



TAMPEREEN TEKNILLINEN YLIOPISTO
TAMPERE UNIVERSITY OF TECHNOLOGY

JAAKKO KEMPPAINEN
DESIGNING USER EXPERIENCE OF AN APPLICATION FOR
LIVE ICE HOCKEY GAME CONTEXT

Master's thesis

Examiner: professor Kaisa
Väänänen

Examiner and topic approved by the
Faculty Council of the Faculty of
Computing and Electrical Engineer-
ing on 11.1.2017

TIIVISTELMÄ

Jaakko Kempainen: Käyttökokemuksen suunnittelu jääkiekkosovellukseen
Tampereen teknillinen yliopisto
Diplomityö, 64 sivua, 21 liitesivua
Helmikuu 2018
Tietotekniikan diplomi-insinöörin tutkinto-ohjelma
Pääaine: User Experience
Tarkastaja: Professori Kaisa Väänänen

Avainsanat: Käyttökokemus, jääkiekko, mobiilisovellus, suunnittelu

Mobiilisovelluksista on ajan myötä tullut eräs yleisimmistä tavoista tarjota digitaalista sisältöä käyttäjille. Eräs sovellusala on urheiluaiheiset sovellukset. Tämä diplomityö kuvaa urheiluaiheisen sovelluksen suunnittelua ja siihen liittyvää tutkimusta, sekä tutkimuksen tuloksia. Sovelluksen pääasiallinen tarkoitus on parantaa jäähallilla tapahtuvaa yleisökokemusta.

Tärkein tutkimustavoite sovellukselle on käyttökokemustarpeiden kartoittaminen tässä kontekstissa. Toinen tutkimustavoite on varmistaa toteutetun sovelluksen onnistuminen käyttäen kyselytutkimusta.

Tässä työssä käytetään useita käyttökokemussuunnittelun menetelmiä. Ensiksi esitellään kirjallisuuskatsaus aiheeseen liittyvään tutkimustietoon. Sen jälkeen esitellään SWOT viitekehysten avulla toteutettu kilpailija-analyysi. Käyttäjien tarpeita kartoitetaan haastattelujen ja prototypoinnin avulla. Näiden tutkimuslöydösten perusteella suunnittelun tueksi esitellään persoonat, kokemustavoitteet sekä kontekstiskenaariot.

Tutkimuksen perusteella käyttäjien tarpeet suomalaisessa jääkiekkokatsontakulttuurissa tukevat olemassa olevaa SPEX-viitekehystä, sekä Fairleyn tekemiä havaintoja: jääkiekon katsominen jäähallilla on enemmän kuin pelkkää passiivista viihteen seuraamista: se on sekä sosiaalinen viitekehys, että rituaalinomainen tapahtuma itsessään. Katsojat käyvät peleissä viettääkseen aikaa ystävien ja perheensä kanssa. Jääkiekkoa enemmän seuraavat katsojat haluavat enemmän informaatiota jääkiekosta, ja kaiken tämän informaation keskittämistä yhteen, helposti löydettävään paikkaan. Tämän tueksi esitellään sovellusratkaisu. Toteutetun sovellusratkaisun pohjalta toteutetun palautekyselyn suurin löydös voidaan kiteyttää seuraavasti: sovellus on käyttäjille mielenkiintoinen, mutta Älykiekko-järjestelmän tuottamasta datasta haluttaisiin yksityiskohtaisempaa.

Sekä aiemman, että tässä tutkimuksessa esitetyn teorian pohjalta voidaan todeta, että käyttäjät kaipaavat katsontakokemukselta yhteiselämyksiä. Tarvitaan uutta tutkimustietoa siitä, kuinka sovellus voisi toimia työkaluna tällaisten kokemusten luomisessa. Lisäksi toteutetun sovelluksen sisällöstä voidaan sanoa, että käyttäjät kaipaavat sinne videomateriaalia pelitilainten kertauksen tueksi.

ABSTRACT

JAAKKO KEMPPAINEN: Designing user experience of an application for live ice hockey game context

Tampere University of Technology

Master of Science Thesis, 64 pages, 21 Appendix pages

February 2018

Master's Degree Programme in Information Technology

Major: User experience

Examiner: Professor Kaisa Väänänen

Keywords: User experience, ice hockey, mobile application, design

Mobile applications are becoming the norm of digital content. One recently emerged application area is sports. This thesis describes a study and design conducted for an ice hockey themed application. The application's main objective is to enhance the spectator experience of ice hockey fans.

The main research objective of this thesis is finding out what kind of user experience needs are there in a live spectating setting for a mobile application. Secondly, based on these findings, a design is proposed and the success of this design is validated using a questionnaire.

This study uses several methods for creating the application design. First, a literature review for existing theory is conducted. Using SWOT analysis, a competitor analysis is performed. User research is conducted using interviews and prototype evaluations. Based on these findings, information guiding the application design is constructed in form of personas, experience goals and context scenarios.

User needs in the application context corroborate previous research: watching ice hockey is more than passive entertainment. Spectators view the game as a social event. They want to meet friends and family. Avid fans of ice hockey wish to know more detailed information of the game and its events. They also want a centralized location to fetch this data from. For this, this thesis presents a technological solution. The main finding regarding the created solution is that while the solution has potential and arouses users' interest, there is a want for more detailed data.

Further research should be done in the direction of creating an application that spectators can use as a tool for creating co-experiences. Spectators are also interested in seeing the play situations in more detail, and for this, the proposed solution should incorporate video material of the plays delivered to the spectators phone.

PREFACE

In the words of Donald Norman: “It is not enough that we build products that function that are understandable and usable, we also need to build joy and excitement, pleasure and fun, and yes, beauty to people’s lives.”

I would like to thank my co-designer Lauri Inkeroinen for providing help with the project when. I would also like to thank my supervisor Kaisa Väänänen for providing invaluable feedback and guidance for this thesis work.

Special thanks go to screen names Z, wd17 and my girlfriend Emma Tolonen for providing me support when I most needed it.

In Tampere, 30.1.2018

Jaakko Kemppainen

CONTENTS

1.	INTRODUCTION	1
1.1	Background and motivation	1
1.2	Research objectives	2
1.3	Structure of the thesis	3
2.	USER EXPERIENCE DESIGN	4
2.1	Experience	4
2.2	Definition of user experience	6
2.3	Usability	7
2.4	Co-experience.....	8
2.5	User experience goals.....	9
2.6	Creation, evaluation and analysis methods for user experience design	10
2.6.1	SWOT Analysis	12
2.6.2	Personas	14
2.6.3	Context scenarios	16
2.6.4	Affinity diagram.....	17
2.6.5	User Experience Questionnaire.....	18
2.7	Summary	20
3.	LIVE ICE HOCKEY GAME AS AN EXPERIENCE CONTEXT.....	22
3.1	Ice hockey	22
3.2	Venue	24
3.3	Spectatorship	26
3.4	Summary	28
4.	RESEARCH PROCESS	29
4.1	Competitor review	31
4.2	User research	31
4.2.1	Recruitment procedure and participants	32
4.2.2	Interview and prototyping sessions.....	33
4.3	Research data consolidation	36
4.4	Design validation.....	38
5.	RESULTS	39
5.1	Competitor review.....	39
5.1.1	Summary of competitor review.....	43
5.2	User research	44
5.2.1	Experience goals	44
5.2.2	Personas	46
5.2.3	Context scenarios	49
5.3	Resulting implementation	52
5.4	Design validation results	57
6.	SUMMARY AND CONCLUSIONS	61
6.1	Summary of the results.....	61

6.2	Validity of the results	63
6.3	Future work	64
	REFERENCES.....	65
	APPENDIX 1: BACKGROUND QUESTIONNAIRE	69
	APPENDIX 2: INTERVIEW QUESTIONS	71
	APPENDIX 3: STRUCTURE OF THE PROTOTYPING SESSION.....	73
	APPENDIX 4: IMAGES OF THE CONSTRUCTED AFFINITY WALL.....	74
	APPENDIX 5: WRITTEN OUT AFFINITY NOTES	80
	APPENDIX 6: EXPERIENCE GOALS OF SPECTATORS.....	86

1. INTRODUCTION

This thesis has been done in collaboration with Bitwise while working as a user experience (UX) designer in a mobile application project for the Finnish ice hockey team Tapara. The aim of the project was to design a solution that could create a better viewing experience in live settings. Even though this project involves some novel technological solutions at least in Finnish context, this thesis focuses on the user experience design for the project.

This chapter explains the background for this project and presents the goals of this thesis work. At the end of this chapter, the structure of this thesis is explained.

1.1 Background and motivation

The amount of mobile applications has soared during the recent years. Applications range from purely functional to pure entertainment. This trend has found its way also into sports. For example, every National Hockey League team has their own application, specifically targeted for their fans. It is not unusual for major events to have their own applications. For example, the Olympics have their own application providing interesting information and schedules about the event.

The company this thesis work was written for had access to smart ice hockey tracking technology that could provide accurate positional data about players, and experiments with tracking the puck real time were also on way. This created a possibility to create something novel in the field of ice hockey. The name of the technology and project was called “Älykiekko” (Finnish for “Smart puck” or “Smart hockey”).

