Serious gaming as a tool to describe a user-centred design process
This exam work has been carried out at the School of Engineering in Jönköping in the subject area of informatics. The work is a part of the Master of Science Programme User Experience Design and IT Architecture. The author takes full responsibility for opinions, conclusions and findings presented.

Examiner: He Tan

Supervisor: Bruce Ferwerda

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Abstract

The design of software products or services with good user experience (UX) requires a good understanding of the people the product is intended for. One of the design processes that places emphasis on the needs of the people is the user-centered design process. This study creates a serious game as a tool to learn the user-centered design process in order to create awareness of user-centered design practices among UX and non-UX practitioners. To accomplish this, design science research methodology is adopted to allow creation of the game by describing the problem, defining the game requirements, designing and developing the game and finally demonstrating and evaluating it. The evaluation of the game was conducted in three main areas, one to assess the content of the game, the second to assess the functionality of the game and the third to assess the learning potential of the game. Based on the results of the evaluation conducted it is revealed that the content presented is adequate and the participants are able gain concepts about the user-centered design activities, the roles involved in such a process and the various UX techniques employed.

Keywords

User-centered design, human-centered design, user experience, serious games, card game
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1 INTRODUCTION

This chapter outlines the motivation, purpose, research questions and delimitations of this study.

1.1 Motivation

The design for software products and services in current organisation environments requires a multidisciplinary approach, that is, a balance between business, technology and people. It is no longer enough to know the technology behind a design but to also understand the people these services are being designed for. Norman (2013) states that we are designing things for people, so we need to understand both technology and people.

User experience (UX) design plays a role of introducing the people aspect in a product and/or service development. ISO 9241-110:2010 defines user experience as:

“a person’s perceptions and responses that result from the use and/or anticipated use of a product, system or service.”

UX has its roots in human-centered design (HCD) often referred to as User-centered design (UCD), a process that requires starting with a good understanding of people’s needs, ensuring the resulting product meets the needs, and that the experience of use is positive and enjoyable (Norman, 2013).

However, during product and/or service development, different participants have diverse backgrounds and consequently different goals and standpoints with the product. Although organisations recognise the value of UCD, it is still difficult in practice to prioritise user experience practices (Goodman, Kuniavsky, & Moed, 2012). There is a challenge on how a UCD process should be managed among the various stakeholders throughout software product and/or service development by considering the diverse goals associated with a product.

This research proposes a production of a serious game that will be used to describe the UCD process. Organisations dealing with software products/services can use this game as a tool to understand the process and the roles different members of the organisations play in creating a product and/or service with good user experience. The reason for choosing a serious game as the output of this research is that serious games require the full involvement of participants, moreover, the participants are expected to demonstrate the understanding of the material within the context of the game which in turn provides an engaging and quick way of learning (Michael & Chen, 2006).
The use of serious gaming especially in corporate training is not new, corporations have a wide variety of training needs and have shown an increased interest in using serious games in the workplace (Michael & Chen, 2006).

1.2 Problem statement

Although organisations recognise the importance of good user experience in software product development there is still struggle on how a UCD process can be managed among various participants of the process. A survey by Law et.al (2009) presented the difficulties related to a shared understanding of UCD and UX among various practitioners from industry.

There is a need for a means to bring in UCD practices in a collaborative and engaging manner so that organisations understand the role of both UX and non-UX practitioners in the making of a software product or service. For an organisation to produce innovative products there needs to be a balance between the business, technology and people.

1.3 Purpose

The purpose of this research is to create a serious game to describe a UCD process in software product and/or service development. The serious game produced can be used as a tool to learn the UCD process in a collaborative and engaging manner. This is a contribution towards creating awareness of UCD practices among UX and non-UX practitioners enabling them to experience the process of product development from the perspectives of different roles involved.

1.4 Research questions

To achieve the stated research purpose, the following questions will be answered;

1. What elements (i.e., activities, players and methods) are most important in a user-centred design process?
2. How can a UCD process be described by using a serious game?

1.5 Delimitations

The focus of this study is placed upon the UCD process and the main activities or phases of the process. Although the UCD process includes various UX techniques or methods that could be
applied in each phase, this study does not provide a recommendation on how they should be applied within the context of an organisation. Furthermore, the serious game produced from this study will be completed in terms of structure and function of the game. The graphical and aesthetic appeal will not be a focus of this study.

1.6 Outline

The following chapter, that is, chapter 2 presents the theoretical background of serious games and the UCD process in order to understand the challenges and applications of each. Chapter 3 is the method and implementation chapter which presents the method applied when creating the serious game to include how the game was designed, developed and evaluated. Chapter 4 is the finding and analysis chapter which presents a description of the card game created together with the results of the evaluation. The final chapter is the discussion and conclusion chapter which reviews the strengths and weaknesses of the method used, the findings in relation to the purpose of this research and areas for future work.
2 THEORETICAL BACKGROUND

The following chapter discusses existing literature in the field of serious games, UCD and UX. The chapter is divided in two main sections, the first section covers an overview of serious games discussing the state in corporate training and its applications. The second section covers UCD and UX, compares various representations of the UCD process and generates a single general representation based on the comparison. This section also discusses the different challenges of UCD practice in organisations.

2.1 Overview of serious games

Michael and Chen (2006) define a serious game as “a game in which education (in its various forms) is the primary goal, rather than entertainment.” Matallaoui et al. (2016) further describe serious games as complete games that may have an education or learning background, example, a game that teaches the problems of project management. The teaching potential of serious games can be used by educators, corporations, non-governmental organisations or artists, basically, anyone who has something to teach, a skill to pass on, or a message to preach (Michael & Chen, 2006). Moreover, in developing games for the workplace, Prensky (in Michael and Chen (2006)) suggests situations where game-based learning would be useful to include two main areas, one when the subject matter is complex or particularly difficult to transmit and two when developing or communicating corporate strategies. A survey conducted by Fedwa et al (2014) revealed that serious games are growing rapidly both as research field and in industry.

2.1.1 Serious games in Corporate training

According to Basten (2017) a serious game is used to get people more involved and interactive in work related situations, and it helps to motivate communication and collaboration. In their investigation of how serious games can be integrated into companies, Azadegan & Riedel (2012) noted that when employees are given a choice on how to learn most will select playing a game as a preferred learning tool since they enjoy the engagement. Other benefits of serious games adoption in organisations as noted by Riedel et.al (2013) include the ability of serious games to produce learning results quickly as well as getting everyone involved in the process.
2.1.2 Applications of serious games in education and training

An example of a serious game is COSIGA, a multimedia, multi-player computer-based simulation game that was designed to support the education of engineers in the use of concurrent engineering for new product development (Haugea & Riedel, 2012). The game simulates the collaborative process of product development; the players have to work together to make the final product. COSIGA enables the players to experience the process of new product development from the perspectives of the different disciplines involved in the design process and to build their own understanding of the issues of design, manufacture, marketing, project and purchasing management; and the interactions between these disciplines (Haugea & Riedel, 2012). Another application of serious games includes the work done by Léger (2006), he proposes a “learning-by-doing” approach to teaching ERP concepts and ideas through a simulation game called ERPsim. One of the main learning objectives of the game was to develop a hands-on understanding of the concepts underlying enterprise systems. The approach generated a lot of interest and involvement in learning when it was tested with students with a need to learn ERP concepts.

2.2 UCD

UCD is a process that helps make products that meet the needs of their users. A UCD approach can be implemented to ensure that a product maintains great UX (Lowdermilk, 2013). UCD is not limited to the design of a product only, although product aesthetics is significant, UCD ensures that the product meets its designed purpose and user needs.

2.3 Comparison of UCD processes

This section reviews how various authors have discussed the UCD process and activities involved in order to identify the similarities and differences when applying UCD.

The term UCD was coined by Donald Norman in the 1980’s and has been widely used since then, in his recent publication he uses the term HCD instead. According to Norman (2013), there are four different activities in a HCD process which are Observation, Idea generation (Ideation), Prototyping and Testing. These activities are conducted in an iterative manner as illustrated below (Figure 2-1):
Observation is the initial research conducted on the people who will use the product in order to understand the problems they face and the needs they have. The most important aspect is to ensure that research is conducted on the appropriate group of users, that is, the intended audience of the product. The output of the observation phase is a set of design requirements (Norman, 2013).

Idea generation or ideation is a process of creating potential solutions to the problems identified from the research. There are many methods of generating ideas, the most common one being brainstorming; however, the general rule is to create as much ideas as possible and allow for creativity over constraints (Norman, 2013).

