire development process.

Deriving Qualitative Utilization Requirements

User requirements can be specifically derived from the identified needs based on the five guiding questions, which differ only by the included verb (Geis & Tesch, 2019):

“What do users need to ... about the interactive system so that the requirement is satisfied?”

- recognize
- select
- input
- output
- pass on

Formulation of qualitative user requirements

To formulate qualitative user requirements, it is helpful to apply the following template (Geis & Tesch, 2019): The <user group/user> must be able to <object of use> <type of use (recognize/select/enter/export & share)> on the system <under condition in the context of use (if applicable)>.

EXAMPLES

- The business traveler <USER GROUP> must be able to identify from the interactive system <TYPE OF USE> which hotels are available <OBJECT OF USE>.
- Users must be able to enter <TYPE OF USE> on the interactive system when booking a flight <OBJECT OF USE> that a particular food intolerance exists.

- Users must be able to have the reservation confirmation issued in digital form <TYPE OF USE> when making a car reservation <OBJECT OF USE> if no printer is available <CONDITION IN THE CONTEXT OF USE>.

If the user requirement applies to multiple user groups, then instead of <USER GROUP> we can also use "user." This is most often the case. Exceptions are, for example, tasks that may only be performed by a specific user group. For example, a call center employee might be able to cancel a rental car reservation for free, while customers pay a fee for this option. Consider two more examples:

1. An example of a user requirement tied to a specific user group. The rail customer must be able to select a departure time on the system for their planned rail trip.
2. An example of a user requirement not tied to a specific user group. The user must be able to select a departure time on the system for a specific rail customer.

In the first example, the user requirement is tied to the specific user group "rail customer," while in the second example, the user requirement was formulated independent of a specific user group. A call center employee should also be able to select a departure period, for instance, when making a telephone booking.

The <OBJECT OF USE> refers to the task that is to be supported by the interactive system. Since the user group is often already apparent from the task, an explicit naming of the user group is unnecessary.

In the <TYPE OF USE>, the verbs (e.g., "spend") can also be replaced by others that may be more appropriate. For example, the verb "recognize" in the example "The business traveler must be able to recognize from the interactive system which hotels are available" could be replaced by "overview," since there is more than one piece of information that must be recognized by the user at the same time. The verb can also be used to make the description of the type of use more specific. For example, it may be that a document must not only be available in digital form, but also must be printed. In that case, the verb "issued" would be replaced with "print."

Conditions <CONDITION IN USE CONTEXT> are not always given. For example, a condition could be that an action must necessarily be performed at a certain time. Another condition could be that a user knows the rental terms before signing the co-contract for a car.

The following table shows how concrete user requirements are derived from the previously identified requirements.

Table 7: Identification of Requirements from User Needs

Identified user need	Derived user requirement
N1: A user needs to know when the pickup location is open (information) when booking a rental car, so they can check if it is open when they arrive.	UR1: Users must be able to identify pick-up location hours on the interactive system.

Identified user need	Derived user requirement
N2: Users who have previously rented a car need to know which car category they selected in their previous booking (information) so that they can book it again in the future.	UR2: Users must be able to select the car categories they booked in previous reservations.
N3 - Users who have previously rented a car must have access to their user data (resource), so that they can reuse them for a future reservation.	UR3: Users must be able to select the payment methods they used for previous reservations on the interactive system.

Source: Lina Kluy (2022).

Structure Requirements

Requirements can relate to the use of the entire system or to the achievement of subgoals and subtasks (Maguire & Bevan, 2002). User requirements typically specify the interaction at the lowest level of tasks or subtasks that describe the required interaction with the user interface. User requirements should be structured by the goals and tasks to be supported by the interactive system, not by the features of the system.

Structure user requirements according to tasks and subtasks

How exactly are user requirements assigned to tasks and subtasks? First, it is important to understand the difference between tasks and subtasks (Geis & Tesch, 2019).

A description of a task always consists of a noun (head word) and a verb (activity word). For example, “Rent a car (noun) (verb)” is a task. “Cancel a reservation (noun) (verb)” is also a typical task. Subtasks are the steps (activities) necessary to complete the task and achieve the intended goal (e.g., reserve/cancel a car). In the example, a subtask could be, for instance, registering in the car rental app. Subtasks can in turn include even smaller subtasks such as “enter user name” and “enter password.”

For structuring purposes, all identified user requirements are now checked individually to see to which tasks they can be assigned. Individual user requirements can apply to multiple tasks or subtasks and thus be allocated to more than one task. It therefore helps to number the individual user requirements, so that the specification refers to the respective user requirement.

Table 8: Assign User Requirements to Tasks

Derived user requirement	Task and user group
UR1: Users must be able to identify pick-up location hours on the interactive system.	Rent a car (customer, call center employee)
UR2: Users must be able to select the car categories they booked in previous reservations.	Rent a car (customer, call center employee)
UR3: Users must be able to select the payment methods they used for previous reservations on the interactive system.	Rent a car (customer, call center employee)

Derived user requirement	Task and user group
UR3: Users must be able to select the payment methods they used for previous reservations select on the interactive system.	Cancel a car (customer, call center employee)

Source: Lina Kluy (2022).

The user requirements in the table result in the two (core) tasks “Rent a car” and “Cancel a car.” This results in the following for the specification list:

- Task 1: Rent a car (customer, call center employee):
  - UR1: Users must be able to identify pick-up location hours on the interactive system.
  - UR2: Users must be able to select the car categories they have already booked in previous reservations.
  - UR3: Users must be able to reselect the payment methods they used for previous reservations on the interactive system.
- Task 2: Cancel a car (customer, call center employee)
  - UR3: Users must be able to reselect the payment methods they used for previous reservations on the interactive system.

Of course, the example is not complete and contains only a small portion of tasks and corresponding user requirements. It is easy to see that, in reality, there are significantly more user requirements for the task “Rent a car.” For example, users must also be able to see the car category, whether the kilometers are included, whether a navigation system is available, and so on. In practice, this results in a very comprehensive list of tasks with the associated user requirements.

In the final step, the individual tasks are broken down into their subtasks. Consideration must be given as to which subtasks are essential to perform the task. In this way, a separate list is created for each task, with its subtasks and corresponding user requirements.

“CANCEL A CAR”

- Decide which car to cancel.
  - UR1: The user must be able to see which cars they have reserved on the interactive system.
  - UR 2: The user must be able to enter which car they want to cancel on the interactive system.
- Determine the cancellation costs.
  - UR3: The user must be able to see whether there are any charges for the cancellation on the interactive system.
- Perform cancellation:
  - UR4: The user must be able to recognize on the interactive system that the cancellation has been carried out.

- UR5: The user must be able to issue a written cancellation confirmation on the interactive system.

Acceptance Criteria

Defining acceptance criteria may help to formulate user requirements in a clearer and more focused way (Dick et al., 2017). This means finding answers as to when stakeholders are convinced that a requirement has been satisfied. This “from when” can be defined in two different ways. First, by operationalizing a specific situation that the system must demonstrate. Second, a criterion can be established by defining a numerical value as the performance level that must be demonstrated by the system. Acceptance criteria are often captured in an attribute of the requirement specification. This means that acceptance criteria can be defined for each requirement and for different user groups. For example, the head of the company may consider the acceptance criteria for a newly developed app to be success in terms of profitability and return on investment, whereas app users may view success more in terms of its rating in the app store.

5.4 Consolidate User Requirements

In product development, context of use analyses often reveal more user requirements than expected. Since, in most cases, not everything can be implemented at once due to resource constraints, the question arises as to which functions should be prioritized for inclusion in the product.

Methods for Prioritization

There are various prioritization methods for this purpose (Achimugu et al., 2014). These prioritization methods differ in terms of the effort that is required, and range from simple procedures to elaborate analytical methods. Analytical methods are less error-prone and more comprehensible (Lehtola & Kauppinen, 2006), and therefore preferred. In practice, several prioritization techniques are often combined. Moreover, a fundamental distinction is made between ranking and classification procedures. Ranking methods prioritize based on an order, while classification methods prioritize based on predefined categories.

Ranking

The ranking method is a simple and proven method to prioritize user requirements from the user’s point of view. In this method, a ranking of the user requirements to be prioritized is determined by selected stakeholders based on a certain criterion (Lauesen, 2002). For example, users (as stakeholders) can be asked to sort the user requirements depending on their importance (as a criterion).