Enriching spectatorship with technological solutions has been a topic of several scientific studies, but so far not in the context of ice hockey. Shirazi et al. developed a social media platform for connecting remote viewers together during the soccer world cup event [1]. They developed a system for sharing opinions and reactions in real time through a mobile application. Their study suggests that even though users were watching a game in a group, they still wanted to communicate with other users in remote locations. The users reported higher enjoyment when they were able to share their opinions. Esbjörnsson et al. also studied spectating, and developed an application to help rally spectators socialize with each other and to support an active viewing experience. [2] Their proposed solution was a mobile application where users could take pictures of cars and tag them for others to see. Their main finding was that spectatorship is an active experience, and that solutions automating parts of the spectatorship experience will not necessarily enhance the overall

viewing experience. Hallberg et al. created an early augmented reality solution for enriching events with media content in the context of cross-country skiing. [3] Their solution equipped cross country skiers with heart rate sensors and GPS locators and displayed the data in for spectators in a mobile application. Their findings argue that in their context viewers' experiences were enhanced by added data. Even though different sports create different needs for spectators, the underlying motivations and basic needs carry across different sports.

The context of a live sport event provides an interesting challenge for design. Designers want to maximize users' enjoyment of the experience, at the same time providing them services that enhance the experience. An ice hockey arena packed full of fans provides an interesting and challenging design problem.

The project that this thesis addresses, also works with an exciting technological solution "Älykiekko". Smart wearable technology is implemented into players gear and equipment in the ice hockey rink to provide intricate locational data about the events in game. The data can then be analysed and presented in a form of a service. This creates possibility for novel solutions in at least the Finnish ice hockey scene.

When designed and implemented correctly, with user experience in mind, these kinds of solutions have great potential in adding value to users. In the context of ice hockey, complementary applications can provide a more effortless and interesting stadium experience for people who do not frequently visit hockey games or do not even know much about the game. For avid fans, the application could present useful information that could strengthen the viewers connection with the game. For hockey team and stadium owners an application could increase revenue by attracting more customers, or by presenting existing customers with new services. Ice hockey teams could also be interested about the smart data provided by the Älykiekko system because of its possibilities in coaching.

The motivation behind this thesis is to generate more knowledge about spectatorship in a new kind of context. Do existing findings about spectatorship fit into ice hockey context? Can something valuable to users be generated with the technological solutions that this project has access to?

1.2 Research objectives

The main objective of this thesis project was to research user experience for a new mobile application that would make viewing ice hockey games in the arena more interesting for spectators. The project was initially ideated based on possible technological solutions, and the technology was used as a basis for generating the idea for the solution. As the author of this thesis joined the project as an UX designer, ideation and back end implementation had already taken place. Author's role was to conduct research to validate the idea and to guide the project in a direction that would generate tangible value for users.

This thesis aims to answer the following questions:

1. What are the user needs that affect experience design for a mobile application for ice hockey spectators in the arena?
2. Does the implemented service affect the spectatorship experience?

Research question 1 is answered partly by literature review, examining existing solutions and conducting user interviews and prototype testing. The existing solutions are researched using a SWOT framework analysis. User interviews and early prototype testing were used to gather qualitative data. Prototype testing was done early on in the design to minimize wasted resources. Research question 2 was addressed by releasing software to users, and gathering feedback through a questionnaire. The questionnaire asked respondents for open feedback and also used a scientifically validated method for UX review.

In the development process, the thesis worker's role was UX and UI design. UX work consisted of planning and executing user studies and interpreting the acquired data. UI design went hand in hand with UX research, and consisted of drawing wireframes and finalized designs for new features. In the beginning of the project, thesis worker was in charge of this role alone, but in July 2017, designer Lauri Inkeroinen joined the project and the rest of the UX design was done in collaboration. In the development process there were a total of 11 employees involved. Most of the other employees focused on programming, with the exception of the project manager and the UX designers.

1.3 Structure of the thesis

The rest of the thesis is structured as follows. In Chapter 2, the domain of user experience is introduced and explained. The chapter also introduces design methods for user experience. This chapter also introduces the methods used in this thesis. In Chapter 3, the domain sport of ice hockey is introduced, as well as existing theory of spectatorship. Chapter 4 presents the research process and timeline of this thesis. Chapter 5 presents the results of the done user research and design, as well as the results of design validation. Chapter 6 summarizes the results of the studies and discusses the results' validity, as well as need for future work.

2. USER EXPERIENCE DESIGN

As software development has matured, user experience has become a trend and a major selling point when considering information systems. Two sub categories of user experience that are crucial to understanding user experience are presented in their own subchapters: usability and experience. Because of the social nature of spectatorship (more of this in Chapter 3), concept of co-experience is introduced. Concept of user experience goal is also introduced. Lastly, a selection of design methods for user experience are listed and examined using existing theory.

2.1 Experience

User experience is a subset of all experience, and it would be difficult to define UX without first understanding general experience. In his book “Art as Experience” [4], Dewey proposes two categories for experience: general experience, and “an experience”. General experience is something that we are engaged all the time, since we experience life. “An experience” is a term that is more meaningful when designing interactive systems and considering user experience. An experience is something that has a distinct beginning and a distinct end. “An experience” consists of successive smaller experiences that blend into each other seamlessly. Experiences differ in their perceived significance.

According to Dewey, a distinction has to be made between ongoing experiences, and when interpreting experiences in retrospect. When an experience is occurring, it is felt emotionally, but after “an experience”, the final product is intellectual. Applying Dewey’s work to modern design work, in the context of user experience and user interface design, “finding a route to the nearest pharmacy” would be an experience. It consists of a series of tasks, such as opening the application on your phone, evaluating the user interface, choosing a way to on how to find pharmacies, and finally physically arriving to the destination.

Bakhtin [5, 6] examines experience from a different perspective. In his theory, he considers personal qualities, such as commitment, loyalty, identification and trust. His theory focuses on people’s interpretation of experiences in context of their day to day lives, on their selves and on their culture. His theory does not try to describe the first-hand experience of experiencing (that could be described with terms such as absorbing, irritating or captivating), instead it tries to see the practical effects of experience. Wright et al [7 p. 45] give a good example about Bakhtin’s theory: One might find a web site absorbing during my first visit, but if it would not be integrated into my life (if it would not fit my sense of self), it would likely become less absorbing during subsequent visits.

Wright et al. proposed a more practical, holistic view for experience [7]. Their framework consists of two parts: describing experience, and how sense is made of experience. According to their theory, experience consists of four parts, or “threads”: a compositional thread, a sensual thread, an emotional thread and a spatio-temporal thread. Compositional thread is the narrative inside experiencer’s mind considering action possibility, consequences and explanations of actions. According to Wright et al., thinking of questions such as “what would happen if I clicked here?”, “what does this mean?” are analysing the compositional thread of experience. The sensual thread is the sensory feeling of a situation or object. Feeling of tranquillity when entering a garden or feeling of uneasiness in a conversation are examples of sensual parts of experience. The sensual component of experience may sometimes be difficult to describe and distinguish. In everyday speech, it could be described as the “gut feeling”. The emotional thread is the emotional part of experience, consisting of feelings such as anger, satisfaction, fun etc. According to Wright et al. we can relate to other peoples’ experiences’ emotional threads through empathy. Experience’s spatio-temporal thread means the perceived time and space during an experience. For example, the speed of perceived time may accelerate or decelerate, or when feeling anxious, we may perceive some spaces as smaller, as if the walls were “caving in”.

Sense-making is proposed [7] to consist of several different processes which are not necessarily linearly successive. They are: anticipating, connecting, interpreting, reflecting, appropriating and recounting. Users carry certain expectations and possibilities with them when they encounter new experiences. According to the theory, they also revise their anticipations seamlessly when engaging in a new experience, creating new expectations and shaping the experience. By connecting, the theory means the first, pre-linguistic impression we get from the experience. This could be, for example, feeling thrilled when seeing a bright red sports car come around the corner, but when looking at it more closely, you see it’s old, rusty and nearly breaking down. By interpreting, the theory proposes, the experiencer gives meaning to the compositional and emotional threads. Experiencer breaks down the narrative in compositional thread (what might happen next, what has happened) and compares their narrative with their expectations and the feelings evoked in the emotional thread. Experiencers may adjust their expectations based on their feelings. Reflecting means making judgements and evaluating the value of the experience as we are experiencing it, or after experiencing. Appropriating means evaluating the experience against past and future experiences, and assimilating it into our sense of self, as a part of our experience. It is also possible for the experience to change our sense of self and make us accommodate our self-image accordingly. Recounting means remembering the experience afterwards, and telling it to others in some way. According to Wright et al., because users make sense of their experiences themselves, *designers cannot design an experience, only design for experience.*

Using these theories, it may be said that experience itself is a complex, fleeting concept that is hard, if not impossible, to measure objectively and accurately. Recounting an experience as it happened is a difficult task. Designers have to carefully think how experience could be best measured for given context.

2.2 Definition of user experience

User experience is a complex concept, consisting of many sub-concepts. User experience as a field of study is relatively young. Because UX is a merge of multiple fields of study, there is not one singular accepted definition for user experience. One of the most often referred definitions in literature is the ISO standard 9241-210 [8]. It defines user experience as “a person's perceptions and responses that result from the use or anticipated use of a product, system or service”. The standard lists following subcategories as part of user experience: user’s feelings, beliefs, preferences, psychological and physical responses, behaviours and results that are formed before, during and after the use of system or service. According to another widely referenced standard, ISO 9241-2 [9], user experience consists of two parts: experience of the user, and usability of the system or the service.

Chesnut and Nichols [10] define three distinctive attributes to user experience: usefulness, usability and desirability. By being useful, solution provides users with content and functions that are in line with the needs of the user. Being usable means intuitiveness and ease of use. Desirability means that the content of the solution is provided to the user in an engaging and interesting way.

