User experience prototyping
– a literature review

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Abstract

According to the human-centered design process, prototyping is an essential element of user experience (UX) design. This literature review aims to provide an overview of user experience prototyping and answer the following questions based on previous literature: How does UX design benefit from prototyping? What kinds of prototypes and prototyping tools exist? In which phases of the UX design process is prototyping most valuable?

This literature review reveals that prototyping increases the understanding of user needs and context, allows designers to explore and evaluate design ideas and communicate design decisions. Low-fidelity prototypes provide insight early in the design process when possible designs are explored and initial usability evaluations are conducted. High-fidelity and e.g. multi-fidelity prototypes can include more sophisticated interactive features and act as living specification for developers and other stakeholders. Low-fidelity prototyping tools are widely available and easy to use, while higher fidelity tools are often viewed as time consuming and more difficult to use.

Keywords:

User experience, UX, prototype, prototyping
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1. Introduction

User experience (UX) has become a key aspect in the design of products and services. Organizations that apply UX design activities in their product development achieve many potential advantages such as reduced development and product support costs together with increased customer satisfaction (Rajanen & Jokela, 2004).

UX design is iterative by nature and includes several phases where design decisions are made by multidisciplinary design teams. This creates a plethora of possible design solutions for the designers to explore. The human-centered design (HCD) process advocates the use of prototypes to involve users and other stakeholders in the design process.

This literature review aims to provide an overview of user experience prototyping and answer the following questions based on previous literature: How does UX design benefit from prototyping? What kinds of prototypes and prototyping tools exist? In which phases of the UX design process is prototyping most valuable? Answering these questions could help design practitioners in choosing suitable prototyping methods and phasing prototyping activities.

The study is divided into three main sections. The first one outlines the concept of user experience and user experience design. The second one explains the rationale for prototyping and classification of prototypes. The third one explains the motivation behind prototyping tools and provides examples of tools to aid UX design.

Previous literature was accessed via academic databases and Oulu University library. The academic databases included ACM Digital Library, IEEE Xplore, SpringerLink, Google Scholar and Web of Science. The most common keywords used in literature search were “user experience”, “UX”, “prototype”, “prototyping”, “prototyping tool” and their combinations. User experience and prototypes seem to be quite a popular research area and relevant references were easy to find.
2. User Experience

This chapter outlines the concept of user experience and user experience design in the context of human-computer interaction (HCI). It begins with the definition of user experience and places it in the context of human-centered design process. Further on a specific model on designing the user experience is presented.

2.1 Definition

The notion of UX has been commonly accepted in the field of HCI, although an established definition has been lacking (Law, Roto, Hassenzahl, Vermeeren & Kort, 2009). Law et al. (2009) propose the scope of UX to cover ‘products, systems, services, and objects that a person interacts with through a user interface’ (Figure 1). The International Organization for Standardization (2010) defines UX in a similar style, stating it as ‘person's perceptions and responses resulting from the use and/or anticipated use of a product, system or service’.

Hassenzahl and Tractinsky (2006) provide three overlapping aspects to better understand UX (Figure 2). Beyond the instrumental underlines the non-instrumental values of an interactive product such as aesthetics and hedonic qualities that address underlying human needs (e.g. an increase of one's skills). This is opposed to a former narrower paradigm in HCI, where an interactive product’s instrumental value was paramount and user-centered analysis and evaluation were focused on users’ tasks. The aspect of emotion and affect deals with the subjective emotional experience the product creates. Preventing negative feelings and establishing the context for positive emotions is a characteristic of UX. The experiential aspect views product use as situated and temporally bounded. Experience has a clear beginning and an end and UX is a combination of the product and user’s internal state like expectations, needs, motivation and mood. (Hassenzahl & Tractinsky, 2006.)
2.2 User experience design

Most of the interaction that contributes to user experience is conducted via user interface (UI) (Law et al., 2009). Nonetheless the design of user experience involves more than just the UI design. The complexity of how user experience takes shape creates various possibilities for the product design. Rather than actually design a user experience it is possible to influence the experiences users have (Cooper, Reimann & Cronin, 2007) or take experiential aspects into account that contribute to a positive user experience (Hassenzahl & Tractinsky, 2006).

