A User Experience Design Toolkit

Ioanna Michailidou, Constantin von Saucken, Simon Kremer, and Udo Lindemann

Technische Universität München, Institute of Product Development
{michailidou,saucken,kremer,lindemann}@pe.mw.tum.de

Abstract. User experience design (UXD) is a user-centered and interdisciplinary process, throughout which designers need applicable and feasible methods, tools and criteria. Still only few methods and tools supporting designers in understanding, creating and evaluating user experience systematically are to be found. This paper aims at creating a framework of selected methods, which support designers, even non-UXD-experts, in these activities. The methods come from the fields of product development-engineering, industrial design and interface design and have been applied and adapted in a research project with collaboration with industry. With reference to current state of the art, the methods applied are reviewed and extended with recommendations identified by the researchers. The recommendations should support UXD-practitioners in selecting appropriate, usable and applicable methods, which are most likely to result in positive user experience.

Keywords: DUXU methods and tools, Management of DUXU processes, Story telling.

1 Introduction

The research fields of User Experience (UX) and User Experience Design (UXD) aim at analyzing the users' personal impression and on making the emotional impact of products describable or even measurable. UX refers to an "overall designation of how people have experienced a period of encountering a system" [20] and, according to the ISO definition, it states "a person's perceptions and responses that result from the use or anticipated use of a product, system or service" [9]. We assume that UX in the interaction of a user and a product emerges when the effect of a usage meets the user's psychological motives and needs and fulfills or even exceeds his expectations [22]. UXD is a user-centered and interdisciplinary process and adds important dimensions to the challenge of implementing human-centered design in a mature form. The main distinguishing dimensions of UXD are: UX factors; methods, tools and criteria used in UX work; representation of the UX idea; and UX positioning in the organization [20]. The need for applicable and feasible methods, tools and criteria, in particular, is crucial for the creation of successful but also reproducible products. Still only few methods and tools supporting designers in understanding, creating and/or evaluating UX systematically are to be found.

1.1   Objective

This paper aims at creating a framework of selected methods supporting designers (incl. non-UXD-experts) in analyzing, creating and evaluating UX. The methods come from the fields of product development/engineering, industrial design and interface design. With reference to current state of the art, the methods are reviewed and extended with recommendations and development needs identified by the researchers. The recommendations should support UXD-practitioners in selecting appropriate, usable and applicable methods, which are most likely to result in positive UX.

1.2   Methodology

The study is based on literature review and lessons learned from actual application of methods within a three-year interdisciplinary UXD research project in collaboration with industry. The project goal was the systematical creation and evaluation of UX. The team, consisting of one psychologist, two engineers, one industrial designer, and one human factors expert, investigated, adapted and applied methods from all disciplines in a new development project ("from the scratch"). The project was supervised by UX experts and industrial partners, while the outcomes have also been evaluated in user studies.

2   Results: Methods Selected and Recommendations for Use

Twelve methods have been selected as most effective and applicable. They are presented in this section using following dimensions: design phase of application, goal of application and benefit for UXD. The design process is summarized in three main phases: Analysis (A), Creation (C) and Evaluation (E). The goals of application refer to the literature-based scope of each method. Furthermore, development needs for applying each of the selected methods in the UXD context are suggested by the authors. The main findings of this work are the recommended ways of adapting the methods, in order to make them usable for non-UX-experts with various backgrounds in both academia and industry, and to make their outcomes most likely to enhance a positive UX.   In Table 1, the most important results are summarized.

2.1   Mood Board and Overarching Story [17]

Mood boards are typically a collection of abstract media used by designers for personal inspiration and communication with other stakeholders including users. Mood boards are used to promote lateral thinking and help designers refer back to the images when inspiration is needed. Mood boards as tools for communication with non-designers have the advantage of using a shared language getting all stakeholders "on the same wavelength". They are a valuable tool in helping designers to immerse in the user´s world, but also in helping stakeholders to express their emotional needs associated to products. We recommend the use of mood boards to visualize the brand

Table 1.