In their book, Chesnut and Nichols break user experience down to 5 components [10]:

- Information architecture
- Content strategy
- Interaction design
- Usability
- Visual design

Information architecture considers the smaller modules of information systems, which are navigation, content organization, visual priority of page elements (where things are located physically on the screen) and interaction design. By content strategy, Chesnut and Nichols mean that all content should have a purpose. The time, place and topic of the content should be thought out in such a way that it assists the user in performing the task at hand. By visual design, the authors mean the aesthetical aspects, such as colours and imagery. Chesnut and Nichols emphasize that visual design should come second to good usability, since poor usability weighs more when factoring the overall pleasure of use [10, 11].

Law et al. conducted a survey to see, whether the ISO standard (more precisely, draft of the standard at that time) would align with the views of user experience professionals. In

their research, Law et al. suggest that “the term *user experience* to be scoped to products, systems, services, and objects that a person interacts with through a user interface” [12]. This definition, which can be seen in Figure 1, would exclude such things as human to human interaction and art from the scope of UX. According to the survey conducted by Law et al., user experience was seen as dynamic, subjective and dependent on the context.

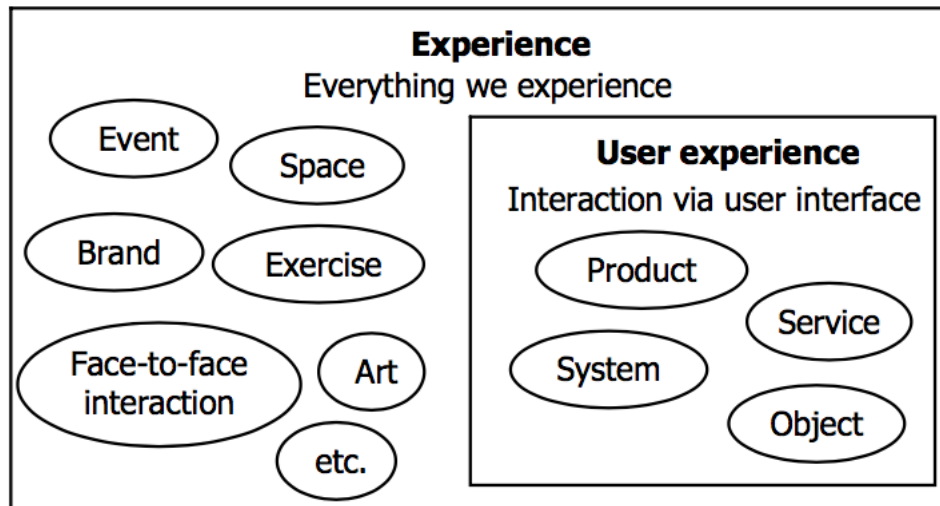


Figure 1. Scope of user experience. [12]

As the study of Law et al. states, user experience is a sub set of all experience. It is dependent on context and the user, and the exact definition is under discussion. This thesis uses the definitions of ISO standards 9241-210 and 9241-2.

Because the complexity of human experience (examined in previous chapter), it is sometimes difficult to distinguish experience from user experience when in context of real world applications. This is why laboratory conducted studies try to isolate environment variables from the usage of product. However, when using a product, there is always context of some kind. This dilemma, whether to study usage in real world context and add unknown variables, or to study in isolated environment, and lose a part of the experience, creates difficulties when designing study settings for UX studies.

2.3 Usability

Usability is defined in the ISO-standard as the usefulness and purposefulness of a product or service, specifically as “the extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use.” [13] On-line dictionary Merriam-Webster defines efficiency as an “effective operation as measured by a comparison of production with cost (as in energy, time, and money)”. Efficiency in the usability context is usually measured as time con-

sumption of a specified task. By effectiveness, the standard means the rate of goal completion; whether users can do what they set out to do. By satisfaction, the standard means the users feeling of the ease of use of the product.

Usability is contextual. For example, even if some product would be highly usable for IT-professionals, handing over the same systems for novices in computer use would most likely not yield good results. When considering usability, following things should be considered: the users of the system, the goals of the users and the context of use.

2.4 Co-experience

Battarbee & Koskinen note that some experiences and situations are only possible, when there is interaction between multiple people and a product [14]. Battarbee & Koskinen define co-experience as user interaction that is created in social interaction. Co-experience in context of user experience, by the definition of user experience [8] could not exist without a product or system being present.

Battarbee & Koskinen present three dimensions that can be used for understanding the nature of co-experience [14]. These dimensions are explorative-organized, synchronous-asynchronous and creation-interpretation. Explorative experiences are not planned in advance, whereas organized are. Organized experiences have a distinct beginning and end, while explorative experiences flow spontaneously from one to another. Synchronous-asynchronous axis considers the form of communication happening during the experience. For example, in an intense viewing situation, a remark may be answered after the play situation is diffused or maybe even after the period has ended. Creation-interpretation are the ways the experiencers create meaning for each other for the particular experience.

Forlizzi and Battarbee use three categories to represent user experience: experience, an experience and co-experience. Two of the former are explained previously, but especially interesting in the scope of this thesis is co-experience, since arena experience is a social event. The model suggests that the meaning of some experiences is only interpreted in social, rather than personal, context. In ice-hockey context this could for example mean that a roughing penalty for the team the spectator is rooting for could either be seen as a display of fighting spirit or as a game losing mistake, depending on how co-viewers interpret it. Even loss of your own team can theoretically be turned positive, if the community chooses to interpret it that way. According to Forlizzi & Battarbee, the expression of emotion is different when in company versus alone, social norms dictate how you can portray emotion in a given social situation. [15]

2.5 User experience goals

An experience goal has been defined as an “intended momentary emotion or the emotional relationship” that a person has with a service [16]. An user experience goal focuses on emotional aspects of experience and it states the wanted experience concisely [17].

UX goals can be derived from different sources: brand, theory, empathy, technology and vision. [17] Brand creates and unified product vision between sibling products. Theory uses existing research to as basis for defining UX goals. By using empathy, designers can envision the users’ mindset as basis for design. Technology enables and creates challenges for products UX. Vision uses other domains as inspiration for UX goals. Kaasinen et al. argue that using multiple of these approaches may reveal conflicting goals. Also, similar UX goals may be revealed by the different approaches, thus revealing their importance. [17]

Table 1. *Benefits and challenges of the approaches to defining UX goals [17]*

Approach	Benefits	Challenges
Brand	Pre-defined easy to share vision of UX	The UX goals have to be interpreted for new products
Theory	Evidence based on scientific research for UX goals	Which theory to choose
Empathy	Supports decision making beyond goal-setting phase	It may be difficult to gain deep enough perspective of users’
Technology	UX goals support the adoption of technology	Chosen technology may not fit all needs of use
Vision	UX goals support creating something new	User acceptance of new vision

Cooper [24] presents also goals that reveal the motivations behind the use of the system: life goals, end goals and experience goals. Life goals mean who the user wants to be. End goals consider the usefulness of the service: what the user wants to do. If the end goals are not met, product is not worth the time and money invested in the use. Cooper defines experience goals as “what the user wants to feel”. Cooper argues that in most cases, end goals are the most important to consider when designing a new service.

2.6 Creation, evaluation and analysis methods for user experience design

As UX has matured as a part of the software development business a multitude of methods for designing have been developed. Since no universal template for design has emerged, methods have to be decided based on case in hand and by software development method. In this section, a selection of design methods is introduced. First, an overview of possible design methods are presented. Then, the methods important for this work are discussed in their own sections.

Michailidou et al. present a method toolkit for user experience design (UXD) [18]. In the toolkit they list methods, the phases of design they are appropriate, their benefits for user experience design and the authors' recommendations for use. Michailidou et al. divide design into three parts: analysis (A), creation (C) and evaluation (E). Analysis means gathering data and processing it into usable format. Creation is what is usually seen as the "actual design work", creating the design idea for solution. Evaluation means examining whether the design idea is successful or not. The methods gathered by Michailidou et al. can be seen in Table 2.

Table 2. *Creation, evaluation and analysis methods for UXD [18]*

Method	Phase	Benefits for UXD	Recommendations for UXD
<i>Mood board</i> [19]	A, (E)	Visualizing the vision for the development project in a comprehensive way.	Use of mood boards to visualize the brand image and first development direction, extended by a narration.
<i>Storytelling</i> [20, 21]	A	Collecting user insights with focus on their underlying motives and needs.	Use of Storytelling to collect user insights and documentation/ structuring as story elements [19].
<i>SWOT analysis</i> [22]	A	Analysing different dimensions of a topic and defining development goals.	Intensive Strength & Opportunity Analysis to define UX-chances (starting points for new positive UX).
<i>Persona</i> [23, 24]	A, (E)	Giving data and statistics a human face.	Creation of market-specific customer profiles based on real data on usage, environment and emotional behaviour
<i>Metaphor/Analogy design</i> [25]	C	Anticipating experiences and communicating their emotional impact.	Use of Emotional Mental Models [24] and image-based metaphor representations.
<i>Use scenarios</i> [23, 27]	A, C, E	Promote holistic understanding, derive requirements and insure design targets.	Creating UX Stories, because of their special characteristics which go beyond use scenarios [19, 26] .
<i>Requirements list</i> [29]	A, E	Creating measures for the design success.	Extension of requirements list by a UX story visualized as Storyboard [26] and use of Kano-model [27] .
<i>TRIZ principles</i> [30]	C	Overcoming contradictions and/or getting inspired by principles and patterns.	Use of UX Principles [29] derived from successful experiences descriptions as inspiration for UXD.
<i>Experience prototypes</i> [32]	C, E	Making the essence of UX visible.	Use of experience prototypes during the whole process, combine different forms (e.g. hardware with UX story).
<i>Function modelling</i> [29]	A, C	Structuring the product in manageable parts and exploring their relations.	Use of user-oriented and relation-oriented function modelling extended by emotional effects.
<i>Design structure matrix</i> [33]	A	Manage complexity, explore relations, and create function clusters.	UX-related domains, mapping between functions and UX-elements

2.6.1 SWOT Analysis

SWOT analysis (acronym of terms “strengths, weaknesses, opportunities, threats”), is a tool for strategic analysis. It is a low cost method for market analysis. SWOT can also be used for decision making in UX problems [34]. SWOT’s benefit is the low cost and speed in aiding the decision making process. [35] As its name suggests, SWOT analysis maps company’s strengths and weaknesses as well as the existing markets opportunities and threats as basis for decision making. Figure displays the division of internal and external factors, and the components of the SWOT analysis. The components of SWOT analysis can be seen in Figure 2.