Top-ten technique

The top-ten technique is also a simple and proven method for prioritizing user requirements. The top-ten technique is similar to the simple ranking procedure, except that the selected stakeholders (e.g., the users) only pick a certain number of user requirements (e.g., ten) based on a defined criterion (e.g., importance) and put them in an order corresponding to the criterion (Lauesen, 2002).

One-criterion classification

In the case of one-criterion classification, user requirements are classified in terms of their importance, i.e., the extent to which they are necessary for the success of an interactive system. Each user requirement is assigned to one of the following priority classes (IEEE Std. 830-1998) (Institute of Electrical and Electronics Engineers [IEEE], 1998b):

- essential. These user requirements must be met so that the success of the interactive system is not jeopardized.
- conditional. These user requirements do not necessarily have to be realized. The omission of individual user requirements of this class would not jeopardize the success of the interactive system.
- optional. Not taking these user requirements into account does not endanger the success of the interactive system.

MoSCoW prioritization

MoSCoW prioritization is a special case of one-criterion classification (Messenger, 2014). The principle is the same, except that a more precise classification is made based on four instead of three classes. The acronym MoSCoW stands for

- must (essential user requirements that must be satisfied at all costs).
- should (user requirements that have a high utility value, but whose satisfaction is not absolutely necessary). They should be implemented if must-user requirements are not compromised.
- could (If higher value user requirements are not impacted, then these user requirements can be implemented).
- won't (user requirements that will not be implemented right away but are of interest for future product releases).

The lowercase letters included in the acronym have no meaning and are used only to enhance readability.

Kano model analysis

According to Kano model analysis, user requirements are related to user satisfaction and fall within three categories (Kano et al., 1984; Dalton, 2019):

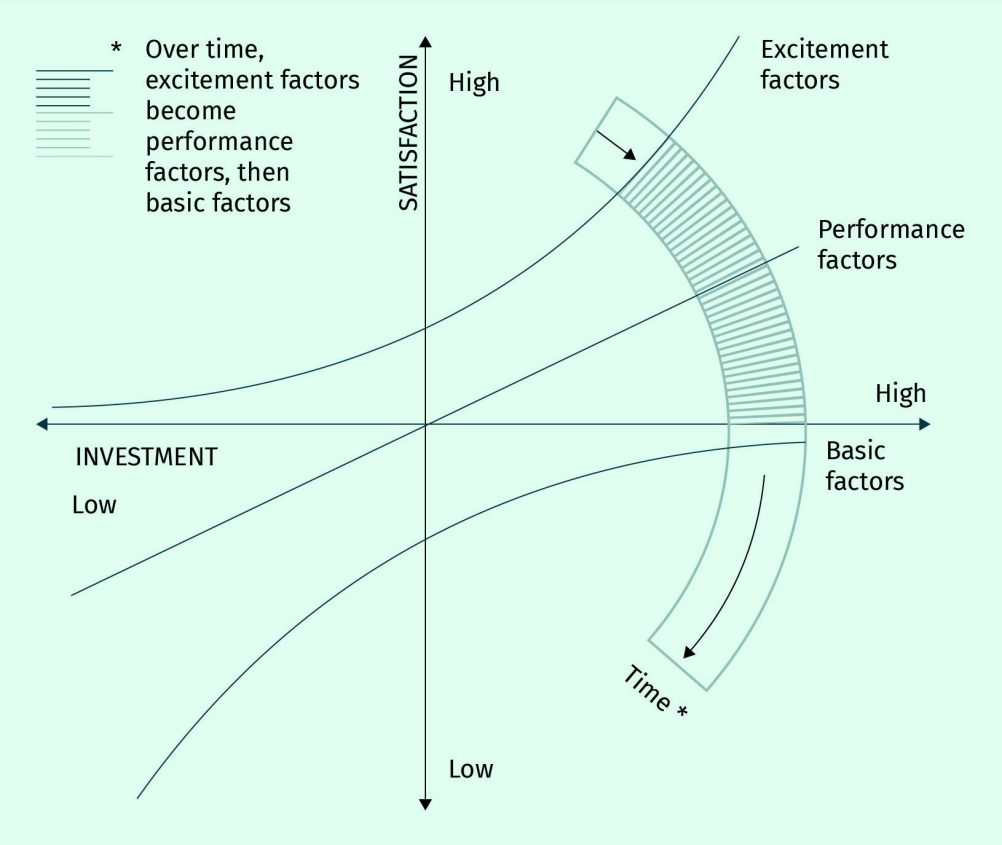
1. Basic factors (must-be qualities). The system is expected to have these features. For example, a car would be expected to have wheels. These factors do not increase the user's satisfaction, but when absent, they can have a strong negative influence on it. These factors are included in the **product backlog**.
2. Performance factors (one-dimensional qualities). These features can result in a linear increase or decrease in satisfaction and can be included in the product backlog.
3. Excitement factors (attractive qualities). These factors can make a significant impact in differentiating a system from other competitive products. Also, these features can be included in the product backlog.

Product backlog
In agile development, a product backlog is a list prioritizing delieverables (e.g., new features of a product or bug fixes).

Additionally, two more characteristics can be identified: indifferent and reverse factors. The former do not alter a user's satisfaction. In the latter, factors users will be less satisfied with more of such a criterion. It may be that the absence of this feature increases satisfaction. User requirements that have been identified as reverse factors should not be implemented in the system.

The different categories and characterizations help to set priorities in product development (Chen & Chuang, 2008). For example, the focus should lie on increasing performance and excitement factors rather than basic factors that are already satisfactorily fulfilled. This greatly affects perceived quality and customer satisfaction.

Figure 19: Graphical Representation of the Kano Model



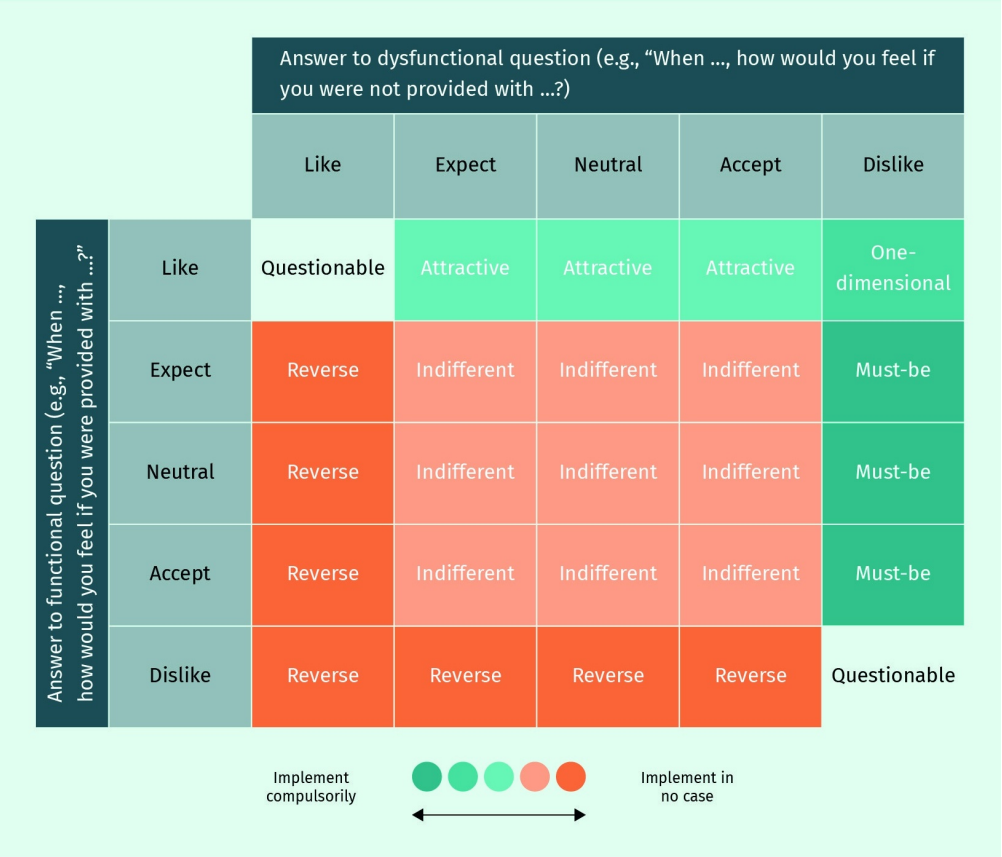
Source: Lina Kluy (2022), based on Dalton (2019).