Prototyping is a process that involves building a quick representation of each potential solution. During the early stages such representations can be sketches, cardboard models or simple images made from drawing tools and these can be converted into digital representations as the project advances (Norman, 2013).

The testing phase involves gathering a population of the intended audience in order to have them use the prototypes created. The goal of this activity is to determine whether the created solutions address the needs of the audience, the result of the test can be used to improve the design solutions (Norman, 2013). These activities are conducted in an iterative manner in order to ensure continual improvement of the solutions, with each iteration, ideas can be refined and developed into a working solution.
The ISO has published standards for UCD and specification of usability, to emphasize on the impact of stakeholders in general and not necessarily users, ISO uses the term “human-centered” (HCD) rather than “user-centered” (Murray & Buie, 2012).

ISO 18529 process model outlines seven HCD processes for introducing and operating systems and services for government projects. These seven processes are divided into enabling HCD, executing HCD and an introduction process. HCD 1 and HCD 2 are enabling processes and these determine how human-centered activities will fit into the whole system lifecycle. HCD 3, HCD 4, HCD 5 and HCD 6 are execution processes and these bare similarities with the UCD activities outlined by Norman (2013). The final process HCD 7 involves the deployment of the new system. Figure 2-2 presents a diagrammatical representation of the HCD process as defined by ISO 18529.

![HCD processes in ISO 18529 (Murray & Buie, 2012)](image)

This section looks further into activities similar to Norman (2013), that is, **HCD 3** – Specify stakeholder and organizational requirements, **HCD 4** – Understand the specific context of use, **HCD 5** - Produce Design solutions and **HCD 6** – Evaluate designs against requirements (Murray & Buie, 2012).

HCD 3 is an execution process whose main goal is to determine the needs and requirements of the organization and relevant stakeholders, moreover, HCD 4 requires identification of the organization and physical environment in which the system will be used. Both of these are similar to Norman (2013) observation phase which requires an understanding of the needs and problem environment. HCD 5 is an execution phase whose goal is to create potential design solutions through the development of design prototypes. This is similar to the Ideation phase and
prototyping phase from Norman (2013). Finally, HCD 6 and is similar to Norman (2013) Testing phase, both of which require collecting feedback on the developed design.

Another author who has discussed the UCD process is Dhandapani (2016), the author documents that UCD processes involve understanding the needs of the users through research, analysing the needs and requirements of the users, coming up with design solutions to meet the requirements and then evaluating the solution through iterative tests and feedback. The steps outlined in this paper have a similar format with previous discussed works.

Moreover, according to usability.gov, an online resource for user experience best practices and guidelines, there are four general phases of the UCD process. These phases are specifying the context of use which involves identifying people who will use the product, specifying requirements which involves identifying business requirements and user goals that must be met, creating design solutions and finally evaluating the designs through testing with users (U.S. Department of Health and Human Services, 2017).

The comparison of the works done by other authors reveals that the activities conducted during a UCD process although adapted to a specific context are usually similar in execution. The main difference lies in the terminology used and at times grouping of activities. However, in general UCD processes require a proper understanding of users and context of use through research, development of potential design solutions, building representation of the design solutions and finally testing the solutions against users in order to get feedback for further improvement. All these activities are conducted in an iterative manner that require revisiting previous activities in order to improve the solutions.

2.3.1 Challenges of UCD practice in organizations

There is still resistance in creating a good user experience in organizations, this is because of the difference in stakeholder goals for the product. Technology is still viewed as more important than user experience (Kraft, 2012). Kashfi et al. (2017) describe communication and collaboration gap between UX and non-UX practitioners as one of the challenges of incorporating user experience practices into product development processes. They argue that UCD practices requires regular communication and collaboration among UX and non-UX practitioners which sometimes can be challenging since these two groups of practitioners often have different responsibilities, education, motivation, and constraints in their work. The authors further state that organizations struggle with knowledge concerning factors such as the concept of UX, the potential of UX to add value to software, existing UX methods and how to apply them in development processes. These
challenges presented make it clear that there is a need to find better means to integrate UCD practices into organizations.

Ardito et al. (2014) provide evidence on the fact that software developers maintain a “developer mind-set”. This means that developers are aware of usability and its importance in improving products however they only focus on the technical and functional aspects of a product. Moreover, there seems to be a lot of knowledge about UX models but there is limited use in the making of services and/or products. This may be caused partially by the lack of connection between designers and developers and because of the lack of agreement in focus. The designer’s primary focus is on the needs of the user whereas the focus of the developer is on functionality (Chamberlain et al., 2006).

Moreover, there is an emphasis on viability in the sense that there is a lack of methods that could be easily integrated into practice without demanding a lot of resources (Ardito, et al., 2014). The authors further recommend that academics need to translate formally described methods into something that makes sense for companies and is ready to be applied.

Another recommendation made by Kraft (2012) in overcoming these challenges is to conduct innovative workshops to different members of the organization on how to maintain UCD practices. This inclusion can lead to generation of ideas and perspectives of different stakeholders.

In summary, it can be concluded that organizations need innovative means to incorporate UCD practices into their software product development activities and teams. This study creates a serious game as a tool for describing the UCD process to organizations taking into consideration the different stakeholder goals. The serious game creates a common environment in which the UCD process can be explored, discussed and learned to gain new understanding. This type of learning allows the active participant to put the knowledge gained into play, moreover, the game allows for communication and collaboration between the various stakeholders in a work environment. The serious game is based on a general representation of the UCD process as shown in Figure 2-3, this representation was created after comparison of different UCD processes as discussed in literature.
Figure 2-3: General representation of UCD process
3 METHOD AND IMPLEMENTATION

The methodology that is implemented in this study follows the principles of design science research (DSR). DSR is the development and study of human made objects known as artefacts with the aim of solving a problem in the real world (Johannesson & Perjons, 2014). The main goal of DSR is to produce a new artefact which can make a problem in the existing world better.

3.1 Design Science Research

Different DSR frameworks exist, such frameworks include the work done by Wieringa (2014), Dresch et al. (2015) and Johannesson & Perjons (2014). In this research the framework by Johannesson & Perjons (2014) is followed. This framework is selected because of its simplicity and the possibility of having focal areas within the framework. The focal area chosen for this study is artefact definition and development.

In general, there are five activities introduced in the framework, these include problem identification, requirements definition, artefact design and development and finally demonstration and evaluation. Figure 3-1 shows an overview of the framework together with results from each activity.

![Figure 3-1: Framework for DSR](image-url)
Problem description is the first activity in DSR, it involves investigating and formulating a problem of general interest together with some underlying causes of the problem (Johannesson & Perjons, 2014). In the context of this study, the main form of problem description is a literature study that reveals UCD practice in organisations dealing with software product development. The problem identified is the inability to manage UCD practices among various participants in a product and/or service development process.

Requirements definition describes a solution to the problem in form of an artefact (Johannesson & Perjons, 2014). In the context of this study the artefact of choice is a serious card game, this is a type of serious game in which playing cards are the main way in which the game is played. A card game is selected because it allows organisations to learn without investing in a lot of resources which is identified as one of the challenges. The card game will be used as a learning tool among practitioners in product and/or service development companies to learn UCD practices.

Artefact design and development involves creating the artefact that addresses the described problem and fulfils the stated requirements. It also includes determining the functionality as well as structure of the artefact (Johannesson & Perjons, 2014). In the context of this research, a literature study on principles of game design has been conducted to understand the various elements that structure a game in order to facilitate the design of the card game.

The fourth and fifth activity involve demonstration and evaluation. This is the point where the artefact is demonstrated to an audience and evaluated based on previously set criteria. In the context of this study, the card game has been evaluated based on the concepts it represents, the functionality based on the requirements and the learning potential.

Preliminary conclusions have been drawn based on the use and performance of the card game by considering its objective of being a tool to describe the UCD process. This enables the research to identify how well the requirements were met and any potential areas for improvements. The following sections cover the activities of the DSR framework in detail.

3.1.1 Requirements definition

Requirements definition is about transforming the identified problem into demands for the proposed artefact, this activity determines the artefact that can be a solution to the problem and the requirements for the proposed artefact (Johannesson & Perjons, 2014).

The problem identified in this study is the difficulty involved in managing a UCD process in an organisation, one of the main causes for this being a lack of shared understanding of UCD and
UX practices among various practitioners. In order to address the problem, the artefact needs to demonstrate the UCD process while considering the different roles and goals involved in creating a software product/service.