2.2.1 Human-centered design

ISO (2010) states that use of the human-centered design approach improves user experience. There are several user-centered design models such as Contextual Design (Beyer & Holtzblatt, 1998), Goal-Directed Design (Cooper et al., 2007) and Elements (Garrett, 2011). All these models agree to the ISO (2010) framework for human-centered design and it’s six key principles:

- The design is based upon an explicit understanding of users, tasks and environments
- Users are involved throughout design and development
- The design is driven and refined by user-centered evaluation
- The process is iterative
- The design addresses the whole user experience
- The design team includes multidisciplinary skills and perspectives

Users, goals, tasks and environment are intertwined to a specific context of use. Understanding this context is key when designing products, systems or services. Involving users is an important source of information about the context of use and other user requirements. Users can e.g. participate in design or evaluate solutions with help of prototypes and other design artifacts. It is usually impossible to design every interaction...
in detail at the beginning of the development. Iteration should be used to refine the design as new user requirements arise during the development (Figure 3). (ISO, 2010.).

**Figure 3.** The human-centered design process (ISO, 2010, p. 11).

Human-centered design teams should have multidisciplinary skills. Cooper et al. (2007) describe UX design of a digital product as three overlapping concerns: form, behavior and content. All these concerns have corresponding design disciplines (e.g. interaction designers and information architects) to ensure a sufficiently diverse design team (Figure 4). ISO (2010) suggests in addition the team to need viewpoints from e.g. users and other stakeholders, subject matter experts, marketing, technical support, user management, systems engineering and human resources. A multidisciplinary design team brings more creativity to the development (ISO, 2010).

**Figure 4.** UX design disciplines (Cooper et al., 2007, p. xxxi).
2.2.2 The elements of user experience

Garrett (2011) presents a conceptual model for UX design. The model simplifies user experience into five interdependent planes to help phase design decisions and design the whole user experience (Figure 5).

The user experience builds from bottom to top. Issues to be considered on the lowest plane are quite abstract e.g. product strategy. On each step towards the top the design decisions become more and more concrete. Each plane is dependent on the decisions made on planes below it.

The Elements model has its roots in UX design for the Web. Web sites have a basic duality. They can be seen as functional applications where UX design mainly focuses on users’ tasks or as an information medium where design considers the information offered by the product. Therefore the model is split half: on the left side there are elements specific to functional products as well on the right side elements specific to information-oriented products.

Figure 5. The five planes of user experience (Garrett, 2011, p. 29).
On the strategy plane user needs are the main design drivers that determine product strategy. These must be lined with product objectives e.g. increasing sales for an e-commerce site. On the scope plane feature sets are described in functional specifications and content requirements. The structure plane explains product behavior and arrangement of content via interaction design and information architecture. On the skeleton plane information design, interface design and navigation design enable users to understand, interact with and navigate the product. The surface plane considers issues involving sensory design: how the product looks and feels like. (Garrett, 2011).
3. Prototypes and Prototyping

This chapter outlines the concept of prototypes and prototyping in the context of HCI. It begins with clarifying the basic nature of prototyping. Further on a classification of prototypes based on prototype fidelity is presented.

3.1 The rationale for prototyping

The role and importance of prototypes is broadly studied in the field of HCI. ISO (2010) defines a prototype in interactive systems as ‘representation of all or part of an interactive system, that, although limited in some way, can be used for analysis, design and evaluation’.

Previous literature notes prototyping to bring benefits especially in certain design activities: 1) revealing and understanding user needs and context, 2) exploration and evaluation of design ideas and 3) communicating design decisions. (Buchenau & Suri, 2000), (ISO, 2010), (Lim, Stolterman & Tenenberg, 2008), (McCurdy, Connors, Pyrzak, Kanefsky & Vera, 2006) and (Rudd, Stern & Isensee, 1996).

Lim et al. (2008) propose a framework for conceptualizing prototypes. They argue that prototypes have two fundamental aspects: 1) filters for exploring a design space to support final design decisions and 2) manifestations of design ideas. Prototype’s strength lies in its incompleteness. An incomplete prototype reveals certain qualities of the design idea and at the same time acts as a filter. It filters the qualities the designer is interested in at that certain point of the design process. The use of the filtering qualities of prototypes helps designers to explore complex design spaces one aspect (e.g. ergonomics or input layout) at a time. A set of filtering dimensions is presented in Table 1. Manifesting a certain aspect of a design requires the designer to consider the prototype’s material, the resolution of detail and the scope of the prototype. A designer can determine the manifestation dimensions by what Lim et al. call the economic principle of prototyping: ‘the best prototype is the one that, in the simplest and most efficient way, makes the possibilities and limitations of a design idea visible and measurable’. The manifestation dimensions and variables are presented in Table 2.