Application of the Kano model

Product owner
A product owner is an important role within Agile development and Scrum, held by a person responsible for maximizing the product value resulting from the project work.

Typical roles using this kind of model are the **product owner**, the product management team, and the Agile team (Dalton, 2019). The assessment of user requirements can be done by means of an interview or a written questionnaire. Kano et al. (1984) have developed a bipolar survey scheme for this purpose. The respondents are asked a positively formulated (functional) and a negatively formulated (dysfunctional) question for each user requirement, which they are to answer on a scale ranging from liking (“That would make me very happy”), expectation (“It should be like this”), neutral (“I am indifferent”), and acceptance (“I can live with it”), to dissatisfaction (“that would bother me a lot”). The priority of implementation for the respective user requirement can then be derived from the answer combinations (functional/dysfunctional).

Figure 20: Prioritization of User Requirements Based on the Kano Model



Source: Lina Kluy (2022), based on Mikulić & Prebežac (2011).

SUMMARY

The context of use information is usually in the form of narrative descriptions, e.g., in the form of actual scenarios or as answers from contextual interviews. User requirements are extracted from these descriptions by examining them sentence by sentence for requirements. For documentation, tabular presentation has proven to be useful. Needs can be assigned to the relevant types of information, resources, and competence requirements. The formulation of requirements is based on syntax rules and can be checked against quality criteria.

Resource and competence requirements often result in organizational requirements. In addition, further requirements can arise from organizational requirements. If instead of requirements, demands are specified with concrete proposals for solutions, then one speaks of an immunization trap. The consequence of this error is that the set of potential solutions is severely limited.

Concrete user requirements can be derived from the requirements both quantitative and qualitative. Formulations of quantitative user requirements contain measured values such as the number or percentage of users who must fulfill the user requirement. They can be derived from experience with existing systems, e.g., previous versions, and are mainly used for the evaluation of design solutions. Qualitative user requirements can be derived from the requirements by means of guiding questions. The formulation of user requirements takes place on the basis of a syntax rule. The documentation of the user requirements occurs in a table initially, before they are structured according to tasks and subtasks and prioritized for implementation using various methods.

UNIT 6

SERVICE DESIGN METHODS

STUDY GOALS

On completion of this unit, you will be able to …

- define service design.
- formulate the goals of service design.
- define and create User Journeys and Service Blueprints.
- define and create a system map.
- write a user story.
- create a research report.

6. SERVICE DESIGN METHODS

Introduction

Not all companies generate their turnover through tangible products alone. Many companies offer intangible goods, i.e., services, or offer extended, product-related services in their product portfolio, in addition to their physical core product. Finding and renting e-scooters via a smartphone app, or printing digital photos via photo vending machines are typical examples of the amalgamation of product and service. The aesthetic and technical features of a product are no longer enough to determine its success. To establish long-term customer loyalty and ensure sustainable success, customers must be guaranteed an all-round satisfactory experience before, during, and after using the product.

Over time, the relevance of service has changed, especially from an economic perspective. Globalization has saturated markets and increased price pressure. Companies are trying to counteract these effects with individual service offers that accommodate customer needs. In the face of increasingly homogeneous product offerings, services tailored to the needs and problems of customers can advantageously differentiate one's own product from those of competitors. The process of designing services is called service design.

Service design thus supports companies in the development and provision of successful, service-oriented products and service offerings (Patricio et al., 2014). To this end, service design analyzes user experiences with products, but also with services, and uses various methods to develop concepts for service-oriented products. However, service design does not deliver the finished service or product, only the concept. It provides the methods and creates the environment so that the project participants from different departments of a company (e.g., designers, computer scientists, economists, engineers) can optimally develop the product or service together. This also includes all processes in the company as well as touchpoints, both personal (e.g., via employees) and automated (e.g., via technologies), with the customers. Service designers analyze these processes and design them so that the service functions as consistently and smoothly as possible. In other words, they ensure optimal interaction between products, processes, people, technologies, and environments in a company, so that customers have a positive and consistent service experience.

6.1 Objectives and Approaches

Services are often not perceived as a product, which is a mistake. A service is in fact a special form of product, namely a service product. The unique feature of this product is that it cannot be physically touched and is not directly tangible, which poses a special challenge for design. This is mainly because design within companies often deals with the visual design of, for example, user interfaces, or objects of daily use. Service design, however, is not about the design of physical products, but rather about the design of service concepts or the design of processes for creating services.

Objectives

Companies spend most of their resources (time, budget, and logistics) on customer-facing activities, while internal processes are neglected. The result is that, especially in larger and more complex corporate structures, different departments or employees are unaware what the others are doing. Customers may perceive these service deficits, i.e., how well or poorly the service functions behind the facade of the company, and judge the quality of the service and entire product accordingly. The goal of service design is to close these organizational gaps through the following improvements (Gibbons, 2017a):

- optimization of business processes. Business models and service design models often conflict because business models do not always match the service provided by the company. Service design takes a holistic view of the process surrounding the product or service and optimizes it.
- designing cross-departmental solutions. Weaknesses and misalignments are revealed through targeted discussions about procedures, processes, and policies. This allows companies to develop collaborative and cross-functional or cross-departmental solutions.
- reducing redundancy. By mapping the full cycle of internal service processes, companies can adopt an encompassing view of their service ecosystem, whether it is one large offering or multiple sub-offerings. This can reveal where duplicate efforts exist, which typically leads to employee frustration and wasted resources. Eliminating redundancy can save resources, increase employee efficiency, reduce costs, and increase customer satisfaction.
- linking intra-company relationships. Service design helps to link the various actors involved in providing a service within a company. Service design thus attempts to balance the interests of the company and its customers.

Service Design Tasks

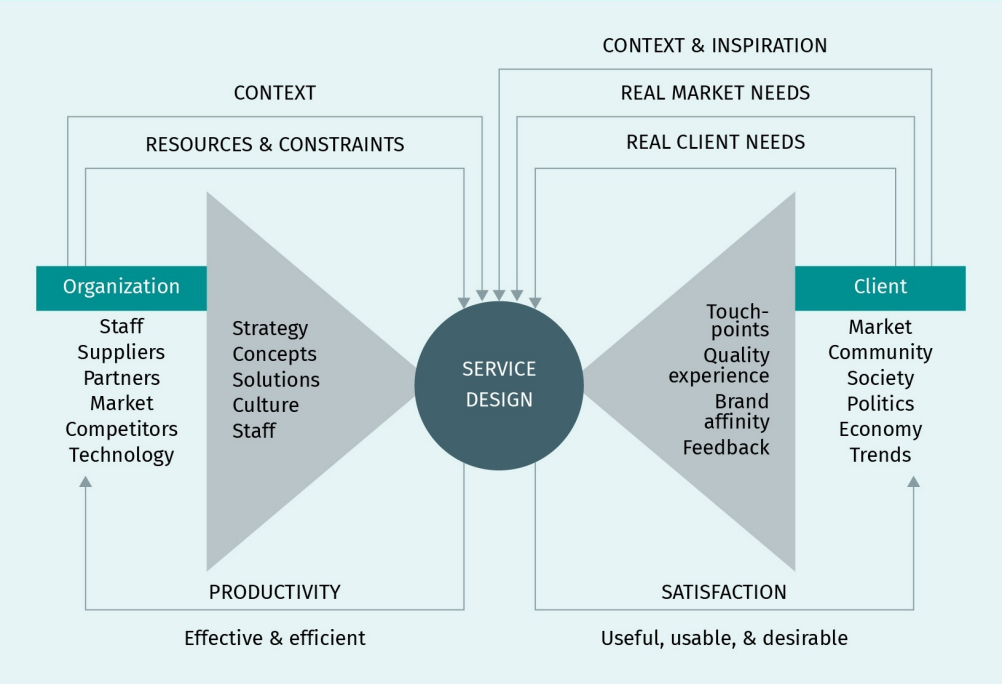
Service design tasks closely follow the phases of iterative design and can be classified within them (Moritz, 2005). Each task (e.g., interview) is an intermediate step to achieve a goal (e.g., understand users).