The artefact proposed to solve this problem is a serious card game, the game helps solve the identified problem by providing a collaborative, communicative and engaging way to understand the UCD process. In particular, a card game is chosen as opposed to a digital game because it has the advantage of facilitating real life interactions and discussions. Furthermore, card games are cheaper and more accessible compared to digital games making it a viable option even for organisations that do not want to make major investments.

In order to build the card game, requirements need to be defined. A requirement is a property of an artefact that is considered necessary, it is used for guiding the design and development of the artefact. Requirements can concern the functions, structure, or environment of an artefact as well as the effects of using the artefact (Johannesson & Perjons, 2014). The following sections outlines the functional and non-functional requirements of the card game.

**Functional requirements**

The functional requirements represent what the game does, and these have been derived from the problem the game is intended to solve.

- The card game shall correspond to the UCD process
- The card game shall include UX and non-UX practitioner roles
- The card game shall require the players collaborate

**Non-functional requirements**

- The game rule sheet must be easily understood by a player when provided during game play

### 3.1.2 Artefact Design and Development

This section discusses the various components of the card game, the purpose of each component in relation the requirement it addresses and the literature that has contributed to the design of the game.

#### 3.1.2.1 Card game design components

The foundation of game design begins by understanding the various elements that make up a game, these include players, objective, procedures, rules and resources. These are formal elements
which give a game structure, it is essential to understand how these elements interrelate to create a game experience. Different innovative element combination provides a unique game structure and experience (Fullerton, 2014). The following section discusses each of these elements and how they have been used to structure the card game created in this study.

**Players**

The first element is players, these are the people who play the game, they must accept the rules and constraints of the game in order to play (Fullerton, 2014). One of the functional requirements of the card game is to have both UX and non-UX practitioner roles in game play and hence the card game is designed to support three basic players, each player has a specific role to play in the game.

The choice of the number and role of players is motivated by Norman (1998) where he indicates that HCD requires three equal partners, technology, marketing and user experience. A product development process has to consider functionality, marketability and usability aspects of the product, the three legs provide diverse but necessary strengths when developing a product and should ideally be balanced. A similar concept is discussed by Brown (2009) where he talks about design thinking, a human centered approach to innovation. He states that there are three overlapping constraints for successful products, the feasibility (technology possibilities), the viability (business requirements) and the desirability (needs of the people). For innovation to happen all the three should be considered and an attempt should be made to make them peacefully co-exist.

The game designed uses these concepts and incorporates three basic roles which are a business representative (business officer), a technical representative (programmer) and a design (people) representative (UX designer). The three roles will be required to collaborate as one of the requirements of the card game in order to complete the game objective.

**Objective**

Objectives describe what the players are trying to accomplish within the rules of the game, they give players something to strive for and set the challenge and tone of the game (Fullerton, 2014). There are various categories of game objectives some of which include capture, rescue or escape, construction, exploration, outwit, race or solution (Fullerton, 2014). The card game designed employs a form of solution objective, this type objective requires players to solve a specific task, in the context of this study the task to solve is a UX project. One of the set-out requirements for
the card game is for the players to collaborate and hence the players are required to complete the task cooperatively while using available resources.

In the card game four types of UX projects have been identified to set the game objective, these classes of UX projects have been motivated by (Unger & Chandler, 2012), the authors suggest that there are four different categories of projects a team may be working on. These include a brand presence solution, a task-based solution, a content source solution or a market campaign solution, the four types of projects have distinguishing characteristics from one another.

According to Unger & Chandler (2012), a brand presence solution is a platform that enables the relationship between the company and a general audience, that is, anyone interested in the company’s products or services, an example of this is a company’s main home page. A marketing campaign on the other hand is a targeted application meant to deliver specific response from a particular audience over an agreed upon period of time, example, a company’s webpage with a specific offer.

The third type of project is a content source, this stores information potentially of different formats meant to inform and involve users, for example, a company’s intranet. The final type is task-based solution, this is a collection of tools designed to allow users to complete a set of tasks aligned to their needs, for example, a ticket buying application (Unger & Chandler, 2012).

The players of the card game will be given a project based on the four categories identified and will be required to take the necessary action to complete it while following the UCD process.

**Procedures**

Another element of game design is procedures, these are various actions a player can execute in order to reach the objectives of the game (Fullerton, 2014). Procedures identify who does what, where and when. According to Fullerton (2014), there are four types of procedures games tend to have, these include starting action which describes how a game is put into play, progression of action which describes ongoing procedures after a game begins, special action which describes conditions changing the state of the game and finally resolving action which describes how the game comes to an end. Procedures are usually explained in the game rule sheet and put into action by the players, the card game procedures can be found in Appendix 1.
Resources

Resources are assets used that can be used to accomplish the objective of the game, for a designer it is important to understand what resources will be used, how to control them and how players can access them to accomplish the objective (Fullerton, 2014).

During game play, the players’ objective is to complete a project while following the UCD activities (research, design, prototype, test). In order to do this, they can employ various UX techniques, these techniques form part of the resources of the game.

Table 3-1 gives a brief description of each technique used in the card game and instances where it is most useful based on the classification of the UX projects.

*Table 3-1: Research techniques (Unger & Chandler, 2012)*

<table>
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<tr>
<th>Technique</th>
<th>What it is</th>
<th>When it is useful</th>
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<tbody>
<tr>
<td>Interviews</td>
<td>A conversation with a participant who belongs to one of the project user groups</td>
<td>Task-based tool, content source, brand presence and marketing campaign</td>
</tr>
<tr>
<td>Contextual inquiry</td>
<td>An on-site visit with participants to learn how they work in their environment.</td>
<td>Task-based and content source application or website</td>
</tr>
<tr>
<td>Surveys</td>
<td>A set of closed-ended questions used to identify patterns among a large number of people.</td>
<td>Marketing campaign and Brand presence</td>
</tr>
<tr>
<td>Card Sorting</td>
<td>Users are given items on cards and are asked to sort them into groups that are meaningful to them.</td>
<td>Content source application or website</td>
</tr>
<tr>
<td>Focus groups</td>
<td>Users are brought together and asked to answer specific questions or to complete tasks.</td>
<td>Marketing campaign, task-based application or site</td>
</tr>
</tbody>
</table>

*Table 3-2: Design techniques (Unger & Chandler, 2012) and (UX Mastery & Co Pty Ltd, 2017)*

<table>
<thead>
<tr>
<th>Technique</th>
<th>What it is</th>
<th>When it is useful</th>
</tr>
</thead>
</table>

| **Sitemap** | A list of all pages available on the application or site to visualize the basic structure and navigation. | Task-based and content source application or website |
| **Workflow diagram** | Representation of activities performed by users in an application or website | Task-based application or website |
| **Wireframing** | Low fidelity representation of the elements that will be displayed on the page | Task-based tool, content source, brand presence and marketing campaign |
| **Mock-ups** | A representation of the visuals of a product to include colour schemes, typography, icons. | Task-based tool, content source, brand presence and marketing campaign |

**Table 3-3: Prototyping techniques (Tonic, 2017) and (Unger & Chandler, 2012)**

<table>
<thead>
<tr>
<th>Technique</th>
<th>What it is</th>
<th>When it is useful</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Paper prototyping</strong></td>
<td>A paper representation of the application or website interface.</td>
<td>Task-based tool, content source, brand presence and marketing campaign</td>
</tr>
<tr>
<td><strong>Interactive prototyping</strong></td>
<td>Digital and interactive representation of a website or application</td>
<td>Task-based tool, content source, brand presence and marketing campaign</td>
</tr>
<tr>
<td><strong>Coded prototyping</strong></td>
<td>Prototypes made by writing code such as HTML and CSS to create the preliminary version of the application.</td>
<td>Task-based tool, content source, brand presence and marketing campaign</td>
</tr>
</tbody>
</table>

**Table 3-4: Testing techniques (Unger & Chandler, 2012) and (Interaction Design Foundation, 2018)**

<table>
<thead>
<tr>
<th>Technique</th>
<th>What it is</th>
<th>When it is useful</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Usability testing</strong></td>
<td>Ask users to perform tasks on the application or website and note their pain points and successes.</td>
<td>Task-based and content source application or website</td>
</tr>
<tr>
<td><strong>Expert review</strong></td>
<td>An expert walkthrough of the user interface to identify any issues with the design</td>
<td>Brand presence, Marketing campaign</td>
</tr>
<tr>
<td><strong>Eye tracking test</strong></td>
<td>A tool to record the movement of a user’s eyes as they use an application</td>
<td>Task-based tool, content source, brand presence and marketing campaign</td>
</tr>
<tr>
<td>-----------------------</td>
<td>--------------------------------------------------------------------------</td>
<td>------------------------------------------------------------------</td>
</tr>
<tr>
<td><strong>Task analysis</strong></td>
<td>A way for detecting and highlighting activities that users want to perform in a product to achieve their objectives.</td>
<td>Task-based and content source application or website</td>
</tr>
</tbody>
</table>

**Rules**

Rules define game objects and acceptable actions in play (Fullerton, 2014), an example of a rule in chess is that a King can only move one block but in any direction. It is important that the rules of the game remain as simple as possible in order not to confuse the players. The rules of the card game have been presented in a rule sheet which contains the game overview, game set up, instructions on how to play, the game components and the criteria for winning or losing the game. The rule sheet can be found in Appendix 1 and will be provided to the players together with the game.