<table>
<thead>
<tr>
<th>Filtering Dimension</th>
<th>Example Variables</th>
</tr>
</thead>
<tbody>
<tr>
<td>Appearance</td>
<td>Size, color, shape, margin, form, weight, texture, proportion, hardness, transparency, gradation, haptic, sound</td>
</tr>
<tr>
<td>Data</td>
<td>Data size, data type, data use, privacy type, hierarchy, organization</td>
</tr>
<tr>
<td>Functionality</td>
<td>System function, users’ functionality need</td>
</tr>
<tr>
<td>Interactivity</td>
<td>Input behavior, feedback behavior, information behavior</td>
</tr>
</tbody>
</table>

Table 1. Example variables of filtering dimensions (Lim et al., 2008, p. 7).
Table 1. (Continued).

<table>
<thead>
<tr>
<th>Filtering Dimension</th>
<th>Example Variables</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spatial structure</td>
<td>Arrangement of interface or information elements, relationships among interface or information elements – which can be either two- or three-dimensional, intangible or tangible, or mixed</td>
</tr>
</tbody>
</table>

Table 2. The definition and variables of manifestation dimensions (Lim et al., 2008, p. 7).

<table>
<thead>
<tr>
<th>Manifestation Dimension</th>
<th>Definition</th>
<th>Example Variables</th>
</tr>
</thead>
<tbody>
<tr>
<td>Material</td>
<td>Medium (either visible or invisible) used to form a prototype</td>
<td>Physical media, e.g., paper, wood, and plastic; tools for manipulating physical matters, e.g., knife, scissors, pen, and sandpaper; computational prototyping tools, e.g., Macromedia Flash and Visual Basic; physical computing tools, e.g., Phidgets and Basic Stamps; available existing artifacts, e.g., a beeper to simulate an heart attack</td>
</tr>
<tr>
<td>Resolution</td>
<td>Level of detail or sophistication of what is manifested (corresponding to fidelity)</td>
<td>Accuracy of performance, e.g., feedback time responding to an input by a user—giving user feedback in a paper prototype is slower than in a computer-based one); appearance details; interactivity details; realistic versus faked data</td>
</tr>
<tr>
<td>Scope</td>
<td>Range of what is covered to be manifested</td>
<td>Level of contextualization, e.g., website color scheme testing with only color scheme charts or color schemes placed in a website layout structure; book search navigation usability testing with only the book search related interface or the whole navigation interface</td>
</tr>
</tbody>
</table>
3.2 Prototype fidelity

Majority of the studies involving prototypes discusses the fidelity aspect of prototypes. The concept of fidelity denotes the similarity of a prototype and the final product. Based on refinement, prototypes are usually classified as low-fidelity or high-fidelity. (Rudd et al., 1996). To extend this duality and better describe more recent prototyping approaches, classifications of mixed-fidelity (McCurdy et al., 2006) and a multi-fidelity (Coyette, Kieffer & Vanderdonckt, 2007) are proposed.

3.2.1 Low-fidelity prototypes

Low-fidelity prototypes portray design alternatives, concepts and screen layouts rather than describing a system's functionality in detail. Lo-fi prototyping is supposed to be rapid and occur early in the design process. A low-fidelity prototype implementation usually consists of a series of static layouts representing scenarios and flows. (Rudd et al., 1996). The implementation can be either computer-based or paper-based (Sefelin, Tscheligi & Giller, 2003).

A common low-fidelity prototyping method is paper prototyping. Paper prototypes are usually hand-drawn sketches or simple wireframes of the user interface. User then interacts with the prototype with the help of a human facilitator (Rettig, 1994). Another lo-fi method especially feasible for systems involving speech or gesture recognition is the Wizard of Oz. In this method a human simulates the intelligence of the prototyped system and interacts with the user. (Maulsby, Greenberg & Mander, 1993).