- Discover and learn: tasks that enable learning about user, contexts, insights (e.g., context of use analyses).
- Thinking about strategy: analytical tasks that help to set up a project plan (e.g., affinity diagrams, touchpoints).
- Generating concepts: creative tasks for developing ideas and concepts and creating solutions (e.g., brainstorming, parallel design).
- Filtering the best options: tasks for selecting the concepts and evaluating them (e.g., focus groups, cognitive walkthroughs).
- Explaining: tasks for making concepts tangible and giving insights (e.g., experience prototyping, mock-ups).
- Realizing: tasks for implementing and delivering the service (e.g., performance testing, blueprints).

Service Design Overview Model

This service design model was developed to classify the service design and provide an overview of influences and associated factors (Moritz, 2005). The model illustrates the mediating role of service design between companies and customers. For companies, service design produces higher productivity by making services more effective and efficient. For customers, service design brings satisfaction through useful, usable, and desirable services. At the same time, the contexts and resources of organizations are taken into account, as are the needs and contexts of customers and the market. In an organization, service design helps in developing strategies, concepts, solutions, cultural changes, and talents. As for the customer, this approach helps to establish touchpoints and create an experience and brand affinity. At the same time, feedback can be gathered from users.

Figure 21: Service Design Overview Model



Source: Lina Kluy (2022), based on Moritz (2005).

Approaches to Service Design

Approaches to service design can be the optimization of existing services (service optimization), the development of new service offerings (service innovation), or the formulation of customer-oriented service strategies (service strategy).

Service optimization

An inspiring customer experience is crucial to the success of a service. The customer experience cannot be designed directly as it is highly subjective, but can be significantly influenced by, for instance, attractive, useful, and convincing service offerings, smoothly func-

tioning processes and interactions, and understandable service elements and products. Service optimization is about improving the user experience for existing offerings and ensuring optimal interaction between all service components. To achieve this, existing services are examined for weaknesses and optimization potential, and elements and processes within the service system that need improvement are modified. This can include the reorganization of service processes, training of employees, and the design of service environments, products, and communication channels.

Service innovation

Service innovation involves identifying a company's innovation opportunities and designing service models that either open up completely new business areas, address previously unsatisfied user needs, or sustainably differentiate a proven service principle from the competition through radical innovation.

Service strategy

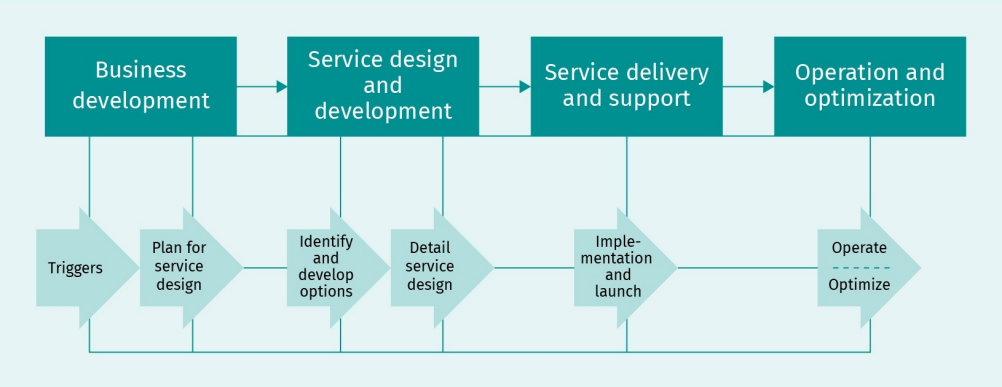
An authentic and successful service offering is based on customer-oriented corporate strategies and values, as well as a suitable business model. Therefore, service design and delivery often go hand in hand with the development of customer-oriented service strategies, the adaptation of business models, and the transformation of corporate culture and values.

Service design process model

Service design and design thinking sound very similar and actually have much in common, such as the phases to go through and the iterative character. However, there are also slight differences. Design thinking is mostly practiced by non-designers. It is about using a process of diverging and converging to solve a wide range of problems. Many "soft" factors are involved, such as team dynamics, changing mindsets, and user centricity. Service design is a process across the **four Ds** (Discover, Define, Develop, and Deliver) of user-centered development as well and uses more elaborate and extensive design methods, focuses on service development, and can have an even more direct impact on all facets of an organization (Moritz, 2005). The use of tools is important and business goals are service-related, such as minimizing churn.

Four Ds
The four Ds are the phases in user-centered design as denoted in the double-diamond design process model of the British Design Council.

Figure 22: Service Design Process Model



Source: Lina Kluy (2022), based on Moritz (2005).

The bigger picture of the service design process is divided into four main stages (Moritz, 2005):

1. Business development. Driven by identified knowledge gaps, deficits, or opportunities (triggers), a project is set up and resources are planned.
2. Design and development. Here, the first three of the four Ds of iterative user research begin—discovering, defining, and developing options. Detailed service design means the development of all components and experience specification.
3. Delivery and support. In this phase, the service is launched and implemented.
4. Operation and optimization. As is typical in iterative design, the service must not only be performed, but also monitored after implementation and continuously refined through feedback and reviews.

6.2 User Journeys and Service Blueprints

Designing and developing a product or service often involves a large team with varying backgrounds and experiences. It is important that there is agreement on the project goals, user requirements, and processes. This common understanding is often built with the help of visualizations. User journeys and service blueprints are two frequently used visualization methods.

User Journeys

When a user uses a company's interactive system or service to achieve a desired goal, the user embarks on a journey from point A (the beginning of a task) to point Z (reaching the goal). A user journey graphically represents this path and describes how a user interacts with the system, step by step. The process (the journey) is depicted from the user's perspective as a timeline in a user journey map, and describes what happens in each phase of the interaction, which **touchpoints** are involved, and which problems and obstacles (pain points) the user encounters.

There is no standard form of representation for user journey maps. These maps often contain additional layers that represent the degree of positive or negative emotions that can occur during the interaction. This includes what happens during the interaction with the system or service, as well as everything that happens before (e.g., goals, tasks, and context) and after (e.g., feelings) the interaction.

Touchpoints
These are all contact points where users interact with a product, system, service, or company.

Application and benefits of user journey maps

User journey maps are an important tool in the user-centered design process for both physical products and for services. The representation of the entire process that a user goes through during interaction creates a common, memorable, and precise vision for all project participants. Especially in larger companies, where individual fragments of the interaction are assigned to different departments in isolation, a common vision is important. Only in this way can agreement be reached on which measures will optimize the user experience.

User journey mapping creates a holistic view of the user experience. This process of merging and visualizing thus leads to better collaboration between departments (Kaplan, 2016). In addition, user journey maps help build empathy for users and their needs and goals, and uncover optimization potential for each moment of interaction.

In summary, user journey maps can be used to answer the following questions:

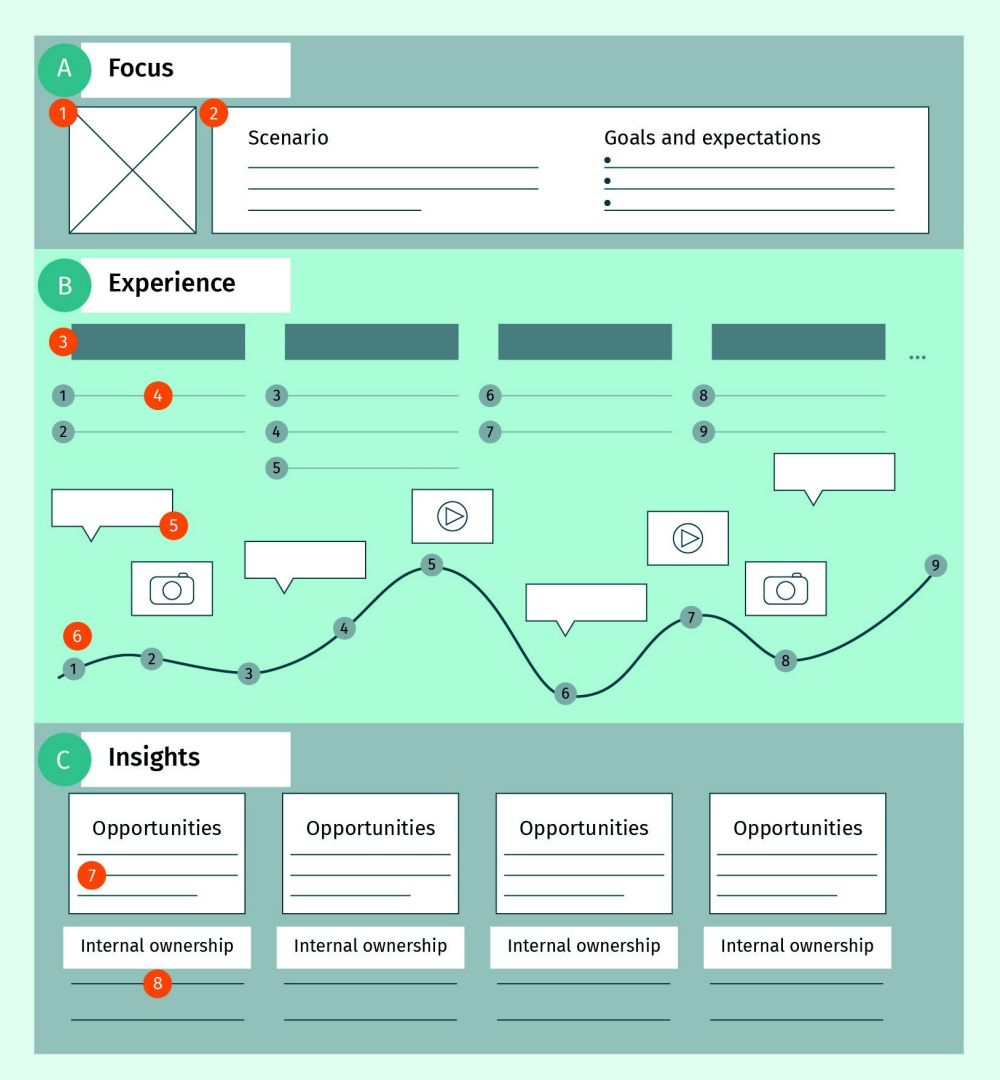
- Which steps does a user go through from the beginning of a task to the achievement of the desired goal?
- What is the user's current interaction with the product or service? Where are the touchpoints and what should the interaction ideally look like?
- Which factors influence users in their interaction with the product?
- What problems and obstacles are users confronted with along the user journey?
- At which points in the interaction are negative emotions evoked and what needs to be altered there?
- How can the interactive product or service optimally support the user to achieve their goals?
- At which points along the user journey can the user experience be optimized to strengthen customer loyalty and relationships in the long term?
- How do the various user groups differ with regard to the use of the interactive product or service?

Create a user journey map

User journey mapping starts by summarizing the individual steps a user goes through during the interaction on a timeline. Next, the individual steps are elaborated upon with the user's thoughts and feelings to create a narrative. Finally, the narrative is complemented by visualizations. User journey mapping thus combines the two methods of storytelling and visualization (Kaplan, 2016). Even though user journey maps refer to different interactive systems or services, they follow a general visualization model, which always contains three sections (Kaplan, 2016). The numbers in the following descriptions refer to the figure below:

- Focus. This section is used to narrow down to whom and what the user journey map refers. It contains a persona (1) or description that represents the user group and the scenario (2), including user goals and expectations.
- Experience. This section is the core of the user journey map. The journey is divided into different phases (3), which represent the chronological sequence or individual steps of the interaction. For each phase, the user's actions (4), thoughts (5), and emotions (6) are documented and complemented by user quotes, photos, or videos.
- Findings. In the last section, the findings are summarized, the potential for optimizing (7) the user experience is described, and the people or departments responsible within the company are identified (8).

Figure 23: Visualization of User Journey Maps



Source: Lina Kluy (2022), based on Kaplan (2016).

To successfully create user journey maps, the right elements are needed, as well as the right content (Kaplan, 2016). Therefore, the process of mapping should be a collaborative process with different stakeholders. Additionally, the map should be used as a living document, which can actively be experienced and enhanced from time to time. Before the start of the process, well-defined goals are needed. One should be clear about which users and experiences should be depicted in the map, who the users of the journey maps are, and how it is shared and distributed. As with every deliverable within user research, the map needs to be built from research and although one might get a different impression, content is more important than aesthetics.

To reliably identify problem areas and opportunities for innovation, as well as areas in which the system or service is already acceptable, separate maps are needed for each persona (Marsh, 2018). Furthermore, the maps are formulated and constructed from the users' perspective and are time-based (i.e., showing a period of time, which may not be linear).

Service Blueprint

A service blueprint is a method of visualizing a service and can be seen as an extension of a user journey map. It is a diagram that resembles a table with a vertical and horizontal axis, displaying the entire process of providing a service. The diagram contains all activities that are carried out in the corresponding phase by the different roles (actors) involved. On the vertical axis, all actors involved are listed and on the horizontal axis, all steps required to provide the service are detailed.

The resulting matrix represents the flow of actions that each role must perform during the process, highlighting the actions that the user can see (above the visibility line), versus those actions performed in the back office (not visible to users). Roles can be performed by people or other types of entities (organizations, departments, artificial intelligence, machines, etc.).

Use and benefit of service blueprints

Service blueprints provide an organization with a comprehensive understanding of the service and the underlying resources and processes that enable the service. Focusing on this broader understanding provides the company with strategic advantages (Gibbons, 2017b).

Service blueprints can be used to identify weaknesses. Poor user experiences (UXs) are often due to internal organizational shortcomings. While it is usually relatively easy to identify problems in a user interface, it is much more difficult to identify problems in the system. Service blueprints provide an overall picture and an overview of dependencies, allowing the organization to uncover weaknesses and identify opportunities for optimization. This is especially useful for complex services because the service is represented across departments (Gibbons, 2017b).

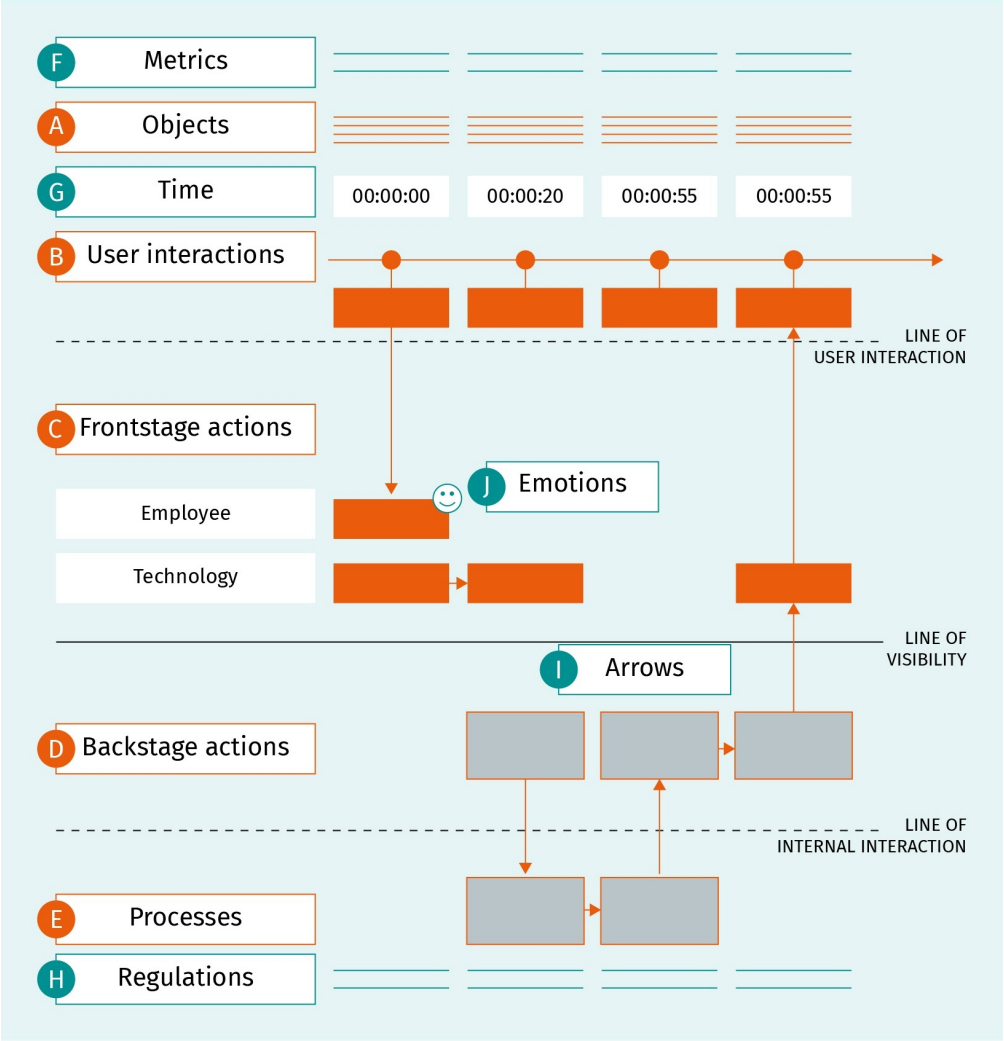
Specific key use cases within the design process were identified in a survey among 97 practitioners across industries by Joyce and Gibbons (2019). Service blueprints are used to identify research needs and the correct allocation of resources when defining the research plan, but also in the stages of the design process. In the discovering phase, service blueprints may help bridge the gap between end-users and employees. In the defining phase, fields for improvement can be identified and prioritized due to service blueprints, and in the ideation phase, they can be used for prototyping. Once the service is implemented, service blueprints can assist in the evaluation of successes.