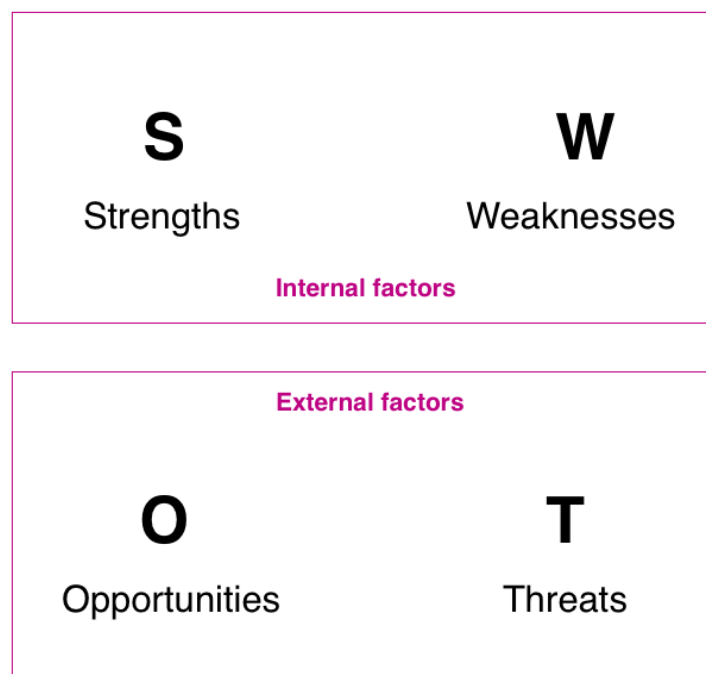


Figure 2. SWOT analysis model

Internal factors address the organization, which is performing the project, whereas external factors address the situation of the existing market (competitors). The competitors that are analysed can either be direct or indirect. Direct competitors have the same user end problem that they try to solve, and may share users. Indirect competitors have some overlap in the user base and functionality. [36]

Strengths are organizational qualities that have a positive effect on the company’s development and its ability to compete in the market. Weaknesses of the company are the opposite of strengths: the aspects of an organization that have a negative effect on the de-

velopment and competitive capabilities. Opportunities mean the possibilities the organization has considering the market situation. Threats are the external factors that may hinder organizations strategy's success. [37]

Probert presents a framework for using the SWOT model. First identify the strengths of the company, then the weaknesses. After that focus on the external factors and identify opportunities and threats. After identifying these factors, establish a strategy. [35]

When developing a software idea, the SWOT method may help in understanding you applications market fit, avoiding fails in the design phase and in revealing strengths and opportunities for the application. [34]

A number of questions can be asked to determine the strengths, weaknesses, opportunities and threats for an application idea. SWOT is best used in the early development phase, before implementation takes place to save wasted resources. A list of example questions can be found in Table 3 [37].

Table 3. *A question set for SWOT in software development.* [37]

Strengths	Weaknesses
<ul style="list-style-type: none"> • What advantages does your idea or business have? • What unique selling proposition do you have? • What does your app do better than anyone else? • Are there any unique resources you can draw upon? • What is the final goal that you define as a sale? 	<ul style="list-style-type: none"> • What improvements could you bring? • What should you abandon? • What do your users consider as weakness? • What characteristics of your product do negatively affect your sales?
Opportunities	Threats
<ul style="list-style-type: none"> • What trends and technologies can you implement? • What weaknesses of your competitors can you use? • What opportunities can you get when scaling your idea? 	<ul style="list-style-type: none"> • What are difficulties you might face? • How do your competitors overcome threats? • How do quality standards influence your mobile app or idea? • Will your mobile app be ready for changing technologies? • Have you made sure that you will not have funding problems?

SWOT analysis gathers information about a competitor in one easily glanceable table. The method can be also used to conduct UX research. An example table for a mobile application competitor analysis using SWOT can be seen in Figure 3.

Strengths	Weaknesses
<ul style="list-style-type: none"> • Great global Navigation Bar • Attractive Banner • Easy to navigate 	<ul style="list-style-type: none"> • Long subscription progress • Poor mobile optimization • Text difficult to read
Opportunities (Competitors' Weaknesses)	Weaknesses (Competitors' Strengths)
<ul style="list-style-type: none"> • Speed in loading • New way to retain users visit 	<ul style="list-style-type: none"> • Exclusive social media engagement • Inimitable app function

Figure 3. Example of SWOT used for UX analysis for a mobile application [34]

According to criticism, because of the descriptive nature of the model, it does not provide any concrete directions for the decision-making process. Because the process does not include prioritization of factors, users of the process may end up focusing on factors that are not important. This may lead to time waste and loss of resource. [37] Some information generated by the SWOT process may also prove useless [34].

2.6.2 Personas

Personas are a tool for analysis and evaluation phase for user experience design. When enough data is gathered, researchers look for patterns in the data. Based on this data, a consolidated archetype of a user group, presented in form of one single user, is constructed. This is called a persona. The use of personas is to create a humanized example of an abstract user group for developers, and this way provide meaningful direction for development. [38, 39] Personas are useful in determining necessary requirements and behaviours of a product. Personas are useful when communicating the product vision with stakeholders, and also help in keeping the design and implementation focused on real users. Personas can be used for quickly evaluating the viability of new product ideas. [40] Personas should always be based on user research. [40]

By personifying an abstract user group, personas invoke empathy. This helps stakeholders and engineers think about user as a real human being Subsequently this helps them become more interested about the experience of the user. [40]

Personas are usually concise enough to be fit in one sheet of paper. Personas usually include the following: a name, photo, narration of user's life situation, their goals and important behaviours related to the design [38, 41, 42]. The persona may be presented in text form, but some aspects may also be visualized with graphs or images. The maximum number of personas per project should be limited, for example five personas, to avoid targeting outlier groups. A goal is to find a single, primary persona, to whom target the design, and whose goals can be satisfied with the design. Secondary personas, whose needs mainly are covered by the primary persona but may contain some additional needs, may be identified. [43]

Tools, such as the affinity diagram, may be useful when constructing personas. [40] Personas are a method of communication, and they should be on open display to the designers and development team to aid discussion. They may also be used as justification when communicating with stakeholders. An example of a persona can be seen in Figure 4.

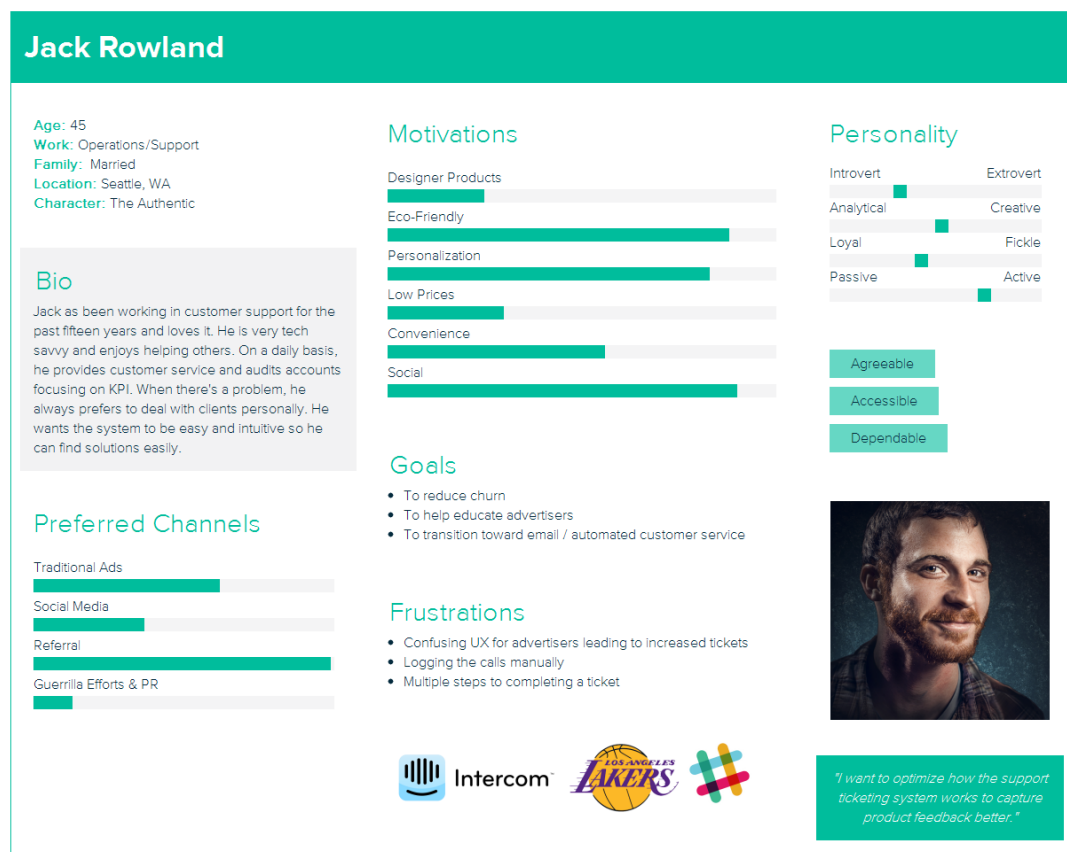


Figure 4. An example persona [43]