Low-fidelity prototyping methods have gained a great deal of positive attention for validating designs and uncovering requirements with extremely low cost early in the design process (McCurdy et al., 2006). Advantages and disadvantages of low-fidelity prototypes by Rudd et al. (1996) are presented in Table 3.

Table 3. Advantages and disadvantages of low-fidelity prototypes (Rudd et al., 1996, p. 80).

<table>
<thead>
<tr>
<th>Low-Fidelity Prototypes</th>
<th>Advantages</th>
<th>Disadvantages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lower development cost.</td>
<td>Limited error checking.</td>
<td></td>
</tr>
<tr>
<td>Evaluate multiple design concepts.</td>
<td>Poor detailed specification to code to.</td>
<td></td>
</tr>
<tr>
<td>Useful communication device.</td>
<td>Facilitator-driven.</td>
<td></td>
</tr>
<tr>
<td>Address screen layout issues.</td>
<td>Limited utility after requirements established.</td>
<td></td>
</tr>
<tr>
<td>Useful for identifying market requirements.</td>
<td>Limited usefulness for usability tests.</td>
<td></td>
</tr>
</tbody>
</table>

Buxton (2007) emphasizes the significance of sketching throughout the design process, but at the same time underlines a difference between a sketch and a low-fidelity prototype. Sketching is more explorative by nature and takes place earlier in the design process than prototyping. Hence the investment made in the sketches is even lower than in the lo-fi prototypes. The role of prototypes is larger when design ideas are converging in the design funnel (Figure 6).
3.2.2 High-fidelity prototypes

High-fidelity prototypes carry the complete functionality and interactive features of a service or a product. Users may not tell the difference between a high-fidelity prototype and a finished product. On one hand, implementing a high-fidelity prototype is notably more expensive and time consuming compared to low-fidelity prototypes. On the other hand, high-fidelity prototype can act as a living specification. Other advantages and disadvantages of high-fidelity prototypes are presented in Table 4. (Rudd et al., 1996).

High-fidelity prototypes don’t necessarily reveal more usability problems in usability tests. Users are able to imagine how the final product would appear based on the lower fidelity prototypes. (Sauer, Seibel & Rüttinger, 2010).

Table 4. Advantages and disadvantages of high-fidelity prototypes (Rudd et al., 1996, p. 80).

<table>
<thead>
<tr>
<th>High-Fidelity Prototypes</th>
<th>Advantages</th>
<th>Disadvantages</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Complete functionality.</td>
<td>More expensive to develop.</td>
</tr>
<tr>
<td></td>
<td>Fully interactive.</td>
<td>Time-consuming to create.</td>
</tr>
<tr>
<td></td>
<td>User-driven.</td>
<td>Inefficient for proof-of-concept designs.</td>
</tr>
<tr>
<td></td>
<td>Clearly defines navigational scheme.</td>
<td>Not effective for requirements gathering.</td>
</tr>
<tr>
<td></td>
<td>Use for exploration and test</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Look and feel of final product.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Serves as a living specification.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Marketing and sales tool.</td>
<td></td>
</tr>
</tbody>
</table>
3.2.3 Mixed-fidelity prototypes

Floyd (as cited in Rudd et al., 1996) recognized the need to develop vertical and horizontal prototypes. A vertical prototype has high-fidelity functionality but only to a limited extent. A horizontal prototype includes more extensive high-level functionality, but only a narrow lower-level implementation.

McCurdy et al. (2006) extend this thinking by proposing five independent dimensions for characterizing prototypes. Each dimension of a prototype can be implemented either low-fidelity or high-fidelity, which results in a mixed-fidelity prototype. The five dimensions are 1) level of visual refinement, 2) breadth of functionality, 3) depth of functionality, 4) richness of interactivity and 5) richness of data model. The independency of these dimensions allows designers to allocate more prototyping resources to the dimensions most imminent in the design.

3.2.4 Multi-fidelity prototypes

In the multi-fidelity prototyping approach a prototype includes elements of different fidelities. The difference between multi-fidelity and mixed-fidelity is that in mixed-fidelity only one fidelity is acted upon at a time and the fidelity level for an element can be always switched. (Coyette et al., 2007).