Method	Phase	Benefits for UXD	Recommendations for UXD
Mood board [17]	A, (E)	Visualizing the vision for the development project in a comprehensive way.	Use of mood boards to visualize the brand image and first development direction, extended by a narration.
Storytelling [4, 19]	A	Collecting user insights with focus on their underlying motives and needs.	Use of Storytelling to collect user insights and documentation/ structuring as story elements [19].
SWOT analysis [24]	A	Analyzing different dimensions of a topic and defining development goals.	Intensive Strength & Opportunity Analysis to define UX-chances (starting points for new positive UX).
Persona [1, 7]	A, (E)	Giving data and statistics a human face.	Creation of market-specific customer profiles based on real data on usage, environment and emotional behavior
Metaphor/Analogy design [16]	C	Anticipating experiences and communicating their emotional impact.	Use of Emotional Mental Models [25] and image-based metaphor representations.
Use scenarios [1, 6]	A, C, E	Promote holistic understanding, derive requirements and insure design targets.	Creating UX Stories, because of their special characteristics which go beyond use scenarios [18, 19].
Requirements list [12]	A, E	Creating measures for the design success.	Extension of requirements list by a UX story visualized as Storyboard [18] and use of Kano-model [12].
TRIZ principles [2]	C	Overcoming contradictions and/or getting inspired by principles and patterns.	Use of UX Principles [26] derived from successful experiences descriptions as inspiration for UXD.
Experience prototypes [5]	C, E	Making the essence of UX visible.	Use of experience prototypes during the whole process, combine different forms (e.g. hardware with UX story).
Function Modelling [12]	A, C	Structuring the product in manageable parts and exploring their relations.	Use of user-oriented and relation-oriented function modeling extended by emotional effects.
Design structure matrix [13]	A	Manage complexity, explore relations, and create function clusters.	UX-related domains, mapping between functions and UX-elements

image and a first development direction in a comprehensive way. Traditionally, a marketing department would provide designers with words and numerical data to work from. Further, we recommend their extension by a narration describing the vision in a more understandable and memorable way ("overarching story").

2.2   Storytelling with Story Elements [4, 19]

Narratives are a helpful tool for supporting communication, collection and compilation of qualitative information. A storytelling approach can be applied during the whole design process to improve the quality of developed concepts regarding UX, as well as to support designers in exploring and communicating their new concept ideas [4]. Narrative methods are commonly applied during the early design phases of situation analysis/field research, mostly in form of real user stories collected through observations and interviews; personas from marketing research; scenarios describing future trends. Storytelling is an appropriate method to collect user insights with focus on their underlying motives and needs, but cannot be used in further development phases unless the results are documented in a useful way. We recommend that the statements obtained from the storytelling sessions should be divided into text blocks and clustered as UX story elements [19]: motives, psychological needs, characters, system components, use cases, key events. Story elements serve as guideline for the interdisciplinary team to structure and summarize its findings and also support the elaboration of (mostly qualitative) requirements.

2.3   SWOT-Analysis and UX Chances [24]

Purpose of a SWOT-analysis is identifying opportunities and risks, analyzing current situation and future developments, identifying strengths and weaknesses. It can be applied as part of product planning or objective analysis and is suitable for strategic as well as operational issues. Its effects involve increased transparency of facts and increased support of the development team in cross-divisional communication and decision making. Particularly important when defining development goals for UXD are the positive aspects of the analysis: strengths and opportunities can serve as starting points/chances for the design of positive experiences. Therefore, we recommend an intensive Strength and Opportunity Analysis to define such UX-chances. Analog to the SWOT-approach, the team analyses the Strengths and Opportunities via appropriate questioning techniques ("What is going well/which are positive experiences?"). Once both fields have been sufficiently illuminated interactions between the two fields are questioned ("How can we use our strengths to exploit the opportunities?"). Results of the analysis are derived UX chances and development goals.

2.4   Persona and Market-Specific Customer Profiles [1, 7]

Personas are fictitious, specific, concrete representations of a customer of a real target group [1], based on behaviors and attitudes of observed real users and representing

them throughout the development process [7]. Persona is an excellent method to discuss and prioritize different types of users and their needs in a memorable way and to turn designers' attention on satisfying those customers' needs, making the entire development process more customer-oriented. However, the persona approach can fail due to five main reasons: the persona creation is not accepted/supported by the management; personas appear implausible and are not associated with a methodological approach and use of real data; personas are communicated poorly; the design team has not understood how to use them; their use results into bias and stereotypes. To overcome these difficulties and create a bridge between research and marketing, we suggest creating Customer Profiles with following recommendations:

— create market-specific profiles based on real data
— create a vivid representation in the form of a profile but also show the data they are based on to enhance their conceived validity
— extend real data (e.g. usage and environment data) by findings on emotional behavior and needs
— Customer Profiles should be approved by the management
— their use in next phases (e.g. as UX story characters) should be clearly defined

2.5   Metaphor/Analogy Design and Emotional Mental Models (EMMs) [16, 25]

Human beings understand the world by constructing working models of it in their minds, which are simpler than the entities they represent, known as mental models. Mental models, widely used in usability, are a good approach to influence expectations, although emotional aspects are not considered so far. For the communication and purposeful development of UX stakeholders need to have a shared understanding about the targeted experience. EMMs enrich the concept of mental models in the context of UX [25]. The creation of mental models enhances the usability; EMMs help anticipating the experience and communicating their emotional impact. EMMs enable the capture of emotional responses of people and their explanations and sustain the vision of the design team throughout the design process. For the communication of EMMs image-based metaphor representations focusing on the emotional description of users' motives instead of technologies are recommended.