**3.1.2.2 Card game development**

This section covers details on how the card game was prototyped from the identified design elements.

Prototyping is the construction of a working version of a game idea which allows to test for feasibility and making of any improvements to it when necessary (Fullerton, 2014). The prototype card game is based on the game elements and components defined in the previous section. This prototype has been used to demonstrate and evaluate the game.

The prototype cards have been developed by Adobe InDesign, this is an application that allows creation and publications of documents for print and digital media (Adobe Systems Incorporated, 2017). Since this study is not focused on the graphical design of the cards then Adobe InDesign is a sufficient tool to represent all the basic information on each card.

The cards designed are poker sized (2.5” x 3.5”) or size “B8” as defined by ISO 216. The reason for choosing this dimension is that, this is among the most common playing card sizes and users are expected to be acquainted to handling such cards. Furthermore, the card dimension facilitates easy reading of the text to represented on each card. The following section describes how the created prototype was demonstrated and evaluated as a final activity in DSR.
3.1.3 Demonstration and Evaluation

The purpose of this study is to create an artefact in form of a card game that will be used to describe the UCD process. In order to evaluate the game, three types of tests have been conducted. One assesses the content validity of the card game to determine whether the constructs represented are within UCD, the second assessment is a playtest to check the functionality of the game and the third assessment is to give preliminary results as to whether the players learn the concepts the serious game is meant to inform. The following sections provide more details concerning each assessment conducted.

Content validity assessment

In order to assess a serious game’s validity, it is important for practitioners to examine the game’s content to determine whether it adequately resembles the concepts it aims to describe (Graafland, et al., 2014). Since the card game is describing the UCD process, it is important to assess whether these concepts have been correctly captured in the game.

In order to do this, a UX Designer from En appstudio¹ has been consulted to assess the concepts employed in the game. The designers from En appstudio follow a UCD approach when making products and services and hence can provide input into how well UCD has been represented in the game.

The data collected during this evaluation was qualitative in nature through questionnaires. A systematic literature review of serious games evaluation by Calderón & Ruiz (2015) revealed that 90% of serious games were evaluated using questionnaires. The questionnaire consists of open questions, that is, questions with no predefined answers which allow the respondents to answer in their own words (Johannesson & Perjons, 2014). Open questions were chosen as a data collection method because the respondent is expected to provide detailed information regarding the content of the game.

Functionality assessment

In order to assess whether the game has met the defined requirements a playtest has been conducted. A playtest is a process by which a designer tests a game to gain insight into how players experience the game and notes any revision to be made (Fullerton, 2014). Playtesting is selected in

¹ En appstudio is a company that produces applications to help customers solve problems and identify opportunities. https://enappstudio.se/
this study because the artefact involves interaction between a created experience and a participatory audience. The data collected during the playtest is also qualitative in nature through observation.

Observation is a data collection method in which a researcher directly observes a phenomenon, it offers the advantage that the researcher can observe what people do rather than say or think (Johannesson & Perjons, 2014). Observation is selected in this study because it allows to capture the experience of the game from the perspective of the participants which happens during game play.

There are two types of observation, that is, participant and systematic observation. In participant observation, the researcher builds a close familiarity with participants being observed in their daily activities. Systematic observation employs a predefined system for classifying and recording events called an observation checklist, this checklist tells the researcher what to look out for and how to record the observations (Johannesson & Perjons, 2014). This study involves observing participants among different playtest groups and hence systematic observation was used in order to record similar events in the different play test groups. This method was used to determine whether the defined functional and non-functional requirements of the game have been met.

Learning outcome assessment

Although the focus of this thesis is to create a game to describe the UCD process, the card game is meant to be a serious game, that is, a game with intentions to educate. Hence, aside from assessing the functionality and content, including an educational assessment will provide insights on the educational potential of the card game created. This provides initial insights on whether the game provides any educational value to the participants playing it.

The data was collected by using open-ended questionnaires, the participants were asked to answer two questions, the first one relating to product design process and the second relating to the roles involved. The participants were asked to account whether they have learned anything new regarding the two areas involved during product design.

Participant selection

When reviewing academic methods for evaluation of serious games Yáñez-Gómez, Daniel, & Sevillano (2017) state that the minimum number of users required to evaluate serious games according to literature is five. Because the game requires three people to play, six participants were used during evaluation, all six participants played the same game, however, each participant
represented a distinct behaviour during game play. The selected participants were divided into two playtest groups consisted of three players each.

Moreover, in order to evaluate the learning outcome of the game, the participants were required to have little or no previous knowledge of UCD. To achieve this a Google form was distributed on Facebook in Jönköping University asking students to sign up for a game playtest, the form required respondents to state their awareness of the UCD process as either existent or not.

To adhere to research ethics, all participants were asked to give approval of their participation in the research by using a consent form which stated the goals of the research, description of the research procedure and the protection of participants through anonymity.

### 3.2 Data collection

The following section provides a description of how data was collected in order to evaluate the three aspects of the card game.

**Content validity assessment**

In order to collect data about the content validity, a questionnaire was disseminated through email to a UX designer from En appstudio. The questionnaire contained four open ended questions relating to the concepts presented in the game and required the respondent to provide an opinion from a practical perspective regarding the validity of the concepts presented in the card game. The response to the questionnaire can be viewed in Appendix 3.

**Functionality assessment - Playtest design**

After selecting the play testers, the participants were divided into two groups. Each group was presented with the game prototype together with the game rule sheet. Each participant in a play test group was allocated a letter between A and C which identified them as the data source for the study. Data was gathered by observing the behaviours identified in the observation checklist below, if any participant exhibited such behaviour it was recorded by marking an “X” to the specific participant and behaviour. Also, remarks were taken to take note of any additional information.

Since observation presents a possibility of missing out on some information while making notes, a video and audio recording was used in order to enable review of the sessions and to identify any overlooked information during game play.

Table 3-6 shows the observation checklist used in this study together with the requirements for checking each behaviour:
Table 3.5: Observation checklist

<table>
<thead>
<tr>
<th>Behaviour</th>
<th>Participant</th>
<th>Requirements for checking the behaviour</th>
</tr>
</thead>
<tbody>
<tr>
<td>Understanding the objective of</td>
<td>A</td>
<td>If the players communicate a shared understanding of the goals of the game from the rule sheet before starting the game.</td>
</tr>
<tr>
<td>the game</td>
<td>B</td>
<td></td>
</tr>
<tr>
<td></td>
<td>C</td>
<td></td>
</tr>
<tr>
<td>Player dynamics: Communication</td>
<td>A</td>
<td>If each player is communicating with the rest of the team concerning their role, play or any strategy established</td>
</tr>
<tr>
<td></td>
<td>B</td>
<td></td>
</tr>
<tr>
<td></td>
<td>C</td>
<td></td>
</tr>
<tr>
<td>Player dynamics: Collaboration</td>
<td>A</td>
<td>If players are solving the project collectively as a team and whether they divide the tasks among each other in order to finish the game.</td>
</tr>
<tr>
<td></td>
<td>B</td>
<td></td>
</tr>
<tr>
<td></td>
<td>C</td>
<td></td>
</tr>
<tr>
<td>Player discussions</td>
<td>A</td>
<td>Any points of confusion or discussions concerning how to play or how to utilise the techniques of the game.</td>
</tr>
<tr>
<td></td>
<td>B</td>
<td></td>
</tr>
<tr>
<td></td>
<td>C</td>
<td></td>
</tr>
</tbody>
</table>

**Learning outcome assessment**

After the participants finished playing the game, they were each presented with a questionnaire consisting of two open ended questions in order to express their views regarding what they learned in terms of the product design process and the roles involved. The results of the questionnaire can be seen in Appendix 5.
3.3 Data Analysis

The data collected in this study is qualitative in nature and hence a qualitative data analysis has been conducted. There are many approaches towards qualitative data analysis such as discourse analysis, content analysis, grounded theory and an inductive approach.