Cooper et al. suggest using three levels of user goals when creating personas. These levels of goals are life goals, end goals and experience goal. When creating personas, these goals must always, directly or indirectly, have something to do with the usage of the product. Cooper et al. propose end goals make up the majority of useful goals when considering persona creation. Consumer products usually benefit more from taking life goals into

consideration when compared with enterprise products. Usually one experience goal is enough per persona. [40]

Experience goals describe how users want to feel while using a product. End goals are users' motivations for performing the underlying task by using the product. Life goals are users' long term wants and needs, which explain users end goals. [40]

Cooper proposes an eight-stage process for constructing personas. [40 p. 81]

1. Group interview subjects by role
2. Identify behavioral variables
3. Map interview subjects to behavioral variables
4. Identify significant behavior patterns
5. Synthesize characteristics and define goals
6. Check for redundancy and completeness
7. Designate persona types
8. Expand description of attributes and behaviors

2.6.3 Context scenarios

Scenario, as the concept is known in HCI today, originates from the 1990s. Carroll describes these scenarios as a way to describe how users accomplish tasks, and according to him, context scenarios' goal is to help guide and coordinate the design project. Carroll describes these scenarios through an abstract character he calls "agent" or "actor", a vague abstraction of user. The actor is often named and characterized using a work title or other fitting high-level abstraction. [44] Scenarios are a method for analysing, evaluating and creating design.

Cooper et al. built their framework using the same idea as Carroll, but they replaced abstract actors with actual representation of users, personas. Cooper et al. call these scenarios "context scenarios", differing from Carroll's scenarios by grounding the intended design to a tangible representation of the user. Context scenarios are a tool used to breach the gap between design intentions and actual implementation, and also as a way to communicate early stage ideas. As context scenarios use narration as a story telling method, they are also a powerful tool for guiding imagination, thus helping create new, innovative solutions. Context scenarios have to be based on data gathered from user research to ensure that design efforts are guided towards solving actual users' actual problems. Cooper summarizes context scenarios as "concise narrative descriptions of one or more personas using a product or service to achieve specific goals". [40 p. 102]

Cooper et al. present three types of persona based scenarios. Context scenarios describe how the product could satisfy the personas' needs in the best way possible. After the design process has evolved to the point, where products data elements and functional elements are constructed, context scenarios are revised. The scenario is modified to describe the users' interaction with the product in greater detail. These scenarios are called

“key path scenarios”. Validation scenarios are more vaguely described scenarios, which are used during development to see if the developed features still fit the need of personas. [40] Scenarios should be used to extract design requirements.

A meaningful context scenario narrates a persona’s interaction with the designed product, taking into account the environment, motivations, needs and goals. Context scenarios describe the moments when the persona typically interacts with the system. Describing persona’s interactions in context scenarios should be kept high-level, focusing on the user perspective. The focus of the context scenarios should be in the future: how would the system ideally work in the viewpoint of the user. [40] Cooper provides an example list of the questions context scenarios address [40 p. 113]:

- What kind of settings the product will be used in?
- How long is the usage time?
- Are there interruptions in use?
- Are there multiple users on the device?
- Are there other products used at the same time?
- What are the primary activities the persona needs to perform to accomplish his/her goals.
- What end result persona is expecting?

Scenarios are presented in writing and remain at high level of abstractions to focus more on the user rather than details of the solution.

2.6.4 Affinity diagram

Affinity diagram is an analysis tool used for a variety of purposes, which include consolidation of contextual inquiry data and interview data [45, 46], idea generation [47, 48] and consolidating usability test data [47, 38].

When constructing an affinity diagram based on contextual inquiry or interview data, all meaningful findings (approximately 50-100 from a single contextual inquiry) are typed on separate post-its. Notes, with several themes are divided to multiple notes so that every note contains only one theme. If notes share a theme (for example, problem or an affinity), they are grouped together, and labelled based on the common theme. Groups are given a label based on the common theme. After this initial grouping, these first level groups may be further grouped into larger themes if necessary. During this process, notes may also be move do another category, if it is seen as better fit. [45, 38] Figure 5 depicts a typical hierarchy in an affinity diagram.

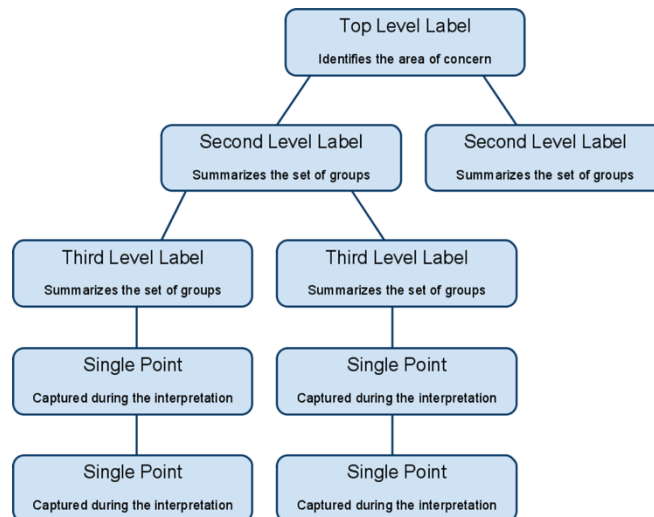


Figure 5. Example hierarchy of an affinity diagram (Image: https://en.wikipedia.org/wiki/Affinity_diagram)

Affinity wall is usually constructed on large sheets of papers to maximize the portability of the wall. Post-it's are typically used, as they are easy to rearrange. The wall should be documented when it is finished. Photographing the wall is a common solution.

2.6.5 User Experience Questionnaire

User experience questionnaire (UEQ) is an analysis tool. It is a question set for gathering quantitative data about a service's user experience [49]. Typical use cases for the questionnaire are comparing user experience of two existing products, testing a products user experience or finding out where an existing product could be improved. The questionnaire consists of semantically differential questions regarding different aspects of user experience, called scales. It uses Different scales can be seen in Table 4. Other scientifically validated questionnaires exists. One widely used UX questionnaire is AttrakDiff, which measures a product's pragmatic and hedonic quality and the product's attractiveness [50].

Table 4. Scales of the User Experience Questionnaire [49]

Scale	Description
Attractiveness	Overall feel of the product. Whether product is liked or disliked.
Efficiency	How efficiently can the user solve tasks with the solution?
Stimulation	Is the solution exciting?
Perspicuity	How easy the product is to use.
Dependability	How well user feels in control of the solution?
Novelty	Is the product new and creative? Does it catch the interest of users?

The scales have altogether 26 questions. The order of the questions is randomized among categories, and the order of the axes in individual questions is randomized. All questions have a 7-stage scale.

If certain scales are deemed not useful, they can be left out of the questionnaire [51]. The scales must be excluded in whole, and no individual questions should be left out to preserve the validity of the test.

When used online, the answerers of the questionnaire may include persons, who do not answer seriously. This phenomenon can be addressed by looking at answers within a scale, and determining if they are at least somewhat similar. If multiple scales have high distances between answers, it can be deduced that the user has been answering randomly. [51]

The UEQ provides a data analysis tool, which calculates mean, variance and standard deviation for individual scales. Figure 6 depicts example results for an example product. Values between 0.8 and -0.8 represent a neutral result, while higher values are positive and lower negative. Values range from very good (3) to very bad (-3), but because of the answering tendencies it is extremely unlikely to see values over 2 or under -2 [51].

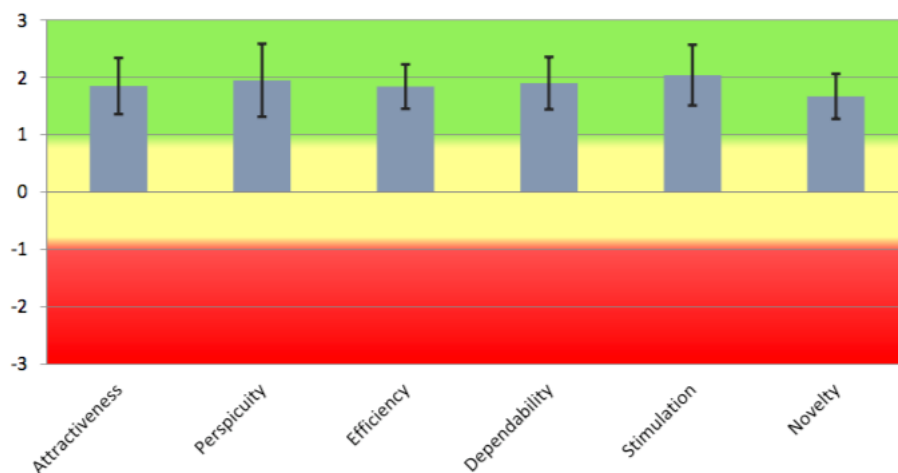


Figure 6. Example result figure of UEQ data analysis [51]

The UEQ data analysis tool provides a benchmarking. The benchmark consists of answers from 246 studies and over 9000 individual answers. An example figure for the benchmark is depicted in Figure 7.