2.6   Use Scenarios and UX Stories [3, 6, 18]

Anggreeni [3] defines scenarios as "explicit descriptions of the hypothetical use of a product" with three points: Scenarios describe a process or sequence of acts, are formulated from the view point of an actor, which corresponds to a stakeholder and its scope and can range from "narrow" (describing what the product does) to "rich" (describing a larger context of use). Different scenario types can be applied in different design stages, influencing each other and building on each other, as they consist of common elements. Scenarios capture important contextual aspects but miss emotional elements concerning usage over time. The dynamic nature of experiences and temporal aspects of product usage are very important for UXD: indirect

experiences can appear before use, e.g. through expectations, as well as extends after usage, e.g. through reflection of previous usage. We recommend creating UX Stories, because of their special characteristics which go beyond use scenarios [18, 19], such as their memorable and understandable narration-format, their specific nature with focus on specific and untypical rather than (proto-) typical situations and on a well-drawn character with known motives and needs rather than an "actor", as well as their personal nature enabling receivers' identification. The UX story bases on user research data collected in the beginning of product development, but can still evolve during the process analog to a requirements list. Both documents accompany the rest of the process as basis for decision making, evaluation and moreover for marketing. Story-building promotes understanding of the interaction and its context holistically, helps identifying qualitative requirements and insuring design targets.

2.7   Requirements List Extended by Storyboard and "Excitement Features" [12]

The aim of a requirements list is to structure and document requirements for task clarification especially at the beginning of the development process but also accompanying during the overall development. The clear documentation of the requirements of a product provides a basis for a complete requirements management; better communication and decision procedures; transparency of priorities and responsibilities; more systematical evaluation and selection of alternative solutions. Traditionally, a requirements list consists of technical, economic or organizational requirements for the life cycle of the product. Because of all these reasons, requirements lists are necessary in UXD projects. Still, they do not capture important UX aspects: contextual and temporal aspects, user motives and goals and interrelations among product attributes or other system components affecting the holistic experience. We therefore recommend extending the requirements list by a UX story visualized as Storyboard [18]. Regarding the requirements prioritization we highly recommend the use of Kano-model [12] to create measures for the design success with emphasis on the features causing customers enthusiasm.

2.8   UX Principles and Patterns [2, 26]

A successful approach to enhance innovation is the "Theory of Inventive Problem Solving-TIPS" [2], developed by G. Altschuller. His approach bases on the claim that successful patented inventions are based on a low number of principles and patterns to overcome contradictions leading to innovation. By analysing a large number of patents (approx. 30000) Altschuller derived 40 innovation principles with examples of successful application to support the creativity process. The approach of overcoming contradictions and getting inspired by principles and patterns can be transferred in UXD: We propose using UX Principles [26] derived from successful experiences descriptions as inspiration for UXD, analog to the use of TRIZ innovation principles. The principles and corresponding examples give helpful recommendations for improving UX aspects.

2.9   Experience Prototypes [5]

"Experience Prototyping" (EP) is a form of prototyping that enables design team members, users and clients to gain first-hand appreciation of existing or future conditions through active engagement with prototypes. EP contributes to design projects in three key ways: Firstly, in understanding essential factors of an existing experience, by simulating important aspects of the whole or parts of the relationships between people, places and objects as they unfold over time. Secondly, EP can provide inspiration, confirmation or rejection of ideas based upon the quality of experience they engender. Thirdly, by enabling others to engage directly in a proposed new experience it supports communication of issues and ideas. For all these reasons we highly recommend the use of EP during the whole design process. Another lesson learned by the application of experience prototypes was that combining different forms of prototypes increased the positive effects: mood boards, UX stories and EMMs can be used besides the hardware prototypes and create a better understanding of UX.