According to Thomas (2006), inductive approach involves analysing of qualitative data while being guided by specific evaluation objectives. Since the game evaluation objectives were already set, that is, content validity analysis, functionality analysis and learning potential analysis then the inductive approach has been used in this study. This method involves studying raw data in order to derive concepts or themes through interpretations made from the data set, the main goal is to allow findings to emerge from the data collected.

Analysis of the observation data collected is based on identifying the frequency of behaviour as outlined in the observation checklist among the participants. In addition, the remarks jotted down during the playtest have been accounted to facilitate identifying common themes among participant behaviour.

For the open-ended questionnaires, the responses have been digitally documented and reviewed in order to categorise the data into themes.
4 FINDINGS AND ANALYSIS

In this chapter the card game developed is described and its functions are analyzed based on the requirements defined previously. Moreover, the results of the three types of evaluation conducted are presented and analyzed in relation to the purpose of this research.

4.1 Card game description

The purpose of this study is to create a serious game to describe a UCD process in product and/or service development. Based on the representation of a UCD process and the various game elements defined in previous chapters, a card game has been developed. The card game is a three-player collaborative game which requires the participants to work together to finish a product development project while following the UCD process.

The card game is consisted of different types of cards to include four project cards (Figure 4-1) which describe the type of project the team will be solving, three role cards (Figure 4-2) which describe the role the player will be assuming, four phase cards (Figure 4-3) which represent the activities in a UCD process, twenty eight technique cards (Figure 4-4) which represent the UX methods players can apply to complete a UCD activity, twenty modifiers (Figure 4-5) which describe the action the players need to take during game play, thirty capital cards (Figure 4-6) which give players buying power for techniques and finally eight drawback cards (Figure 4-7) which add engagement to the game by warning players of potential to fail the project.

All of the cards have been printed and fitted into poker sized (2.5" x 3.5") card sleeves in order to allow playability. A full description of the game overview, setup and instructions of play has been provided through a game rule sheet in Appendix 1.
Figure 4-1: Project card design

Figure 4-2: Role card design

Figure 4-3: Phase card design

Figure 4-4: Technique card design

PROJECT
Make a task-based solution

UX DESIGNER
"Your role is to ensure the desirability of the product"

Special ability:
Get any research technique freely

RESEARCH
Understand the users you are making the solution for

INTERVIEWS
"A conversation with a participant of the user group"

Used for:
Task-based tool
Content source
Brand presence
Marketing campaign
4.1.1 Card game requirements analysis

The second DSR activity is requirements definition, this activity defines the properties of the artefact that are important in order to solve the problem the artefact is intended to solve. In chapter 3.1.1 two sets of requirements were defined for the card game, three functional and one non-functional requirements. This section discusses whether the created card game has met the properties defined in the requirements in order to fulfil the purpose of this research.

The first functional requirement stated that the card game shall be correspond to the UCD process. This requirement has been met by implementing the representation of the UCD activities defined in chapter 2.3 in the game. The players in the game have to follow the phases of the UCD process in order to win. Each phase card gives a brief description about what the UCD activity is about and can only be completed by applying appropriate techniques. The phases are represented by research, design, prototype and test cards as shown below.
The second functional requirement stated that the card game shall include UX and non-UX practitioner roles. The card game involves three roles as supported by literature, the roles are a business representative, a UX designer and a programmer. The UX Designer is a representation of a UX role and the business representative and programmer are a representation of non-UX roles and hence fulfilling the requirement. Each role card contains a brief description of the general responsibility of the role to allow players to learn and a special ability which relates to what the roles do in a project during game play. The three role cards as present in the card game are shown below.

The third functional requirement stated that the card game shall require the players collaborate. This is because the purpose of the study was to learn UCD collaboratively and in the perspective of different roles. This requirement is met by ensuring that no single player can win the game alone, the players have to work together to collect enough techniques while utilizing each other’s
strengths to finish each phase and consequently the project. This requirement is further evaluated through a playtest the results of which can be seen in section 4.2.2

The one non-functional requirement stated that game rules must be easily understood by a player as provided in the rules sheet. The language used in the rule sheet is plain and contains sectioned instructions on the game overview, how to play, conditions for winning and a description of the cards used during play. This requirement was also assessed using a playtest where the participants were presented with the game rule sheet to read and understand the objective of the game before beginning play. The results of this assessment can be viewed in section 4.2.2

Following the development, an evaluation of the card game was conducted in which the findings will be presented in the next section.

4.2 Card game evaluation

According to DSR an artefact has to be evaluated after it is developed, in the context of this study the card game developed was evaluated based on three categories content validity, functionality and learning outcome. The following sections outline the findings and analysis from each of the evaluations.

4.2.1 Content validity findings and analysis

A UX designer from En appstudio was consulted to comment on the validity of the concepts presented in the game through a questionnaire. The questionnaire contained four open questions relating to four card types, that is, the roles cards, the project cards, the phase cards and the technique cards. These cards were presented because they are the cards that contain the UCD and UX concepts the players are intended to learn and hence needed to be verified. The remaining three card types were also presented to allow the designer to understand the dynamics of the game play.

All of the cards presented in the questionnaire were seen as a good representation of the UCD process and the UX techniques. Recommendations were made on how to further improve the cards, these will be discussed in later chapters.

Table 4-1 presents a summary of the comments provided by the designer in relation to each of the four card types.
Table 4-1: Comments on content validity

<table>
<thead>
<tr>
<th>Card type</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Roles cards</td>
<td>The three roles are good, a recommendation was given to also have the</td>
</tr>
<tr>
<td></td>
<td>option to add a client as a role.</td>
</tr>
<tr>
<td>Project cards</td>
<td>The project cards are fitting, a recommendation of adding examples to</td>
</tr>
<tr>
<td></td>
<td>the cards was given.</td>
</tr>
<tr>
<td>Phase cards</td>
<td>The phase cards were commented on as perfect and a recommendation of</td>
</tr>
<tr>
<td></td>
<td>having iteration was provided.</td>
</tr>
<tr>
<td>Technique cards</td>
<td>Technique cards are perfect. No changes recommended.</td>
</tr>
</tbody>
</table>

4.2.2 Functionality findings and analysis

4.2.2.1 Findings

A total of six participants were chosen from eight who had signed up with the Google form. All the participants selected had indicated that they had no awareness of the UCD process. The participants were divided in two groups and provided with the card game together with the game rule sheet. Each group was then observed by the researcher as they played, the observation data was collected through an observation checklist containing four behaviours derived from the functional and non-functional requirements of the game. For each behaviour a participant exhibited, a check mark (X) was placed under the specific behaviour and participant, the observation notes taken can be viewed in Appendix 4.

Table 4-2 and Table 4-3 describe the behaviours marked during observation for group 1 and group 2 respectively.
Table 4-2: Observation checklist for group 1

<table>
<thead>
<tr>
<th>Behaviour</th>
<th>Participant</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>A</td>
</tr>
<tr>
<td>Understanding the objective of the game</td>
<td>X</td>
</tr>
<tr>
<td>Player dynamics: Communication</td>
<td>X</td>
</tr>
<tr>
<td>Player dynamics: Collaboration</td>
<td>X</td>
</tr>
<tr>
<td>Player discussions</td>
<td>X</td>
</tr>
</tbody>
</table>

Table 4-3: Observation checklist for group 2

<table>
<thead>
<tr>
<th>Behaviour</th>
<th>Participant</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>A</td>
</tr>
<tr>
<td>Understanding the objective of the game</td>
<td>X</td>
</tr>
<tr>
<td>Player dynamics: Communication</td>
<td>X</td>
</tr>
<tr>
<td>Player dynamics: Collaboration</td>
<td>X</td>
</tr>
<tr>
<td>Player discussions</td>
<td>X</td>
</tr>
</tbody>
</table>

4.2.2.2 Analysis

Based on the findings above the observation data has been analysed in two main forms, the first is a frequency count of each behaviour among participants and secondly common themes are identified from the remarks made during observation.

A frequency count of the observed behaviour among all six participants is presented in Table 4-4.
Table 4.4: Summary of observed behaviour among all 6 participants

<table>
<thead>
<tr>
<th>Behaviour</th>
<th>Number of players to exhibit behaviour out of 6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Understanding the objective of the game</td>
<td>6</td>
</tr>
<tr>
<td>Player dynamics: Communication</td>
<td>6</td>
</tr>
<tr>
<td>Player dynamics: Collaboration</td>
<td>6</td>
</tr>
<tr>
<td>Player discussions</td>
<td>6</td>
</tr>
</tbody>
</table>

During game play remarks were taken regarding each behaviour the participant was exhibiting according to the observation checklist. These remarks have been described below for both group 1 and group 2 with common themes identified.