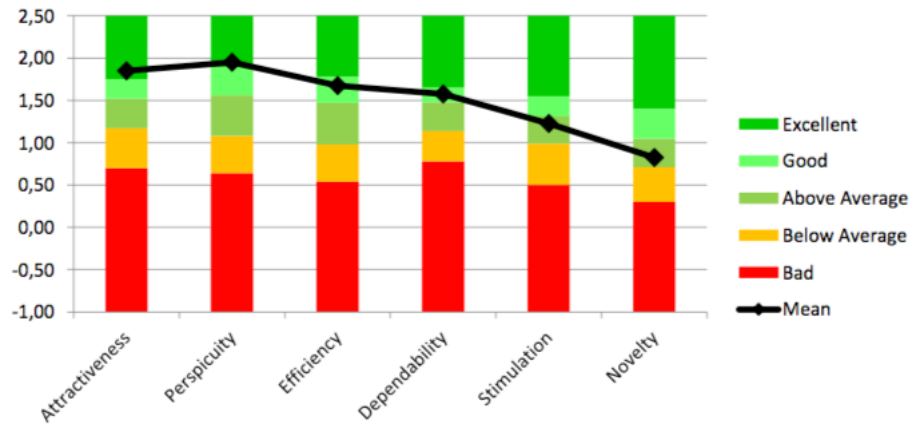


Figure 7. Results for an imaginary solution using the UEQ benchmark. [51]

The benchmark assigns a category for each scale. The meaning of these categories are explained in Table 5.

Table 5. Categories for UEQ benchmark [51]

Category	Explanation
Excellent	In the range of top 10% of the results
Good	10% in the benchmark set are better, 75% worse
Above average	25% in the benchmark set are better, 50% worse
Below average	50% in the benchmark set are better, 25% are worse
Bad	In the range of worst 25% of the results

2.7 Summary

In the context of this work, the experience in an arena consists of two things: the usage of the application (user experience), as well as the experience at the arena itself (an experience). As previous research suggests, the application should not stand in the way of the experience of the spectatorship, instead it should concentrate on enhancing it. As the viewing is often done with friends or acquaintances, creating co-experiences is possible. The explorative-organized and creative-interpretative aspects of an ice hockey game are

especially interesting when designing for an ice hockey match: can we make the organizing of the event easier? Can we support users' communal creativity? Älykiekko also provides a way to present novel smart data to support spectators' knowledge of the game.

The methods presented in this chapter provide a toolset for gathering data about the nature of the viewing experience and the needs of users, creating a design supporting these findings and evaluating the success of the design. The main focus of the presented toolset is to be practical. The tools listed are also usable with a small development team. SWOT analysis is a low cost method. Data analysis using an affinity wall and constructing scenarios and personas provide good means of communication for passing it through to the rest of the development team.

3. LIVE ICE HOCKEY GAME AS AN EXPERIENCE CONTEXT

This chapter describes ice hockey from the point of view of a spectator. First, general introduction to the game is presented. The rules of ice hockey are covered to an extent which is deemed to give a reasonable understanding of ice hockey as a spectator sport for the reader of this thesis. Then, spectatorship as a phenomenon explored using existing theory.

3.1 Ice hockey

Ice hockey is a fast-paced team sport. It is the most popular sport in Finland [52], with over 190 000 amateur players and over 74 000 licensed player, over 10 different leagues operate within Finland [53]. Ice hockey is a wide spread sport that is mostly played in the Nordic countries and in northern America. National hockey league, NHL, is a north American institution, and the arguably the most prestigious league in the world. The franchise based on NHL include a popular video game series, collector card series and clothing.

Competitively, ice hockey is played in indoor arenas, but amateur games may take place in outdoor arenas as well. The sport is played on ice, where players wear skates. The players try to score goals by moving the puck inside the opponent's goal using their sticks. The sport is played with 6 players on the rink from each team: 5 regular players and 1 goaltender. A typical game has 3 periods of 20 minutes, with 15 minute intervals between. Body checking (slamming your own body against the opponents) is allowed, and injuries are not uncommon in games. Tensions run high between players, and fistfights between players sometimes break out during matches. The game events happen quickly, and especially plays around goals may be hard to perceive (Figure 8).



Figure 8. A typical ice hockey play situation

Even though there is no universal set of rules for hockey, there are two widely used sets of rules, which cover most professional ice hockey games: the National Hockey League (NHL) rulebook and the International Ice Hockey Federation (IIHF) rulebook. The rules for official ice hockey are a complex document of over 100 pages and 226 different rules.

Even though the rule sets are vast and may differ, main structure of the game remains similar everywhere it's played. The game consists of 3 periods of 20 minutes, possible overtime and a possible shoot-out contest. Between the periods are breaks that vary in length depending on the rule set used. In this chapter, rules for SM-liiga [54], which differ in some respects from the IIHF rules are used as an example.

The game starts with a face off, where players compete for the possession of the puck with their sticks, after the referee drops the puck onto the ice. This is called a face off, and it's repeated every time there is a stoppage in the game. Both teams try to put the puck into the opponent's goal with their sticks. The team with most scored goals after the game is the winner.

A goal is considered valid, when the puck has gone completely over the goal line inside the goal. If there is an unclear situation about whether the puck going inside the goal, the referees may consult a video recording of the play. The video recording may be used only for resolving situations considering scoring. No other plays may be reviewed by the referees, they have to make the best judgement possible from what they have seen during

the actual play. The decision made by the referee are final during the game. They cannot be attenuated even after the game, but they may be made harsher by an expert review.

One of the most important rules to know when spectating ice hockey is the offside rule. An offside is called, when a player is in the opponent's defence area before the puck. This rule is placed to prevent opponents from waiting around opponent's goal for long passes, since it would make gameplay uninteresting to spectate.

The referees may sentence players to penalties. For minor offenses, such as tripping another player or having too many players on ice, the referee may sentence a two-minute penalty, called a minor penalty. For more serious offenses a double minor penalty, four minutes, may be sentenced. For more serious offenses that may physically harm another player, such as checking (body slamming) a player from behind, a game misconduct penalty may be sentenced. The rules are complex to learn, and especially learning how to observe them in real time is difficult in such a fast-paced sport.

3.2 Venue

The event itself takes place in a special venue. High profile games draw a lot of spectators. For example, the largest indoor arena in Helsinki seats over 13,000 spectators and the largest arena in Tampere 7,300 spectators. Tampere is currently building a new, larger arena to facilitate around 11,000 viewers.

Official games are most often played in indoor conditions, but sometimes show matches are played in outside rinks as well. The IIHF rulebook does specify if the arena should have a roof or not, as long as the condition of the ice, boards and markings on ice are as specified [54]. Because the surface of the rink has to stay frozen, temperatures in an indoor arena in the vicinity of the rink may be as low as -5 degrees Celsius, but further away from the ice, the temperatures rise, to around 10 degrees Celsius [55]. Viewers have to dress accordingly or have to move to generate heat to stay warm during the whole game.

Visibility to rink depends on the location of the seating. Some arenas feature terraces, areas stripped of seats, where the game is viewed standing up. Usually the seating in the stadium is constructed so that the seats further away from the rink are higher up to allow visitors to see over the persons in front of them. Thus, seats closer to the rink get closer to action, but it may be harder to see to the events at the other end of the rink. The seats higher up in the stadium get a better overall view of the game, but especially to viewers with poor eyesight, it may be hard to see all the details of the events. The rink is enclosed with boards that are approximately 1 meter high [54], and especially if sitting further away from the boards, covers some of the action happening near the boards. The teams change sides between periods, so that they play on the same side at least two periods of the game [54]. This may affect the preferred seating of spectator, if they would like to sit

at the end of the rink and see for example their preferred team attack closer up. As can be seen in Figure 9, it is difficult to see the events clearly on the other side of the rink.



Figure 9. Hakametsä ice hockey arena (Photo by Roopeank, CC BY-SA 4.0, <https://commons.wikimedia.org/w/index.php?curid=52628020>)

Some stadiums have restaurants or kiosk's where snacks and beverages can be bought. Some of these restaurants are only open between periods, and may experience a rush of customers during this short, 15-20-minute period. If the restaurant serves alcohol, Finnish legislation forbids taking the alcoholic drink away from the restaurant premises.

Venues differ in the level of equipment they have and services they provide. Some venues provide narration of the game through a public audio system. Some arenas have a display that shows a scoreboard and may have screens to display additional visual information. For example, as can be seen in Figure 10, in Hakametsä ice hockey arena, the score and the remaining time of the game is displayed, along with video material of selected match events. The video material includes replays of the events in the game, as well as team and player introductions before the game.



Figure 10. *The video screen of Hakametsä ice hockey arena (Picture by Nataspop, CC BY-SA 3.0, <https://commons.wikimedia.org/w/index.php?curid=27068890>)*

During intermissions of play (between periods), some ice hockey teams arrange entertainment or competitions for viewers. These can include things such as cheerleader dance shows and competitions for audience. The competitions vary greatly, from raffles in the form of roulette displayed on the video screen to games where the audience members have to get the puck through a small hole in a board that's covering the goal. In Hakametsä arena, these events are announced through the loudspeakers when an intermission starts.