Create a service blueprint

Like user journey maps, service blueprints follow a general visualization model. The model contains the following sections (Gibbons, 2017a).

A	The object section contains the physical objects with which the user comes into contact during the interaction. This can be, for example, the website of a company.
B	The user actions form the customer journey and include all activities, interactions, steps, and choices that the user performs during interaction with a service to achieve a desired goal. User actions are derived from a user journey map.
C	Frontstage actions contain the parts of a service that are visible to the user. A distinction is made between interactions from a user to a person (e.g., a call center agent) and interactions from a user to a (self-service) technology (e.g., a ticket vending machine or a chat assistant).
D	Backstage actions entail the steps and activities that take place behind the scenes to support what happens on the “frontstage.” These actions are not visible to the customer, such as a warehouse employee picking online orders for shipping.
E	Processes include internal steps and interactions that assist employees in providing the service. This section contains everything that must be in place for all of the above events to be enacted. For instance, this includes credit card verification, pricing, and quality testing.

Figure 24: Visualization of a Service Blueprint



Source: Lina Kluy (2022), based on Gibbons (2017a).

Three lines (Gibbons, 2017a) separate the individual sections:

1. The line of user interaction shows the direct interactions between the user and the company.
2. The line of visibility separates all service activities visible to the user from those not visible.
3. The line of internal interaction separates the employees who have direct user contact from those who do not.

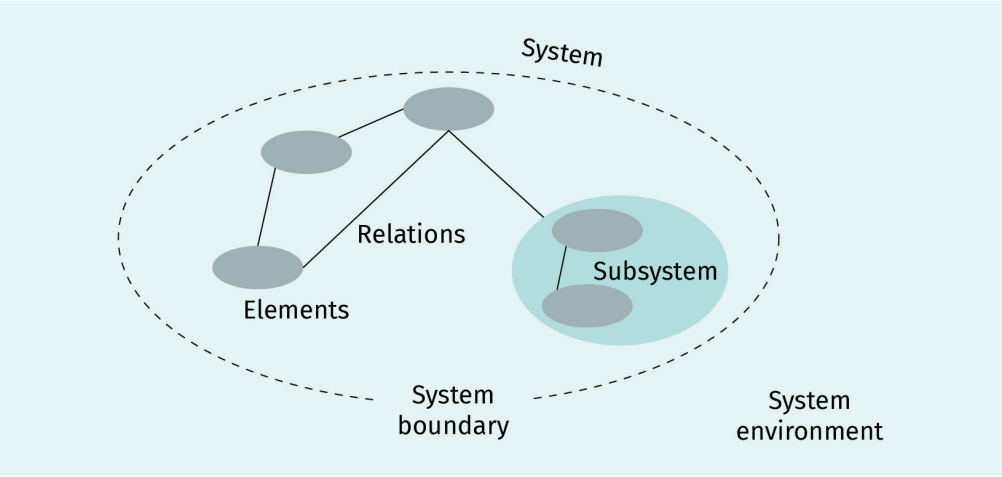
Depending on the business objective, it may be useful to include additional sections in a service blueprint (Gibbons, 2017a):

F	Using these numbers, the organization can identify where, for example, time or money is being wasted due to misunderstandings or inefficient workflows.
G	If time is a critical variable in the service offering, then an estimated duration for each action should be provided.
H	Often it is useful to integrate (legal) regulations or guidelines to produce an overview of what may and may not be changed during optimization.
I	The relationships and dependencies between the individual elements are visualized using arrows.
J	Similar to how user emotions are represented in a user journey map, employee emotions can also be represented in a service blueprint. Emotions can be represented using smileys or emoticons, for example. Where are employees frustrated? Where are employees happy and motivated?

6.3 System Maps

A system map (also known as a “touchpoint map”) is a tool for depicting and understanding the workings of complex systems and the interrelationships between the individual elements of the system. In system mapping, a system is seen as a collection of elements that are connected at certain points to form a whole. Basically, in everyday life we constantly move between more or less complex systems, just as our world in general consists of interconnected and interdependent systems. For example, a bicycle is a system, as is the human body, a community, outer space, and a company or a service offering, as well as an interactive system. According to its definition, a system has the two characteristic properties of being both dynamic (constantly changing) and evolving (forming new properties).

Figure 25: Abstract Structure of a System



Source: Lina Kluy (2022).

Kauffman (1980) defines a system, for example, using a cow as an analogy: if you divide a cow in half, you do not get two smaller cows. The essential nature of the cow—among other things, a living system that can turn grass into milk—would then be lost. This is what is meant when we talk about a system functioning as a "whole." Its behavior depends on its whole structure and not just on the behavior of its various individual parts. The cow itself is the system in this example, and its skin represents the system boundary. The system environment is what surrounds the cow, perhaps the meadow or the barn. The individual elements are, for example, the cow's organs, which have different relationships to one another. If individual elements, e.g., vital organs of the cow, are removed, the system no longer functions. You can easily apply this example from nature to an interactive system, e.g., a mobile phone: If you remove the "element" electricity, then the mobile phone system is useless.

Create a System Map

Systems thinking requires a change in our perception of the world around us. To build a new multidimensional framework of thinking, we must appreciate the dynamics and interconnectedness of existing systems. This is where system mapping tools come into play. They allow an exploration of the system, provide understanding, and enable the identification of knowledge gaps, intervention points, and insights.

However, before starting system mapping, the system boundaries must be defined first. This is important because without a clear boundary there are an infinite number of interconnected possibilities. Once there are defined boundaries, mapping can begin.

There are some digital tools (e.g., Kumu or Touchpoint Dashboard) for creating a system map. However, as it is a collaborative process (group work) and often difficult, especially in the beginning, it often makes more sense to use analog tools such as pen and paper. It is important to know that there is no "one" system map that is clearly defined. Rather, it is a set of different mapping tools that can be used to show relationships between different elements in a system. The point is to understand how the elements in a complex system relate to and function with one another. This is how weaknesses in the system can be identified and corrected.

One way to create a system map is similar to the mind map principle, but with predefined system boundaries. Here, a topic, a question, or a problem is written down on a large sheet of paper. The team members then write all the elements they associate with the topic on the sheet in an unordered manner. It is important to recognize that there are no wrong or right terms or ideas. A range of pen colors help to differentiate the individual elements (people, materials, etc.). Once all the elements, actors, and components are written down, the connections and relationships between the individual elements are drawn in using lines and directional arrows. In this step, all system elements that are not immediately obvious are also worked out or become visible. In addition, nodes can be identified, i.e., elements where most of the lines and arrows converge. A common mistake is trying to organize the chaos. The connections between the individual elements are complex, so it is appropriate that the system map seems disordered.

6.4 Writing User Stories

Scrum
For Agile development of software and other products, Scrum is an iterative and structured process framework.