**Understanding the objective of the game**

Participants in both groups had an understanding of the game objective after reading the rule sheet. This enabled both groups to play the card game to completion.

**Player dynamics: Communication**

It was observed that participants communicated during game play, the participants formed a team strategy and made suggestions to each other on each turn of play.

**Player dynamics: Collaboration**

During game play it was noted that participants of both groups collaborated by trading techniques when they could and divided tasks among themselves in order to finish their assigned project quickly to win the game.

**Player discussions**

In both groups players had decision points and discussions during game play, the most common one from the findings above is that some participants (three out of six) did not know where to
place the cards on the table. Another matter concerned the language used in the phase modifier cards, one of the groups misinterpreted what the cards meant.

4.2.3 Learning outcome findings and analysis

In order to evaluate the learning outcome of the game, open ended questions were administered to participants at the end of game play to allow them to comment on information acquired during game play. All participants stated that they had learnt something new, but the responses fell into different categories. Table 4-5 and 4-6 present the responses from the participants with regard to the two questions administered while categorizing the type of information they learned into themes.

*Table 4-5: New perspective about product design. Categories and responses*

<table>
<thead>
<tr>
<th>Category and description</th>
<th>Responses</th>
</tr>
</thead>
</table>
| **Design process**       | • The game has allowed me to see what stages are needed to develop a new product  
                           • The game was a good illustration of the product design process in order to illustrate all influences |
| **Collaboration**        | • Each role in a project needs to think about what other roles are doing and talk to the other roles. |
| **UX Techniques**        | • I have learnt about the different techniques used such as prototypes and research tools  
                           • The game helped to choose the method for product design by priority |
| **Roles**                | • I have learnt more about the different roles involved in a project  
                           • I have gained new perspective on the roles played in a project |
Table 4-6: Insight about the roles included during product design. Categories and responses

<table>
<thead>
<tr>
<th>Category and description</th>
<th>Responses</th>
</tr>
</thead>
</table>
| **Teamwork**             | • Strategy and cooperation needed in product design  
                           • Different roles can collaborate in order to ensure their product is well designed  
                           • Insight on the way of collaboration |
| The importance of collaboration while doing a UX project. | |
| **Purpose of each role** | • The designer has to do research before to make sure the customers will desire a product. I thought this was only a job for the marketing team  
                           • Every role in a project is equally important  
                           • Insight of different competences of employees |  |
| The purpose of each roles in a project | |
| **Resource management**  | • Resources have to be used properly and planned before execution  
                           • Handling of resources among different competences |  |
| The various techniques and tools used in UCD | |
5 DISCUSSION AND CONCLUSION

In this chapter the method used in this study is discussed to include its strengths and limitations, the results of the analysis are also discussed in relation to the purpose of the research. The chapter is divided into two main sections, the discussion of the method and the discussion of the findings.

5.1 Discussion of method

The method applied in this study is DSR, this method was chosen because the study aims to create an artefact in form of a card game. One of the key benefits of DSR is that it allows an incorporation of other research methods within its activities. In this study complementary data collection methods were used. Literature research was used to define the problem and create a representation of the UCD process which answered the first research question of this study while observations and questionnaires were used to evaluate the created card game.

However, because DSR is a science of discovering artefacts, one of the problems introduced is the problem of the design scientist, DSR is highly dependent on the individual characteristics of the researcher which means researcher assumptions, knowledge and interpretations are used in creating of the artefact hence making repeatability difficult (Baskerville, Kaul, & Storey, 2017). This was a challenge encountered while applying DSR, it was dealt with by ensuring that the created card game is based on existing literature and is evaluated based on functionality, validity of the card game content and knowledge it produces with regard to the purpose.

Overall DSR proved to be a good method to serve the purpose of the study, the activities involved in DSR, that is, problem description, requirements definition, design and development and finally demonstration and evaluation provided a step by step guidance on how the card game should be created.

Reliability and validity

Reliability is the ability of a repeated investigation to obtain the same result (Gummesson, 1991) while validity refers to whether the research is credible, or the information presented in the research is correct. The reliability and validity of this research will be discussed in terms of the artefact (card game) itself, the knowledge it generates, and the research methods used in the study.

Both reliability and validity are crucial elements of any research however they have been less investigated and elaborated in DSR (Baskerville, Kaul, & Storey, 2017). To overcome the problem
of the design scientist introduced by DSR as described in the previous section, each component of the card game developed is based on supporting literature and previous investigations, hence the choices of the card game components can be traced back to supporting theories and are not based entirely on assumptions made by the researcher which increases reliability.

Moreover, to increase the validity of the knowledge embedded and generated by the card game, a content validity evaluation of the game was conducted by consulting a practitioner in the industry to ensure that the knowledge being presented is correct.

With regard to the data collection methods used during evaluation of the card game, a structured observation with a pre-defined checklist was used to reduce the threat to validity and reliability. According to (Johannesson & Perjons, 2014), an observation schedule tells researchers exactly what to look out for and what to record and hence data collection becomes systematic improving its reliability.

One of the threats to validity while using structured observations as identified by (Saunders, Lewis, & Thornhill 2009) is observer effect, this means that the subjects being observed may change behaviour if they are aware that they are being observed. One way to overcome this as suggested by the author is to minimise the interactions with the participants under observation. During group observations in this study, interactions with the participants was minimised in order to provide a more natural setting for behaviour.

The second method of data collection was questionnaires, when designing the questions, validity and reliability was considered to ensure that the questions were consistently interpreted by respondents as the researcher intended (Saunders, Lewis, & Thornhill 2009). The data collected from the questionnaires reveals that all respondents interpreted the question the same way and as intended by the researcher, hence provided answers in line with what was being investigated.

5.2 Discussion of findings

The purpose of this research is to create a serious game to describe a UCD process in product and/or service development. The game would contribute into learning UCD collaboratively, creating an awareness of UCD practices and the different perspective of roles involved. This purpose was to be met by addressing two research questions, the two research questions and how they have been answered have been discussed below in relation to the findings.
5.2.1 Research question 1

*What activities are most important in a UCD process? (Chapter 1)*

The first research question aimed at identifying the elements (i.e., activities, players and methods) that are most important in a UCD process. The activities were identified fulfilled by creating a representation of the UCD process after comparing the works of various authors who have researched into UCD as presented in chapter 2.2. The UCD activities identified from the literature study were research, design, prototype and test.

The second element, that is, players include the business representative, programmer and UX designer captured as the roles used within the game. The third element, that is, methods are the research, design, prototype and test techniques applied in the game as resources.

These elements were further evaluated by a UX designer practicing UCD from the industry, the results of the questionnaire support the literature search and these elements were identified as a good representation of the UCD process.

5.2.2 Research question 2

*How can a UCD process be described by using a serious game? (Chapter 1)*

The second research question involved describing the identified UCD process in form of a serious game and in this instance a card game. From the UCD process representation described above, the card game was created by following the DSR method which involved identifying the problem, defining requirements, design and development and finally demonstration and evaluation. The card game prototype as presented in chapter 4.1 was evaluated to identify any improvements to be made, the following section presents the changes made and how the card game was finalised to fulfil the second research purpose.

**Finalised card game**

Based on the results from the analysis in chapter 4, the card game needed to undergo a few adjustments to accommodate the recommendations made during game play and content assessment.

The results of the content validity assessment provided recommendations on how the card game can be enriched, the first included provided examples in the project cards so that players can better understand the different types of UX projects. This then led to adjusting the project cards and adding examples of each project.
The second recommendation made concerned the ability to iterate within the different phases as it is with a real UCD process. The concept of iteration has been captured by the phase modifier cards which require players to return to an initial phase once they get it during game play. These cards, however, were not clearly understood because of the language used, the cards have now been adjusted and provide clearer instructions to the players to return to a previous phase. With the changes made the card game was finalised and the full deck of cards has been presented in Appendix 2.

**Learning potential**

The main goal of a serious game is not only to entertain but also educate, this section discusses whether the card game had any potential to teach UCD concepts as it was intended. The results of the questionnaires given to the participants give preliminary indication that the respondents gained new knowledge relating to UCD while playing the card game. The knowledge areas were divided into categories which included the design process, collaboration, UX techniques and the purpose of the roles involved. These themes identified are in line with the purpose of the research, some (2) of the participants gained new knowledge on UCD practices such as UX techniques and some (3) reported a better understanding of the purpose of the roles involved together with the importance of working collaboratively. It should be noted that this was after only one playing session.

