



User Experience Centered Engineering: A Process Model Inspired by Games Development

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Abstract. Following a brief review of standard software engineering processes and examples of software developments in the games industry, a user experience (UX) centered process model is proposed highlighting a set of methods to be performed for the various phases (UX Concept, UX Design, Prototype, System Production, Post Production) and the iterative (and repetitive) stages (Analysis, Design, Implementation, Evaluation).

1 Introduction

User Experience (UX) is defined as "a person's perception and the responses resulting from the use or anticipated use of a product, system, or service." [7]. In the last 20 years, UX was investigated using a variety of definition ranging from approaches that were rather holistic to definitions that were related to one or few concepts. McCarthy et al. [4] argue that UX is a holistic term, as the sum of a set of factors or concepts can be more than just the individual parts. On a more practical viewpoint, it is clear that UX is made up of a set of factors or concepts that we can develop for, and that are more tangible than investigating such a holistic experience (McCarthy, personal communication). A set of (well chosen) factors seems to be a good starting point, to engineering for a better UX. User experience is described as dynamic, time dependent [5] and beyond the instrumental [6]. From an HCI perspective, the overall goal of UX is to understand the role of affect as an antecedent, a consequence and a mediator of technology. The concept of UX focuses rather on positive emotions and emotional outcomes such as joy, fun and pride [10].

From a software engineering viewpoint, a factor or concept oriented definition of UX is a good starting point. Individual factors or a set of factors

can be (easier) engineered for, when developing for a non-specified "experience".

When developing software that focuses on UX, the user and the experience the user has when interacting with the system are of key importance. In the following we propose an adapted UX-centered design and development process with a set of related methods that can help to engineer for a set of UX dimensions or factors.

2 User Centered Process Model

When engineering for UX there are some differences in the design and development cycle compared to standard software engineering models. To be able to involve the user at all stages of the development process, a user centered development process is a good starting point. Figure 1 shows such a standard user centered development process (adapted from [1] , p. 74) enabling iterations.

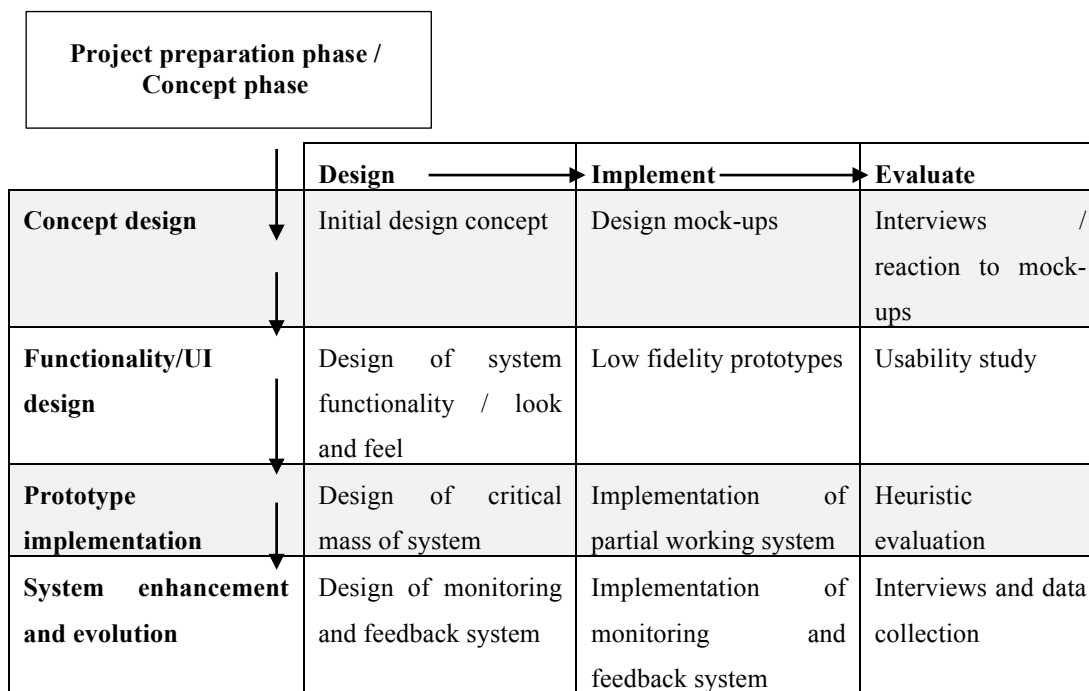


Figure 1. Iterative user centered design and development cycle, adapted from [1]

The process from Figure 1 is still useful today, but has been extended in the fields of Human Computer Interaction (HCI) and Software Engineering (SE) to include a variety of phases and methods depending on the type of interactive system being built. For example, for the development of large systems it is important that project preparation phase and concept design today

typically include the gathering of requirements (also to support requirements engineering). In the waterfall model [3], requirements engineering is presented as an early phase of the development process. Later software development methods, including the Rational Unified Process (RUP), Extreme Programming (XP) and Scrum assume that requirements engineering continues through the lifetime of a system.