A user story is a tool to describe functionalities of an interactive system from the user's point of view. It is used especially in Agile software development (e.g., **Scrum**). Writing user stories offers three advantages in particular:

1. User needs and wishes are communicated in an easily understandable way.
2. The realization effort can be estimated more easily.
3. The iterative approach is supported, as the user story can be gradually supplemented and detailed.

To ensure that all project participants, i.e., even those without a technical background, understand the user story, it is written in simple words and short sentences. The question is WHO (user) wants WHAT (functionality) from an interactive system and WHY (benefit)? It is important that the user story be written from the user's perspective and that a real benefit be described. The (technical) implementation of the function is not important when writing a user story. The following syntax rule has proven useful for writing user stories (Patton & Economy, 2014).

Figure 26: Format of User Stories

```
As <user>
I would like <functionality>
to achieve <use>.
```

Source: Lina Kluy (2022), based on Patton & Economy (2014).

The writing process proceeds from rough to fine resolution. This means that user stories are gradually given more details, until they are so thorough that all project participants understand exactly what they are about.

EXAMPLES

- As a train traveler (user), I want to be informed about current offers (functionality) to plan my next holiday trip (use/benefit).
- As a train traveler (user), I would like to receive a newsletter once a month (functionality) to know which city breaks are being offered (use/benefit).
- As a train traveler (user), I would like to be informed once a month by email about new city trips to Paris (functionality), so that I can book a city trip to Paris online (use/benefit).

User Stories, Epics, and Features

User stories, epics, and features form a hierarchy (Patton & Economy, 2014). An epic is a "big user story" on the highest professional level. From the perspective of a company, customer, or user, it has the right size and content, but not from the development perspective. Hence, epics need to be broken down into smaller stories that are more detailed. The feature refines the functionality descriptions of epics. Features can be used for release planning. However, they are still too to be implemented in one iteration or sprint. A user story refines the functionality descriptions of features. User stories can be scheduled and implemented in **sprints**. Finally, the theme describes a group of related stories.

Sprint
A sprint as defined in Scrum is a time interval (approx. 1—2 weeks) in which a limited and precisely defined scope of functions is implemented.

User Story Mapping

A backlog becomes more and more confusing as the number of entries increases. A visualization of the entries in the form of user story maps provides a remedy. This is a kind of map to visualize the order in which users interact with the system, but also to visualize the assignment of user stories to the users' higher-level desires (epics and/or features) (Patton & Economy, 2014).

The visual structure creates a common understanding within the project team. It helps uncover gaps and errors in the backlog and identify dependencies. In addition, a user story map facilitates the allocation and approval of planning activities.

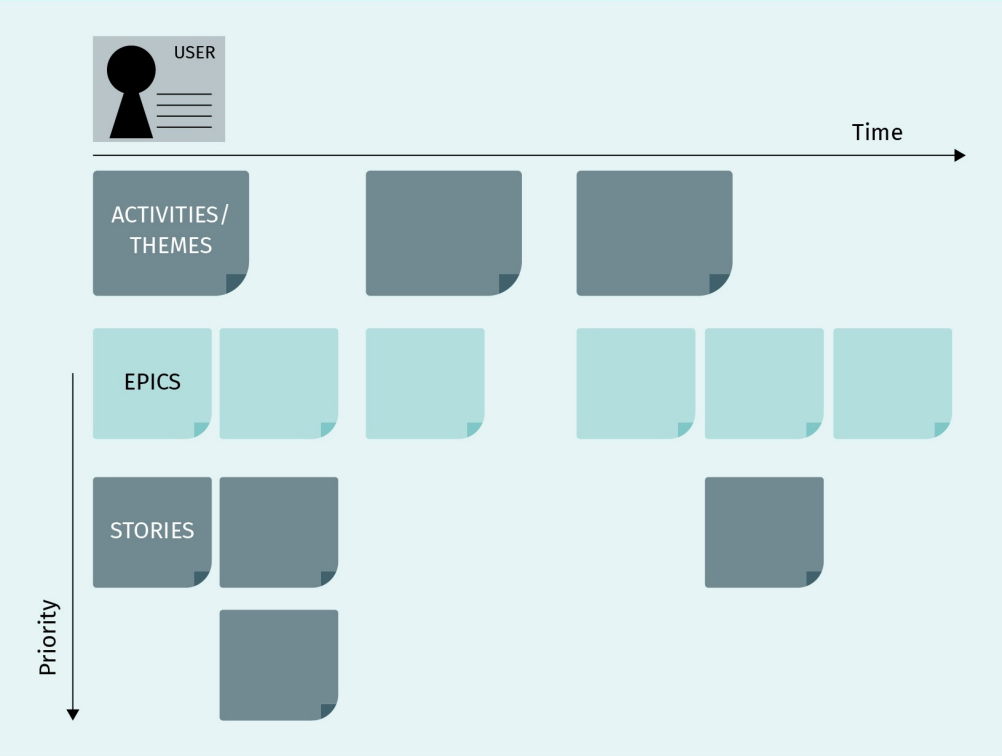
Procedure for user story mapping

A user story map is a dynamic document that, like the product, evolves and changes over time. If new insights are gained in the project, e.g., assumptions are confirmed or refuted, the user story map also changes accordingly. In addition, user goals, the prioritization of user stories, or even technical possibilities may change. For this reason, user story mapping should always be iterative, and assumptions should be reviewed regularly (Patton & Economy, 2014). This requires that the user stories are continuously adapted throughout the entire development process.

User story maps can be created with simple tools such as sticky notes and a whiteboard. However, physical story maps are difficult to update, sticky notes fall off, whiteboards are cleaned, and the story maps are lost. Therefore, in most cases, it makes more sense to use a software tool. For example, there are special plugins for creating user story maps for the **Jira** project management tool (Atlassian, 2021).

Jira
This is a web-based project management tool from Atlassian. Primarily used in software development, it is also used for task management in non-technical areas.

Figure 27: User Story Map



Source: Lina Kluy (2022).

Regardless of the choice of medium, story mapping proceeds as follows (Patton & Economy, 2014):

1. User group(s) are defined.
2. Stakeholder goals are defined.
3. The workflow or user story is visualized as a simple process diagram (backbone). The backbone serves as the skeleton of the story map.
4. User stories are created and assigned to the highest priority user requirements.
5. User stories are prioritized.
6. Dependencies, technical requirements, and gaps are identified.
7. Technical stories and spike stories are used to identify alternatives and to resolve ambiguities.
8. Sprint, release, and acceptance planning are done.

The order of the individual components (e.g., epics, features, user story) is not relevant. They can therefore be arranged from left to right or from top to bottom. It is more important to find a suitable level of abstraction that allows the project participants to easily identify the requirements and better understand their interrelationships.

To represent the different elements and levels of a story map, different colors should be used, e.g., red for goals, green for epics, blue for features, and orange for user stories. If sticky notes and a whiteboard are used, then connections can be shown with masking

tape or threads, for example. Labels can supply additional information or notes. To increase common understanding, it is useful to add additional information (e.g., graphics, videos, documents) to individual elements. In addition, alternatives should always be built in to evaluate more cost-effective or technically robust solutions (Patton & Economy, 2014).

Quality Criteria of a User Story

The following criteria from the INVEST principle can be used to determine whether a user story has been well formulated. The acronym INVEST stands for (Wake, 2020):

- independent. The user story is independent of other user stories and stands on its own.
- negotiable. The contents of the user story are negotiable, and are gradually adapted and elaborated upon until the user story can be implemented.
- valuable. The user story is valuable and offers the user benefit.
- estimable. It must be possible to estimate the effort required to implement a user story.
- small. The user story is so short that it can be realized within a sprint.
- testable. There are acceptance criteria for the user story that can be used to test it.

6.5 Writing Research Reports

In general, a research report in the context of user research is a report on the results of context of use analyses. The form or presentation is not standardized, i.e., there are different ways to report the results. Furthermore, it can fulfill different purposes, such as quantifying the impact of user research or generally communicating the results to different stakeholders. Depending on the audience for whom it is produced and the purpose of the research report, it is written at different stages, perhaps after each study (often in Agile development, for example, to be able to implement the results quickly) or at the end of an analysis phase.