### 5.2.3 Applications in agile software development

In recent years, agile software development has had a major impact on how software development is conducted, agile methods highlight that software development is not linear but rather feedback-loops are necessary to achieve the required outcome (Dingsøyr, Dybå, & Brede, 2010). The agile manifesto emphasizes the involvement of users during software development, however, this has been difficult in practice (Chamberlain, Sharp, & Maiden, 2006).

According to Chamberlain et al. (2006), UCD has the potential to help with the problem of user involvement when paired together with agile methods. The card game created in this research can be used by agile developers to help recognise how UCD activities are valuable for agile software development. Furthermore, it emphasizes on collaboration and communication culture between designers and developers that can help them work together while understanding their independent roles.
By learning the UCD process through the card game created, there can be a better involvement of users in agile development which seems to be a challenge, moreover, it can help understand how UCD and can feed into agile software development.

5.3 Conclusions

The aim of this master thesis was to create a serious game to describe a UCD process among UX and non-UX practitioners collaboratively. To accomplish this, two research questions were developed, the first aimed to identify the most important activities in a UCD process and the second aimed to represent the identified UCD process in form of a card game. In order to answer the first research question, a literature study was conducted on existing UCD process as documented by various authors and a general UCD representation was created from the comparison of these works.

To address the second question, DSR methodology was followed in order to guide the creation of the card game. The card game was created to reflect the UCD process, accommodate UX and non-UX practitioner roles and to allow the participants to learn collaboratively. The game was then evaluated based on the requirements defined in DSR and to determine its learning potential.

The evaluation findings confirmed that the game allowed participants to collaboratively play and learn the UCD concepts depicted in the game such as the roles involved, the UCD phases and the UX methods or techniques used.

Limitations of the study

When performing the content validity assessment of the game there were some limitations encountered. This research set out to get responses from three UX designers from En appstudio regarding the validity of the content, however, this was not possible due to time constraints and lack of availability of two UX designers originally contacted. Because of this, responses to the questionnaire were obtained from only one of the UX designers. It would have been helpful to get more responses to support the current findings, but this can be part of future research.

Future research

Since this study was dedicated to creating the card game, only preliminary evaluations were conducted to assess its impact and learning potential, future research could be conducted with more participants from organisations. This would provide insight into how the card game works from practitioners’ perspective. Furthermore, it would be interesting to see whether repeated
playing of the game over an extended period of time helps the participants to learn and retain more information from the game.

In its current state the game supports only three basic roles, one of the recommendation provided while performing content validity was an addition of a client role. Future work could expand the game to include more roles that are involved while practicing UCD in different organisational contexts.

During game play some of the players were unsure where to place the cards on the table. This problem could not be immediately solved in this research but for further research and as a solution to this problem a game board could be created with clear instructions on where to place the different cards in the deck.

This research did not focus on creating graphics and aesthetic appeal on the cards. For future research, the graphical elements of the cards could be improved to add components such as images which would further improve player immersion and engagement.
6 REFERENCES


7 SEARCH TERMS

C

card game, 9, 12, 13, 14, 15, 16, 18, 19, 20, 21, 24, 26, 27, 28, 29, 31, 34, 35, 36, 37, 38, 54, 55, 56

D

design science research, 3, 11

H

human-centered design, 3, 1

S

serious game, 3, 1, 2, 3, 4, 5, 9, 19, 20, 24, 35, 36, 37, 38

U

user experience, 3, 1, 2, 8, 14
user-centred design, 1, 2
8 APPENDICES

Appendix 1: Game rules sheet

GAME OVERVIEW

In this game, you are part of a company team as either a Business officer, UX Designer or Programmer. Your team needs to complete an assigned project together, each project however has some drawbacks which may pull you back or make you fail the project.

In order to complete the project, your team needs to follow what is called a user-centered design (UCD) process which is made up of 4 phases (Research, Design, Prototype and Test). Your team needs to go through these phases successively and earn enough points to complete it.

At the beginning of the game each team member will be given some capital to spend on the project, to complete each phase of the UCD process you need to apply appropriate techniques, you get techniques by purchasing them with the capital you have at hand.

You need to collect enough technique points to complete the project, only one player can finish one phase at a time and hence your team may have to trade some techniques and utilize each other’s strengths to win the game.

HOW TO WIN

Players must work together to complete the project assigned to them while following the UCD process. You win if you finish all 4 phases without encountering all the project drawbacks in the deck.

NUMBER OF PLAYERS: 3

GAME COMPONENTS (97 cards)

1 Rulebook
3 Role cards
4 Project cards
4 UCD phases cards
8 Drawback cards
20 Modifier cards
28 Technique cards
30 Capital cards

GAME SETUP

1. Each player chooses a character card, there are only 3-character cards.
2. Select 1 project card at random and place it face up somewhere visible to all players.
3. Take the 4 phases cards (Research, Design, Prototype and Test) and place them under the project card respectively.
4. Prepare the following deck of cards

Player deck

Give each player a total of 10 capital cards (in gold).

Techniques deck

Shuffle all the techniques well and set assigned all the techniques deck face down somewhere one of you can access. Pick 5 cards from the deck and lay them under the phases card somewhere accessible to all but leaving enough space between them and the phase cards.

The cost of the card is the number on the bottom right of the card while the number of points it is the top left number.

Modifier deck

Create a modifier deck by taking all the modifier cards and shuffling them together with the 8 drawback cards. Place them face down on the table somewhere accessible to all players.
HOW TO PLAY

1. Each player shuffles their own personal deck and draws a hand of 5 cards from it.

2. Select a player to go first. Players take turns in clockwise order

On your turn do the following:

On each player turn the following 3 things happen:

1. Play the top most card of the modifier deck, do the action instructed on the card and discard it on the side.

2. Play capital cards from your hand and use them to get techniques you can afford from the 5 available at the table. For each technique you pick, replace it with a new one from the techniques deck so that there is always 5 techniques card on the table at all times.

3. After you are done with your purchases, discard your hand and draw 5 new cards for the next turn. If you have run out of cards from your initial draw pile, then shuffle your discard pile and that will give you a new personal deck with better cards.

4. If your hand contains techniques for the phases in play for example if you get a research technique and the phase you are currently on is research, then place your card in front of you for all other players to see. This will enable the possibility for players to form a strategy such as trading a card to complete the phase.

NB: Each technique is colour matched with the phase it belongs as shown below

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Image: Interactions diagram with two cards. One card is labeled "Interviews" and states, "A conversation with a participant of the user group." The other card is labeled "Research" and states, "Understand the users you are making the solution for."
Explanation

Step 1:

On your turn you will reveal the top most card of the modifier deck, this card will have specific instructions for what to do next. There are 6 possible cards you can get in the modifier deck:

- Trade cards: These cards allow you to trade a technique with another player once added to your deck.
- Special ability cards: These allow you to activate your special ability during that turn, the special ability card is discarded after the turn.
- Discard cards: These cards require you to discard a technique from the cards you have at hand.
- Phase modifiers: These cards can add the total number of points required to complete a phase
- Drawbacks: These are the worst cards to get because they bring you closer to losing. Whenever you get a drawback, put it next to the project card. If you get all 8 drawbacks, then you lose!

How to finish a phase:

You use techniques to finish a respective phase by earning enough points. To do this you have to do the following:

- Read on the phase card how many points it takes to finish that phase.
- Collect the total number of technique points for that phase by using what you have purchased or by trading with another player, the base rule is that one player has to collect all points and finish the phase by playing the techniques card under the respective phase.
Appendix 2: Finalised cards

Roles cards

<table>
<thead>
<tr>
<th>BUSINESS OFFICER</th>
<th>PROGRAMMER</th>
<th>UX DESIGNER</th>
</tr>
</thead>
<tbody>
<tr>
<td>“Your role is to ensure the viability of the product”</td>
<td>“Your role is to ensure the feasibility of the product”</td>
<td>“Your role is to ensure the desirability of the product”</td>
</tr>
<tr>
<td>Special ability: Disable the buying power for your hand or any other players hand</td>
<td>Special ability: Get any prototyping technique freely</td>
<td>Special ability: Get any research technique freely</td>
</tr>
</tbody>
</table>

Projects cards

<table>
<thead>
<tr>
<th>PROJECT</th>
<th>PROJECT</th>
<th>PROJECT</th>
<th>PROJECT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Make a task-based solution</td>
<td>Make a content source solution</td>
<td>Make a brand presence solution</td>
<td>Make a market campaign solution</td>
</tr>
<tr>
<td>Example: A ticket buying application</td>
<td>Example: A company’s intranet</td>
<td>Example: A company’s homepage</td>
<td>Example: A landing page with a special offer</td>
</tr>
</tbody>
</table>

Phase cards

<table>
<thead>
<tr>
<th>RESEARCH</th>
<th>DESIGN</th>
<th>PROTOTYPE</th>
<th>TEST</th>
</tr>
</thead>
<tbody>
<tr>
<td>Understand the users you are making the solution for</td>
<td>Develop potential design solutions</td>
<td>Build a representation of the solution</td>
<td>Test the solution against users for feedback</td>
</tr>
</tbody>
</table>
Technique cards

**Interviews**
- "A conversation with a participant of the user group."
- Used for: Task-based tool, Content source, Brand presence, Marketing campaign.