3.3 Experience prototyping

Experience prototyping highlights the experiential aspect of prototyping by allowing the users to directly and actively experience the prototype and thereby understand the existing or desired experience. This differs from the traditional way of prototyping products and services to a passive audience. Rather than a methodology, experience prototyping is an attitude that highlights direct experience via low-fidelity approach. (Buchenau & Suri, 2000).
4. Prototyping tools

This chapter focuses on prototyping tools. It begins with the motivation behind different prototyping tools and continues by providing a few examples of computer-based tools.

4.1 The rationale for prototyping tools

Grigoreanu, Fernandez, Inkpen & Robertson (2009) identify three main problems interactive application designers need tool support for: 1) creating the first version of the design, 2) iterating on it and 3) communicating it.

As prototypes in general, also the tools used to create them are categorized depending on their fidelity: low-fidelity, medium-fidelity and high-fidelity tools (Coyette et al., 2007). Carter & Hundhausen (2010) present six classes for different types of prototyping tools: 1) art supplies, 2) graphics editing software, 3) presentation software, 4) HTML software, 5) programming language and 6) prototyping software.

Low-fidelity tools are quick and easy to use for creating early designs and promoting collaborative sketching. They are also better than high-fidelity tools at generating design feedback, because users often mistake hi-fi prototypes for the final product and are therefore not in the best possible mindset to provide feedback. In turn, lo-fi tools can’t model complex interactions. (Carter & Hundhausen, 2010). Designers augment lo-fi tools such as sketches and storyboards with annotations (arrows, textual descriptions) to better describe interactive behavior (Myers, Park, Nakano, Mueller & Ko, 2008).

Previous literature points out that prototyping interactive behavior (feel) is particularly difficult (Myers et al., 2008) and (Grigoreanu et al., 2009). This is because designing interaction requires design exploration via iteration, for which many prototyping tools provide only a limited support. Designers then have to act as end-user programmers, who need programming skills to support design. The aim of describing and implementing behavior is usually to document it to developers or other stakeholders. (Myers et al., 2008).

Describing the flow of data, events and other resources to be the most important designer need. Describing flow involves e.g. wireframes, timelines and Visio documents. The flow is strongly connected to feel and both have low prototyping tool support. (Grigoreanu et al., 2009).

High-fidelity tools are good for creating rich user experiences by accurately modeling the final product. Also a higher level of reuse is possible with the hi-fi tools compared to lo-fi. On the other hand, many hi-fi tools are time consuming and difficult to learn. Other strengths and weaknesses of different types of prototyping tools are presented in Table 5. (Carter & Hundhausen, 2010).

Carter & Hundhausen (2010) noticed, that most of the designers use more than one prototyping tool within a project. Different tools are used for prototype creation and usability testing. Usually a this a case of using pen-and-paper to create the first designs
and then continue the prototyping in a computer-based tool to support usability testing
with a more realistic user interface.

Table 5. Perceived strengths and weaknesses of prototyping tools for creating and evaluating

<table>
<thead>
<tr>
<th>Tool</th>
<th>Strengths</th>
<th>Weaknesses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Art Supplies</td>
<td>Quick to create, Easy to create, Easy to use, Promotes creativity, Facilitates discussion, Can make quick changes, Obtains good feedback</td>
<td>Can’t model/test complex interactions, Doesn’t look like end result, Difficult to share/digitize, Difficult to alter, Users do not take prototypes seriously, Doesn’t accurately represent product</td>
</tr>
<tr>
<td>Graphics Editing Software</td>
<td>Can create/test realistic interfaces, Availability of premade widgets, Easier to demonstrate to non-technical staff</td>
<td>Time consuming, Can’t model/test complex interactions</td>
</tr>
<tr>
<td>Presentation Software</td>
<td>Easy to create, Can create/test realistic interfaces, Quick to create, Allows for user interactions, Can test user interaction</td>
<td>Can’t model/test complex interactions, Time consuming, Limited by toolset, Cannot handle novel user input</td>
</tr>
<tr>
<td>HTML Software</td>
<td>Accurately models final product, Can evolve into final product, Obtains good feedback</td>
<td>Time consuming, Limited by toolset, Cannot handle novel user input</td>
</tr>
<tr>
<td>Programming Language</td>
<td>Complete control over prototype, Availability of premade widgets, Can test realistic interfaces, Can test complex interactions</td>
<td>Time consuming, High learning curve, Difficult to create novel interfaces, Generated code isn’t perfect, Raises users’ expectations</td>
</tr>
<tr>
<td>Prototyping Software</td>
<td>Can create/test realistic interfaces, Generates code automatically</td>
<td>Generated code often needs to be modified to accommodate study</td>
</tr>
</tbody>
</table>