User research is costly and the analyses can take weeks or even months. During this time, design and development efforts might slow down or even be put on hold. The fact is, however, that without user research, the risk of developing poor or inefficient products is very high, which ultimately cost much more. Research reports are important to justify the costs and inform stakeholders about the concrete financial impact of user research. They also document the development history of a product (Farkas & Nunnally, 2016).

Research reports show the return on investment (ROI) for conducting user research. They illustrate, for example, when initial assumptions were wrong, resulting in lost time and money in developing the wrong product. Quantitative results can be used to improve the overall product and development strategy using hard data. Qualitative validation of changes made because of user research can demonstrate the increased revenue, reduced costs, and improvements in user experience (Farkas & Nunnally, 2016).

There are three additional reasons why it is important to write a research report. Regardless of whether it is an Agile development team or the teammates show interest in the results of the user research(Cvetkova, 2018),

- a research report creates empathy with the users.
- the team feels involved in the user research work.
- the team obtains deep insights into the exact users for whom they are developing.

As with any presentation, the first thing to do is think about who the audience is. It is likely that most of the team members who receive the research report have experience in developing interactive systems. Therefore, it is very important to be as precise as possible and support the content with figures and/or graphs. A hypothesis should also be made for each question, which is then reflected and answered in the results. In summary, when writing a research report (Cvetkova, 2018), one should

- formulate a hypothesis (both quantitatively and qualitatively) for each research question;
- substantiate user problems with excerpts and/or citations;
- present the methods used for the analyses;
- state only things that can be proved by facts and figures;
- be concise and write precisely;
- present the thinking of the users with real examples; and
- at the end of the report (or after each section), address the hypotheses that have been put forward.

Types of Research Reports

Research reports can take different forms. The medium of a research report depends on the stage of product development, the research method, and the audience. Executives, for example, usually have little time and therefore usually require a summary so that they can quickly see what activities have been carried out and why they are important. The development team, on the other hand, requires more details so that they can implement the findings (Farkas & Nunnally, 2016). However, different types of research reports are also suitable, depending on how much the stakeholders trust the results of the user research and how much practical experience they have in the field. The degree of trust and practical experience is referred to as user research maturity (Hott, 2020).

Research report based on user research maturity

If user research is a relatively new field for the company and the aim is to build trust in user research, then it makes sense to develop the research report collaboratively, i.e., together with the development team. The team also participates in the user research activities, which can include contextual interviews. Immediately after each interview, the team discusses and documents the findings together. This method is quite simple and quick to implement, and ensures that all team members are on the same level. However, it is problematic because, in the end, not all team members can participate in every session. Therefore, this method is only suitable for the beginning, to sensitize the team to the topic of user research and to build trust (Hott, 2020).

Once some trust in user research has been established in the development team and the company, the results can be presented on individual slides (e.g., in PowerPoint). Each slide should be dedicated to a research question and contain the objective (research question), methodology, answer to the research question, new findings, and recommendations for the next steps. This form of presentation saves readers time, and they are more willing to read the report. However, in addition to this short form, a detailed report with further information should always be compiled. The slides thus serve more as an overview and incentive to look at the more in-depth content (Hott, 2020).

In the next stage, for example, when there is already a whole user research team, one can move on to writing the results as detailed reports (with footnotes, graphics, quotes from the sessions, etc.). To ensure that they are read, appealing aesthetics should be considered when designing the reports. The disadvantage, however, is that these reports are very time-consuming to produce and not everyone has the time or inclination to read long and detailed reports (Hott, 2020).

If user research is well established in the company, then user studies are usually carried out in increasing quantities. As a result, there is less time to write detailed reports. In addition, most stakeholders know the methods and therefore no longer need detailed explanations of how each method works. The stakeholders then want to receive the information "just-in-time." For the research report, this means starting with the presentation of the results, including only a few carefully selected quotes, and keeping the methods section as short as possible. The structure could then look like this (Hott, 2020)

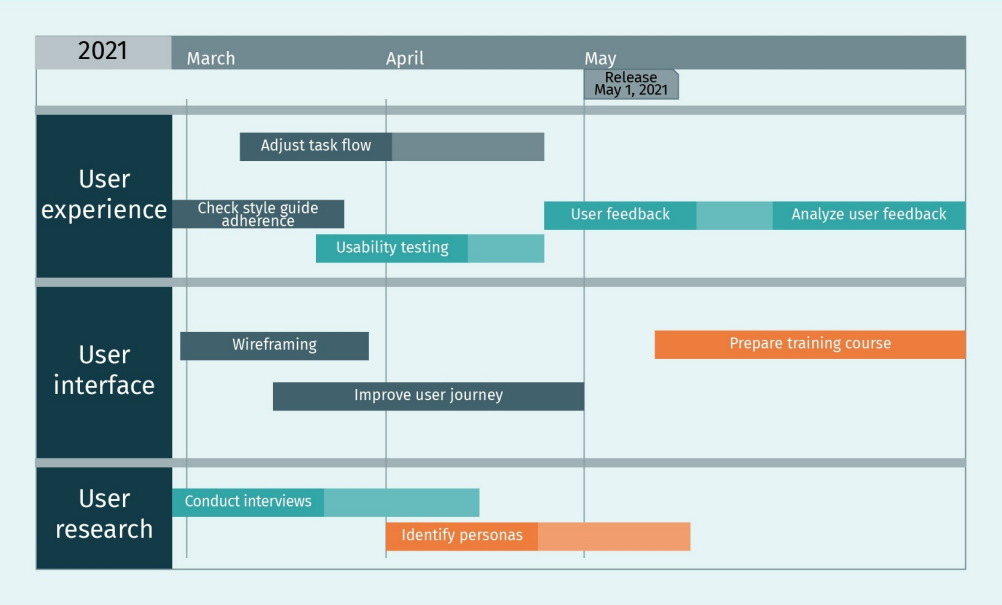
- List of key findings
- One or two user citations for each finding
- Recommendations
- Appendix: Methodology and research questions

Research report for the development team

Research results provide both short-term and long-term benefits to the development team. The results inform design decisions and help the team develop a better product strategy (Farkas & Nunnally, 2016).

If working in an Agile development environment (e.g., Scrum), then deliverables should be broken down into actionable tasks that can be added to the product backlog. The tasks should refer to the associated user research results to justify them and make the context clear. In addition, explain why the solution will benefit users. User research usually raises many new questions; it is important to address these questions in the report. They provide the foundation and justification for further user research activities and their funding. A suitable medium for an Agile development team, for example, is the integration of the user research results into the product roadmap. In a product roadmap, the milestones of product development are visualized over a certain period of time (Farkas & Nunnally, 2016). It is possible to display overlaps between user research and design activities.

Figure 28: Example of a Product Roadmap



Source: Lina Kluy (2022), based on ProductPlan (n.d.)

Research report for leaders

User research findings are as invaluable to executives as they are to the development team, although the individual findings are weighted differently in the two groups. For example, a research report for CEOs and other executives should focus on the gains to be made from the findings (Farkas & Nunnally, 2016).

If executives have participated in user research activities such as contextual interviews, then their comments should be included as quotes in the report. The point is to remind them of what they said and experienced, for instance, “Do you remember the user struggling with feature X?” It is a way to create allies and increase the chances that the results will be incorporated into product development. Nevertheless, the quotations also help to convince other stakeholders who have not participated in the user research activities of the results. For example, if a CEO hears that a core feature of a product is not working from a sales representative they trust, they are more likely to believe it and want to fix the problem than if they hear it only from the user researcher (Farkas & Nunnally, 2016).

SUMMARY

Service design supports companies in the development and provision of successful service-oriented products and services. However, service design does not deliver the finished service or product, only the concept. It provides the methods (e.g., user journey, service blueprint, system maps, user stories) and creates the environment so that the project

participants from different departments of a company can optimally develop the product or service together, and so that the service functions as consistently and smoothly as possible.

A user journey shows, step by step from the user's point of view, how the user interacts with the system in order to achieve their goal. A service blueprint can be understood as an extension of the user journey by visualizing the whole process of providing a service. System mapping is defined as visualizing and better understanding the workings of complex systems and the interrelationships of the individual elements of the system.

User stories are created to describe the functionalities of an interactive system from the user's point of view. This method is used especially in Agile software development. The iterative procedure according to the service design process model is divided into the four steps business development, design and development, delivery and support, and operation and optimization. Based on these steps, the service concept is gradually developed and optimized.