3.3 Spectatorship

Ludvigsen et. Al [56] studied the nature of spectatorship. They argue that spectatorship is an active, rather than a passive experience. Crawford [57] also supports this thinking. Ludvigsen et al. argue that sport spectatorship consists of three elements: the sport, the event and a social aspect. The model, called “SPEX”, can be seen in Figure 11.

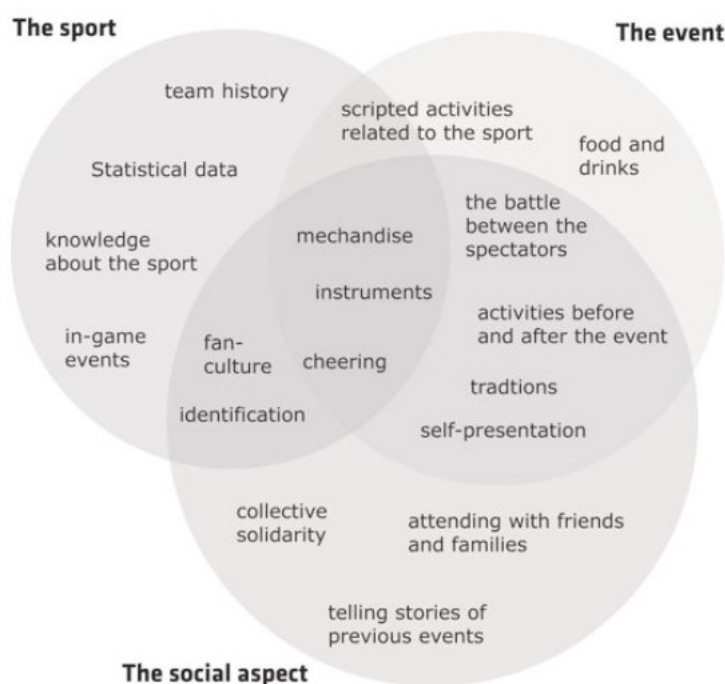


Figure 11. *SPEX-model of spectatorship* [56]

The sport itself consists of ongoing and previous events of the game and the team, the viewer's previous knowledge. The event itself consists for example of eating and drinking, the viewers traditions regarding the event. Spectatorship also consists of the social aspect regarding viewing the game: fan culture, viewing the game with family and friends. There is also overlap between these three elements. Forlizzi & Battarbee's co-experiences (presented in Section 2.4) also plays a role in the social aspect of spectatorship [58].

Ludvigsen et al. argue that since the sport itself is only one part of the whole spectator experience, creating a solution that only provides data about the sport may be useful to some spectators, but rather there is a need for applications that address other elements of spectatorship also, mainly the social aspect. They argue that these kinds of solutions have the potential to enhance shared experiences between spectators [56]. Ludvigsen argues that the most engaging level of social interaction is collective action, where people work towards a shared goal [59].

The ritual of spectatorship spans on a longer time period than the viewing event itself. Fans dress up in merchandise before leaving for the match, follow broadcasts, news and gossip around the teams and converse about the upcoming match. [57] Fairley argues that the social relationship between spectators is a bigger motivator than the sports match itself [60]. The social atmosphere of the arena has been noted as one of the motivating factors for going through the trouble of going to an arena to spectate a game [57]. Some spectators

also want to be active creators of the social atmosphere on the arena, and that way participate in the sport. [61, 62] Spectators also want to chant, sing and celebrate during events [63].

The experiment conducted by Ludvigsen et al. also suggest that users are more likely to engage in external activities, such as games, when the intensity of the game is low. This can be interpreted so that in a live spectating situation, users usually choose to pay attention to the game rather than something else that tries to grab their attention [56].

Esbjörnsson et al. also describe spectating as an active event where user socialize with each other, and try to place the events they witness into a larger story. In ice hockey, an example could be a player initiating a fight with a player, who had body checked him in a previous game. The study also notes the social aspect of spectatorship. Spectators want to converse about what they see. The study also notes that technological solutions designed for spectators should not isolate viewers from this important social interaction, but rather try to make the event more social [2].

3.4 Summary

The studies presented in this chapter reveal that spectatorship consists of much more than passive viewing of the spectated sport. It is an active, social phenomenon. For spectators, ice hockey match is a social context, where they can get together with their friends and family, eat and drink, catch up with each other or discuss about the events happening before them. The sport, social aspect and the event all intersect in form of cheering at the sport with fellow fans and displaying enthusiasm with various equipment.

The resulting solution should take into account that for some fans, the social element may weight more than the sport itself, and the solution should try to support this social aspect of spectatorship. If possible, the solution should be designed so that it can be used during the low intensity periods of the game. The spectators also wish to place the events happening in game into larger context.

Ice hockey also has complex rules that may be difficult to learn and follow, especially for novice viewers. Some game events may be hard to perceive because of location of seating or because of the fast nature of the game.

4. RESEARCH PROCESS

The research goals for this thesis were to research the characteristics of good user experience for a mobile application for ice hockey spectators, and also to test if the implemented design would provide value for ice hockey spectators. First this chapter introduces the timeline of the process. The phases of the project are divided in the sections of this chapter. These sections include the overall description of the phase and the related methodology.

The project was initiated in February 2017. The idea was pitched by one of the design engineers, and based on that, decision was made to start working on the project. During this initial phase, the team consisted of an UI designer (freelancer), two design engineers and a project manager. The idea was to produce a functioning product, and deliver it to a client, who would function as a pilot testing platform. Before the author of this thesis joined the project, initial mock-ups of the idea and sketches of the UI were drawn. Idea was then presented to a potential customer, who agreed to be a pilot team for the application. When the author of this thesis joined the project, some UI-pictures existed, along with written and unwritten ideas about the project.

When the author of this thesis started working on the project, in early May 2017, some of the back-end implementation had already taken place and features for the front end were more or less decided upon. There was a somewhat functional, interactive inVision prototype that was used as basis of design. The design idea was communicated to the author of this thesis mostly verbally and through examining the interactive prototype. To guide the project to better fit actual user needs, user centered design approach was introduced to the project.

In the middle of May 2017, more software developers were allocated to the project, and the speed of implementation began rapidly increasing. In the end of July 2017, the team consisted of 11 members. The aim for the project was to have a minimum viable product for closed testing by the 11th of August 2017, when the first official games of the season of 2017-2018 would be played, and the system could be tested in a real environment for the first time.

Before any front-end implementation took place, a competitor analysis was conducted. Shortly after the front-end development had begun, an user study with interviews was conducted using a high-fidelity prototype. In July 2017 the first user study was planned, and in July participants were recruited and test times were scheduled. The maximum user study sessions was 3 per day. After user studies, during late July and August user studies were analysed together with fellow UX designer, Lauri Inkeroinen, who joined the development team in late July. During august, personas were created based on the study results

and an affinity wall was constructed based on the findings from interviews. In January 2018, around 3 months after the launch of the application, validation of the success of the design was conducted. The timeline of the process is illustrated in Figure 12.



Figure 12. Timeline of the research process

The focus of the user research was to gather data about the experience in the ice hockey arena and users' relationship with ice hockey and their reasons for watching it, and how

to enhance the experience with a digital solution. Secondary focus of the interview was also to validate the applicability of the SPEX-model to Finnish ice hockey fans. Research data consolidation focused on creating usable tools to aid development. Design validation was conducted to measure the success of the applications user experience.

4.1 Competitor review

Services chosen for the competitor review were chosen in collaboration with the development team. When creating the idea for the service, there were no direct competitors to Älykiekko. There were no findings of others using similar technology solutions to provide data for spectators. However, multiple indirect competitors were found. During competitor review, user tests were not yet carried out, so this thesis' worker researched competitors based on the features ideated for the application.

These features included food and drink ordering in the stadium, ticket purchases, smart data about the game using Älykiekko, general statistics about SM-liiga, ice hockey team related news and team member introductions. Based on these features, three indirect competitors were found.

HIFK application provides general information about the Finnish ice hockey team HIFK. The application features video interviews of players, ticket purchasing, team member introductions and statistics about SM-liiga. Yonoton is a food and drinks ordering solution, specifically meant for stadium usage. The main feature of the Yonoton is the mobile application, where users can order food to be picked up from different restaurants at the arena. Users can choose their desired delivery time. At the checkout, Yonoton shortens the queuing time by letting users scan a QR code delivered on their phone, thus reducing the time usually spent for paying. Wolt is a widely used application for ordering food from restaurants. Users can choose between ordering in, picking up the order from the restaurant or eating in. Wolt employs couriers, who deliver the food without the restaurant having to employ extra personnel.

These three competitors were analysed using SWOT. The analysis was done by the thesis worker, the results were then discussed within the development team and the findings were used as justification for including or excluding new features.

4.2 User research

To gather data from users' needs and the context of ice hockey spectating, user research was conducted. The research consisted of a background questionnaire, interview, prototype test, and after prototype test a short interview about the prototype. This thesis uses the term "user research" to reference this phase of development.

Because of the time limits for the project, there were a total of eight participants were recruited for user research. There were three persons present when the research was conducted: the participant, and two team members. One of the team members focused solely on interviewing and moderating the situation, and the other was responsible for video recording of the situation and note taking.