The waterfall model refers to the following phases for SE development: system feasibility, software plans and requirements, product design, detailed design, code, integration, implementation and operations and maintenance [1] (p. 282). What is clearly missing is the ability to iterate and the ability to evaluate.

When focussing on UX the concept and the early phases of design and development can be structured differently. We discuss in the following a standard iterative design and development cycle consisting of (2.1) early design and development phase, (2.2) prototype phase, (2.3) implementation phase several phases and methods that are special when focusing on UX.

2.1 Early Design and Development Phases

Early Design and Development Phases can be referred to as the project preparation phase or concept phase (see Figure 1). When designing for UX, the number and type of participants and competencies can be challenging, as UX is a process that is typically not only targeting at the software itself, but at other processes that can influence the experience of the user. The experience we want to design for is not similar to the user interface (UI) design, but reaches beyond the UI. For the development of new products, this can include industrial design to support the form factors and shapes of the product (e.g. the size and form of the screen on the mobile phone, remote control or shape of the intelligent alarm clock), it can involve material engineering to develop new materials with special abilities (e.g. flexible screens [11], materials that store energy to support wearables [8] ...), it typically includes marketing and public relations (e.g. to develop a brand identity the users can identify with), and so on.

When working with such an interdisciplinary team to identify the type of UX the product shall deliver, simple textual descriptions for requirements are not enough. The communication of UX visions and ideas can be done for example verbally using a method called "Elevator Pitch" where you describe the idea within the time it takes the elevator to reach the floor, or to use only one word to focus on the topic. Other possibilities are to use metaphors,

experiences everyone can relate to (e.g. [9] mentions "to use light like on a dentist chair"), or to use one question.

Non-verbal descriptions include HCI-related methods that can range from Mood Boards [9] , to pictures and concept art (typically rough sketches). They can be complemented by videos showing sample animations.

Specificities for Games and Entertainment: In games development the concept phase "begins when an idea for a game is envisioned - and it ends when a decision is made to begin planning the project" (see [12] , p. 334). This phase is dedicated to the initial game idea and is devoted to producing a first concept document describing the game. The development team in this phase is typically small (e.g. consisting of designer, programmer, artist and producer). In the concept phase the game play experience you want to provide and the target market are identified. The concept phase is followed by the pre-production phase, where a game proposal and a planning are developed as well as additional documentation is produced (art style guide, production plan). The phase ends with the production of the game design document and the technical design document.

2.2 Prototype Phase

Goal of the prototype phase is to create something tangible (see *Concept design* and *Functionality / UI design* in Figure 1). Prototypes can range from low-fidelity prototypes showing main ideas on paper or in a power-point presentation to high-fidelity prototypes that already allow the evaluation of UX dimensions like aesthetics, emotion, identification, stimulation or social connectedness [2] .

Specificities for Games and Entertainment: Goal of this phase is a first working piece of software allowing to demonstrate key characteristics of the game and enabling to understand basic concepts related to the general UX of the game ("Is the game fun to play?"). This requires high-fidelity prototypes that are typically showing the technological aspects that will be new for the system as well as the game play experience. They are also used to show the game idea to a game developer study to acquire funding.

2.3 Implementation Phase

For the implementation of the interactive system there is a variety of SE methods and approaches available that help support a development that is iterative and ready for change (based on evaluation results, see *Prototype implementation* in Figure 1). Methods include SCRUM, agile development and others.

Specificities for Games and Entertainment: The implementation phase for games is typically referred to as production phase and has some special phases:

- **Alpha-Phase:** This is the phase when a game is playable from start to finish, allowing different evaluation methods to be applied to better understand aspects like fun, playability and UX.
- **Beta-Phase:** Main goal during this phase is normally to fix bugs. In terms of UX, in this phase lots of fine-tuning is necessary to improve the overall UX. The beta-phase includes steps like certification or submission (i.e. the hardware-manufacturer of the proprietary platform will test the game).
- **Gold:** In this phase the game is sent to be manufactured.
- **Localization:** An important phase for games that will be delivered to different markets (countries) is the localization phase. In this phase game-play can be adjusted to suit the tastes of the market, to allow for language translation and modifications due to local regulatory authorities.

2.4 After Release

After a system was released on the market, the usage of the system can be monitored (see *System enhancement and evolution* in Figure 1). On the basis of the results from such a monitoring-based evaluation, the system properties and functions can be adapted.