2.10   Function Modeling [12]

Function modeling is a method for analysis and structuring of a product in manageable sub-problems, which are formulated in a solution neutral way. System analysis with identification and description of the system's purpose are in focus, while concrete implementation options are not considered. Positive effects are better dealing with complexity and fewer fixations on existing ideas. There are three types of functional modeling depending on the goal: user-oriented models considering different users during the product life-cycle; flow-oriented considering energy, material and signal conversion; relation-oriented considering relations between functions and depicting connections between useful and harmful functions. Particularly interesting in the UX context are the user- and relation- oriented function models. A user-oriented model can be applied to highlight the differences in the emotional effects caused by the product on different user types. Relation-oriented models are also valuable for visualizing cause-effect relationships and functions useful or harmful to certain emotional effects. By properly adapting the method links such as „caused", „is required for" and „was introduced to avoid" can be used for linking hedonic and pragmatic properties and visualizing the nature (positive/negative) of the relations.

2.11   Design Structure Matrix (DSM) with UX-Related Domains [13]

Matrix-based approaches are widely used for complexity management in many applications in product development, project planning, project management, systems engineering and organization design. Depending on the relations they depict they can be classified in intra-domain matrices (DSMs, in which elements – typically of only one system at a time – and their relationships are mapped), inter-domain matrices (Domain Mapping Matrices-DMMs, linking elements of two different domains), as

well as "Multiple-Domain Matrices" (MDMs) as combination. MDM approaches have further been used for managing different types of knowledge configuration and management of multi-project environments. These applications encourage the use of matrix-based approaches in UXD, since similar issues are addressed. To create a positive total UX "soft" aspects, such as user needs and motives need to relate to product functions and characteristics harmoniously. A systematic analysis of those relations can be supported by matrix-based approaches with UX-related domains. Furthermore, UXD practice is user-centered and interdisciplinary and hence challenging to manage; an MDM approach can be beneficial to the UXD-project management.

2.12   UX Evaluation via Needs Fulfillment [10]

Different methods for evaluating UX can be found in literature, depending on the studied period of experience, the types of study and application, the participants and the development phase of application [21]. In our opinion, process-accompanying and continuous, agile testing with user involvement are key aspects concerning UX evaluation. Our approach bases on two claims: that positive UX emerges when users' needs and motives are fulfilled via product usage [22] and that UX can be communicated via experience prototypes (UX stories, mock-ups). Depending on the development phase different types of experience prototypes can be used to communicate the new product idea and needs to be fulfilled to possible users. In early phases, concepts and addressed needs are communicated via a UX story. As the idea becomes more concrete, the UX story is presented in form of a storyboard or accompanies the first physical prototypes. UX stories are a way to create an interaction context, to get certain needs salient and to create a unique experience, since subjects can relive an experience. The needs fulfillment can be tested in questionnaires, where participants are presented relevant items to each need. Early prototypes (e.g. storyboards) can be evaluated within online studies. When testing high fidelity prototypes or, more importantly, the interaction of an integrated prototype, a filed study is preferred. Apart from the qualitative data from the questionnaires, qualitative interview data or customer feedback are very valuable.

3   Discussion: Originality and limitations of this Study

The original findings are the recommendations made by the researchers. The findings are based on the experience of project participants with various backgrounds and are useful for academics and practitioners (because of the research-industry-cooperation), even for non-UX-experts. They reinforce a holistic approach, since most of the selected methods are process-accompanying. The methods are selected because of their suitability for application within complex organizational structures for the design of complex products. Further, some of the methods presented are not used in UXD context so far, while others are known only in specific fields (e.g. interaction design or engineering). The development needs identified would be interesting for the research community.

A limitation of the current study is that the findings are based on lessons learned from one project within a specific frame, so the recommendations are (mostly) valid for application by interdisciplinary teams and preferably during the whole design process. Application in further projects and product categories is planned to support this research. Furthermore, the collection of methods is not exhaustive and should be considered a recommendation rather than a guideline. Future work focuses on creating such a guideline with recommended sequences of methods based on specific project goals.

4   Conclusions

Twelve methods from the fields of engineering, industrial design and HCI are reviewed based on the lessons learned from application in an interdisciplinary UXD project. The researchers identify development needs and recommend adaptations in the use of the methods to support the analysis, creation and evaluation of UX within interdisciplinary teams. The methods presented can be used selectively in the Analysis, Creation or Evaluation phase; on the other hand, the UXD toolkit forces a holistic approach, since the recommended results build on each other. The desired outcomes are: UX chances as development goals; a mood board and a narration describing the vision for the development project; user insights documented as story elements; market-specific customer profiles; a requirements list extended by a UX story visualized as storyboard and highlighted "excitement features"; emotional mental models and experience prototypes describing the new concept; relations depicted in relation-oriented function models and DSMs; evaluation results based on UX stories and experience prototypes. The methods applicability and positive effect on UX ("significantly increased customer insights and design of better UX") was assessed by industry partners, UX experts and prospective users within project studies.

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