4.2 Examples of prototyping software

In the last over 20 years there has been a good amount of academic research in the field
of prototyping tools to provide custom tools that address designers’ needs. However
only a few practitioners seem to use these tools and continue using art supplies or
software not intended for prototyping. Still there is hope that custom computer-based
prototyping tools will become the first choice for user experience designers (Carter &
Hundhausen, 2010). In this section three different prototyping software tools are briefly introduced.

4.2.1 SILK

Figure 7. A SILK storyboard and sketch (Landay & Myers, 2011, p. 58).

SILK (Sketching Interfaces Like Krazy) is an early computer-based sketching tool, which is based on the benefits on paper-based sketching and academic research. SILK allows designers to create interactive sketches and transform them into operational UI’s with a realistic look and feel (Figure 7). (Landay & Myers, 2001).

4.2.2 Balsamiq Mockups

Figure 8. Balsamiq Mockups.

Balsamiq Mockups is a tool with a low learning curve that promotes low-fidelity approach through sketching and a limited set of interactions. The tool enables designers
and other stakeholder to sketch simple wireframes and link them together. It also provides premade widgets and collaboration features (Figure 8). (Balsamiq.com, 2015).

4.2.3 Axure RP

![Axure RP](image)

**Figure 9.** Axure RP.

Axure RP is one of the most commonly used prototyping software (Carter & Hundhausen, 2010). The first version of Axure RP was released in 2003 and it is now considered a de facto tool among UX practitioners. It supports low and high-fidelity prototyping in terms of appearance and interactive behavior. There are also documentation and collaboration features to aid specification and teamwork (Figure 9). (Axure.com, 2015).
5. Conclusions

Iterative design and evaluation combined with user involvement seem to be fundamental in the human-centered design process. Previous literature studied in this review points out prototyping to benefit UX design in many ways. Prototyping provides a better understanding of user needs and context, allows designers to explore and evaluate design ideas and also communicate design decisions. This validates the use of prototypes in UX design activities.

Fundamentally, prototypes have two aspects. They allow designers to explore design space one aspect at a time by filtering the qualities of interest at a certain point of the design process. Prototypes also manifestate the design by their material, level of detail and scope. The level of detail – fidelity, usually categorizes prototypes. The basic dichotomy is between low-fidelity and high-fidelity prototypes. Currently prototypes seldom are simply hi-fi or lo-fi but something in between. This is why extended concepts like mixed-fidelity and multi-fidelity have emerged. Lo-fi prototypes are paper or computer-based and the tools to create them can be as simple as pen and paper. Hi-fi prototyping is usually done by programming tools or custom prototyping software tools. Prototyping interactive behavior seems to be one of the biggest challenges for designers. Describing behavior with the help of lo-fi prototypes is time consuming as well as implementing complex behavior into hi-fi prototypes. Hence prototyping software that has support for implementing behavior is in demand.

The most valuable phase to utilize prototypes is in the early stages of design. Methods like experience prototyping can provide invaluable insight to understanding the existing experience. Lo-fi prototyping provides a low cost way of designers to explore design alternatives and gather feedback early in the design process. Usability studies conducted with lo-fi prototypes are as legitimate as tests with higher fidelity prototypes. This is valuable, since majority of usability problems can be addressed before the investment in a high-fidelity prototype let alone working software. Also the exploration of design ideas by sketching multiple design alternatives even before actually doing any prototyping per se is important. It helps to choose the right design before becoming too committed to a single prototype. Incomplete prototypes also seem to provide better feedback than more complete ones. The utility of higher fidelity prototypes is later in the design process. Hi-fi prototypes include polished appearance and sophisticated interactive behavior. This makes them useful in discovering more usability problems, providing marketing and sales support and ultimately serving as living specification.

The majority of previous literature on prototyping deals with user interface prototypes. It would be interesting to gain more insight on how to prototype the whole user experience. This literature review could be extended to a master’s thesis by adding a case study where e.g. the non-instrumental and emotional aspects of prototyping would be further examined.
References