Specificities for Games and Entertainment: This phase is called post production and is becoming more and more important, as there is lot of activity to balance the game play, to improve and extend the number of game options or levels and so on (see [12] , chapter 5 for more).

3 A User Experience Centered Process Model

When developing for UX, it is important to follow an iterative design and development process. Following the four major steps of analysis, design, implementation and evaluation it is possible to react quickly to incorporate necessary changes to improve the UX.

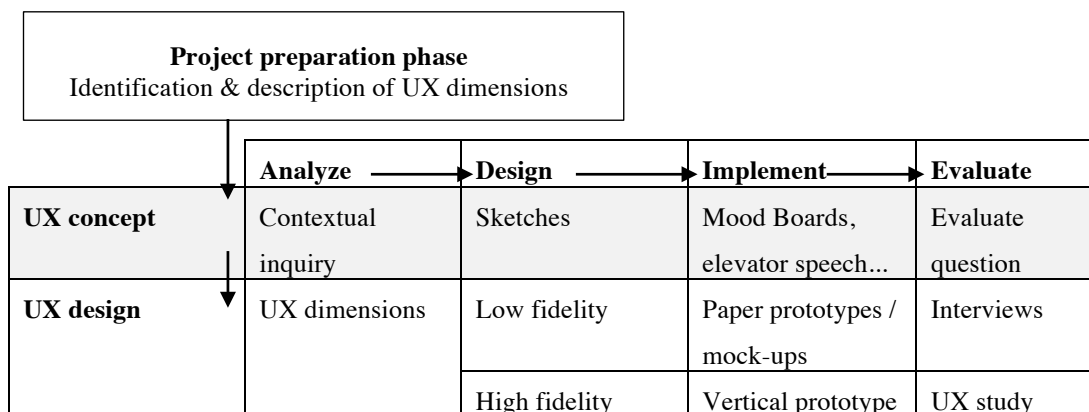
To analyse UX there is a variety of methods. Standard social science methods like focus groups, interviews and observation can be used at early stages to discover what type of experience we design for and how the context the product is used in is influencing experiences. For the design methods and

approaches like mood boards, videos and photos as well as high-fidelity prototypes help to design for the experience that is envisaged.

For the implementation there has recently been a lot of development (especially in games) enabling to model different users to support individual play styles [13], to analyse the history of interaction with the game to vary the difficulty of the game as well as interaction mechanisms that help to cheat if people are playing together.

For the evaluation of UX there are three types of methods available: expert-oriented methods, user-oriented methods and automatic methods [2].

As Figure indicates for a UX-centered design and development, we propose to follow the four iterative steps including *analysis*, *design*, *implementation* and *evaluation*. The process model consists of five phases: (1) the *UX concept* phase with the main activity of analysing the usage context, users and how this will affect the UX dimensions you want to support with the system, (2) the *UX design* phase that will (contrary to standard user centered design and development) consist of several iterations including low, but also high-fidelity prototypes and sometimes even partly functional systems to study UX. (3) The *Prototype* phase includes the first tuning on UX dimension selection, and might lead to shifting to a different experience. Possible evaluation methods at that phase will be expert evaluations (and insight from marketing) checking if the initial premises on how to support the UX dimensions were successfully applied. (4) The *Production* phase will typically be repeated - for games, production can be up to 2 years with hundreds of programmers, so tradition SE approaches are combined with agile methods as well as approaches like regular builds by the end of the week or first playable version, alpha and beta release as milestones. (5) Today, the *Post-production & evolution* phase is one of the most important phase for interactive systems, as they are continuously changing and developing due to new features, extensions or changed expectations of the users. Websites like Facebook or Amazon are changing on the fly, continuously enhancing the UX.



Prototype	UX dimensions tuning	Design of critical mass of system	Implementation of partial working system	Heuristic evaluation
Production (can be repeated)	Fine tuning	Development of deliverable system	Implementation & installation	Usability tests
Post-production & evolution	UX enhancement	Monitoring & feedback system	Implementation of mon. & feedback system	Interviews and data collection

Figure 2. Proposed Phases and Methods for UX-oriented design and development of interactive systems.

4 Conclusion

Including UX as central driver for software development is a difficult endeavour. This position paper argues for a five phases UX-centered development process that integrates the typical iterative design and development phases of analysis, design, implementation and evaluation. Main goal of this work is to lay a foundation for discussion within the workshop to identify gaps of the process model, to enable gathering of methods that are applicable and to vividly discuss how to support UX with engineering methods like user models, adaptive systems, personalisation and individualisation to support that user experiences are changing over time, based on the context the system is used in, and are individual to each user.

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