**Contextual Inquiry**
- "An onsite visit with participants."
- Used for: Task-based tool, Content source.

**Surveys**
- "A set of closed-ended questions used to identify patterns."
- Used for: Task-based tool, Content source, Brand presence, Marketing campaign.

**Card Sorting**
- "Users asked to sort items on cards in a way meaningful to them."
- Used for: Task-based tool, Content source, Marketing campaign.

**Focus Group**
- "Users are brought together and asked to answer specific questions or tasks."
- Used for: Brand presence, Marketing campaign.

**Wireframe**
- "A representation of the elements that will be displayed on the page."
- Used for: Task-based tool, Content source, Brand presence, Marketing campaign.

**Sitemap**
- "A list of all pages available on the product."
- Used for: Content source.

**Mock-ups**
- "A representation of the visuals of a product."
- Used for: Task-based tool, Content source, Brand presence, Marketing campaign.

**Workflow Diagram**
- "A sequence of low-fidelity images used to illustrate a task."
- Used for: Brand presence, Marketing campaign.

**Paper Prototype**
- "A paper representation of the product."
- Used for: Task-based tool, Content source, Brand presence, Marketing campaign.

**Interactive Prototype**
- "A digital and interactive representation of the product."
- Used for: Task-based tool, Content source, Brand presence, Marketing campaign.

**Coded Prototype**
- "Coded digital representation of the product."
- Used for: Task-based tool, Content source, Brand presence, Marketing campaign.

**Usability Testing**
- "Users are asked to perform tasks on the product."
- Used for: Task-based tool, Content source, Brand presence, Marketing campaign.

**Expert Review**
- "An expert review of the product to identify issues."
- Used for: Task-based tool, Content source, Brand presence, Marketing campaign.

**Eye Tracking Test**
- "A tool to record the movement of a user’s eyes as they use a product."
- Used for: Task-based tool, Content source, Brand presence, Marketing campaign.
Modifier cards

- "Two points have been added to the research phase"
- "Two points have been added to the design phase"
- "Two points have been added to the prototype phase"
- "Two points have been added to the test phase"
- "You can trade a technique with another player"
- "Discard one resource from your hand"
- "Activate special ability"
Appendix 3: Documentation of content validity assessment questionnaire

1. In your opinion, do the roles represented in the cards below reflect participants involved in UX projects and the user-centered design process?

Yes. I believe that maybe a place should be made for the client either as a role to play or some sort of Joker as to not forget the role that the client and stakeholders play in the process.

2. In your opinion, do the cards below contain information regarding types of UX projects?

I think they are very fitting. Perhaps examples can be used.

3. In your opinion, do the cards below contain activities/phases in a user-centered design process?

Yes, perfect. But some sort of iteration event where the client changes their mind, or the circumstances somehow change that forces the players to move back a step might be interesting to emphasize the importance of being able to iterate. If it’s not too complicated to understand!

4. In your opinion, are techniques/methods presented in the cards below used while practicing user-centered design?

Techniques are perfect!
# Appendix 4: Observation notes

**Playtest Group 1**

<table>
<thead>
<tr>
<th>Behaviour</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Understanding the objective of the game</td>
<td>All participants discussed objective of the game and made an attempt to understand each other’s roles before beginning gameplay. Participant A reminded the team to focus on the objective of play.</td>
</tr>
<tr>
<td>Player dynamics: Communication</td>
<td>All participants communicated to form a strategy as a group before playing on their turn. Participant A verbally stated out the plan to the team before making any moves. Participant B gave suggestions on how others can utilise their capital cards. Participant C was unsure what discard a resource modifier meant but Participant B helped to clarify the matter.</td>
</tr>
<tr>
<td>Player dynamics: Collaboration</td>
<td>Participants divided the tasks among themselves in order to finish the phases quickly, Participant B focused on design phase, participant A focused on prototyping phase and Participant C focused testing phase. Participants always counted the amount of technique cards each player had in order to purchase the most effective technique cards for a given phase.</td>
</tr>
<tr>
<td>Player discussions</td>
<td>Participant B was unsure of where to place the capital cards and where to place the discarded cards. Participant C did not know where to place the technique cards. Participant A was confused on where to place the discard cards during game play. Participants A, B and C misinterpreted the meaning of the phase modifier cards. Participant A was confused on how to use the modifier cards during game play.</td>
</tr>
</tbody>
</table>
Participants wanted to play another round of the game after completion since they felt they could play better and understand the game elements with repetition.

<table>
<thead>
<tr>
<th>Playtest Group 2</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Behaviour</strong></td>
</tr>
<tr>
<td>Understanding the objective of the game</td>
</tr>
<tr>
<td>Player dynamics: Communication</td>
</tr>
<tr>
<td>Player dynamics: Collaboration</td>
</tr>
<tr>
<td>Player discussions</td>
</tr>
</tbody>
</table>
same when placed on the table. Participant A and C did not know where to place their cards. Participants wanted to play another round of the game after completion since they felt they could play better and understand the game elements with repetition.
Appendix 5: Documentation of functionality analysis questionnaires

Participant 1:

Directions: Please provide a brief response to the questions below relating to any new knowledge gained after playing the card game.

1. Has the game given you new perspective about product design? Explain.

The game has allowed me to see what stages are needed to develop a new product even if it was just a rough plan.

2. Have you gained any insight about the roles included during product design? Explain.

Definitely, there is a lot of strategy and cooperation needed in product design. It showed that every role is included and is evenly important.

Participant 2:

Directions: Please provide a brief response to the questions below relating to any new knowledge gained after playing the card game.

1. Has the game given you new perspective about product design? Explain.

Yes, because it showed that each role had to be thinking about their resources and talk to the other roles. It is not smart if a member just spends their resources without taking note of others in the process.

2. Have you gained any insight about the roles included during product design? Explain.

Yes, the designer had to do research before to make sure the market will desire it. I thought marketing team had to do that, not that designer so it was interesting to learn that.
Participant 3:

**Directions:** Please provide a brief response to the questions below relating to any new knowledge gained after playing the card game.

1. *Has the game given you new perspective about product design? Explain.*

Yes, the game has given me an idea about how to find the most effective way of doing a project. It helps to choose the method for product design by priority.

2. *Have you gained any insight about the roles included during product design? Explain.*

Yes, for designing, UX designers, programmers and Business officers, each of them should be specific on their tasks to finish the project and of course teamwork.

Participant 4:

**Directions:** Please provide a brief response to the questions below relating to any new knowledge gained after playing the card game.

1. *Has the game given you new perspective about product design? Explain.*

I have learnt more about the different roles involved in a project. Also learnt more about the different techniques used such as prototypes and research tools.

2. *Have you gained any insight about the roles included during product design? Explain.*

Yes, During the game all the three roles had an effect on the overall project strategy by using the techniques available to them.

Participant 5:

**Directions:** Please provide a brief response to the questions below relating to any new knowledge gained after playing the card game.

1. *Has the game given you new perspective about product design? Explain.*

I have learned more about the overall design and development process; the game was a good illustration in order to teach product design and simulate all potential influences.
2. Have you gained any insight about the roles included during product design? Explain.

Yes, the way of handling resources, different competences of employees and collaboration. It’s a simplified but very useful illustration.

Participant 6:

Directions: Please provide a brief response to the questions below relating to any new knowledge gained after playing the card game.

1. Has the game given you new perspective about product design? Explain.

Yes, especially the role played in project design and management phases. A New perspective is that it is possible to have a series of drawbacks in your project if there is poor planning of the project.

2. Have you gained any insight about the roles included during product design? Explain.

Yes,

(1) Teamwork – Different roles can collaborate in ensuring their product is well designed.

(2) Resource management – Resources have to be used properly all the time and planned before its execution.