There were no convenient ways of having observer in different rooms or otherwise not visible for the user. The observer was located in the same room, visible for the participant. Before the interview began, users were asked not to pay any attention to the member, and they were told of his role as a quiet observer.

At first, there were 17 interview questions. After the first interview, which was considered to be a pilot interview, 4 questions were dropped out and some questions were modified. The questions that were left out were either providing duplicate data or they were deemed unnecessary. As the first session lasted for nearly 60 minutes, the team decided that due to constraints of time, the sessions should be made shorter. In the end, the length of the interviews ranged from 25 minutes to 60 minutes, an average being around 40 minutes.

4.2.1 Recruitment procedure and participants

Recruitment for user research was done two ways: asking for volunteers from inside the company, and from acquaintances of the researchers through social media. Table 6 shows the participant characteristics. Five out of eight participants were working for Bitwise at the time of testing. These participants were neither working for the project, nor had explicit knowledge about the features of the project. All the participants knew about the theme of the solution being developed and the target customer Tappara. The test subjects recruited from inside the company were chosen because of convenience and also as a method to introduce user-centered design methods to other developers.

Table 6. Participants of the user research

Participant code	P1	P2	P3	P4	P5	P6	P7	P8
Gender	m	m	m	f	m	m	m	m
Age	36-40	28-35	23-27	36-40	28-35	19-22	23-27	23-27
Employee of Bitwise	x	x	x	x	x			
Games watched live last season (2016-2017)	10	5	0	0	0	73	100	3
Games watched from TV last season (2016-2017)	20	15	5	0	1	5	3	10

The users' amount of games visited and age was confirmed verbally or in instant message services before recruiting them to the test to ensure that all segments would be represented. Before recruiting others, one participant was recruited to function as an initial test, and to see if the test would function as wanted, and if there would be need to modify the structure of the user research setting. After the initial test, rest of the participants were recruited.

The participants were chosen based on two variables: age and fandom, which was measured by the amount of live games visited last season. The aim was for the participants to be of different segments regarding age (young-old) and fandom, which was measured by the games visited last season. In total, eight participants were recruited, two from each combination of age and fandom. Some interviewees had viewed only a couple of games live, whereas some had watched every game of Tappara during the ongoing season. four interviewees had only viewed a couple of games, and the rest were deemed as "fans", who had participated in at least five live games last season. This division created a sample size of two participants per group (Table 7).

Table 7. *Different categories of interviewees*

	YOUNG	OLD
AVID FAN	Young avid fans	Old avid fans
NOVICE VIEWER	Young novice viewers	Old novice viewers

Avid fans had visited over 7 hockey games live on last season of play (2016-2017). Young users were aged 18-27 years old, and old users age ranged from 28 to 40. The initial hypothesis was that there are different needs for users who are avid fans of hockey, compared to those who visit the games occasionally. Furthermore, it was hypothesized that young users have different needs and use cases for the application than old users.

4.2.2 Interview and prototyping sessions

The sessions with users consisted of a background questionnaire to gather demographic data about users, an interview session and a prototype testing session. The prototype session was conducted using think aloud method and using an inVision prototype on iPhone. The length of the sessions varied from 25 minutes to 60 minutes. The sessions were all filmed. All interviewees signed a contract agreeing for filming the test and that the results would be used for commercial purposes and as material for the thesis. There were a maximum of 3 interviewing sessions per day, and all interviews were conducted within 2 weeks.

Before the test, user background data was gathered by asking the users to fill a short questionnaire. Aim of the questionnaire was to gather data about the nature of the users' relationship with ice hockey, and about their habits when watching a game and when visiting a stadium. As there were multiple persona hypotheses, it was necessary to gather quantitative data about users' fandom to be able to single out different user groups. Users were asked to evaluate their interest and fandom using the Likert scale [64]. Other questions were multiple choice, and focused on gathering quantitative data about viewing habits when watching an ice hockey game live. Questionnaire in whole can be found in Appendix 1 and interview questions in Appendix 2.

In the sessions, there were two researchers present. One acted as the interviewer, and the other researcher operated the camera and took notes. Before testing began, interviewees were instructed not to pay attention to the camera operator, and to act like he was not present in the room.

First the users filled out a background questionnaire. Then the interview was conducted. After the interview, the users were explained the think aloud method and how to act in the prototyping session. Also, after the pilot session, it was deemed necessary to instruct the users about limitations of the prototype. Since the prototyping was conducted using a smart phone, the pilot user tried to perform gestures that the prototype was unable to perform.

After the prototyping session, the users were given time to give feedback about the session while the camera was turned off. The interviewees, who were not employees of Bitwise were rewarded with a movie ticket for participating. The interview and prototyping data was all consolidated right after the session to avoid problems caused by human memory, and parts that were unclear were confirmed from the video recording.

Before testing, design team made a hypothesis about the personas based on existing domain knowledge. The hypothesis was made based on best guesses about ice hockey fans, and to act as a validation tool after the interviews were made. Four types of personas were assumed. First hypothesized persona was an older man, who has been an ice hockey fan for decades. He strongly identifies as a fan of Tappara. He has a smartphone which he uses mostly for calling and sometimes looking up information on the internet. He does not use a lot of applications, and does not want to spend time learning about functionalities. Interesting features for him was hypothesized to be ordering food and checking match results in real time.

Second assumed persona was a younger person, who is a native smart phone user. He goes to the games once in a while, mostly to spend time with his/her friends. Most interesting features for him were hypothesized to be buying tickets beforehand, ordering food and participating in stadium games to compete against his/her friends.

The third type of persona assumed was an avid ice hockey fan between 21-27 years old. design. This group was thought of being the most likely user group. It was also hypothesized that the most interesting feature of the application would be seeing intricate data about game situations and deepen the knowledge about the game he/she is watching.

The application was tested using a high-fidelity prototype. Prototyping method, high fidelity instead of low fidelity, was chosen based on the state of the project, available resources and because high fidelity testing fit Nielsen Norman Group's checklist (Figure 13) [65] for choosing the form of prototype.

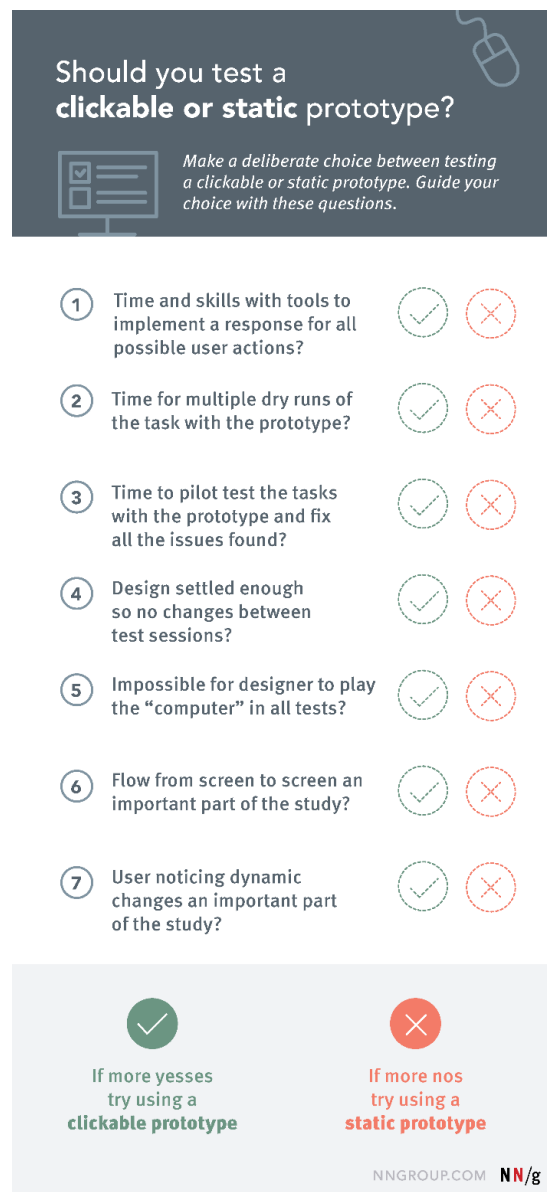


Figure 13. Checklist for deciding prototype fidelity [64]

All list items were thought satisfied when comparing to our prototype. Most importantly, list item 6, the importance of testing the flow of the application was deemed important, since initially the ease of navigation was deemed a high priority. This was because of a

study suggesting that users should not be distracted from the actual viewing experience with applications [2].

The prototyping session consisted of 6 assignments given to user on sheets of paper. The assignments can be seen in Table 8.

Table 8. *Assignments used in the prototyping session*

Assignments used in the prototyping session
1. Register to the application
2. Order 12 pieces of wings with hotness setting “hot”
3. Find the overall amount of points player Aleksi Elorinne made this season
4. Find the score of ongoing game Kärpät-HIFK

The testing was conducted using think-aloud method [66]. Before the actual test, users were first informed about the limitations of the prototype and think-aloud method was explained. After that, the users started completing the given assignments. After completion of the final task, users were supposed to arrive to a certain view. Had users failed the task, they would’ve been moved to that view. The last view that resulted, was then explained in further detail. The explanation was deemed necessary, since the dynamic nature of the data was impossible to present due to limitations of the prototype. After the prototyping session, a small interview of 6 questions was conducted concerning the prototype.

4.3 Research data consolidation

The interviews produced a large amount of research data, and the results were analysed with the help of constructing an affinity wall. The interview notes were printed, and cut up in sentences that encapsulated some form of finding. The notes were then grouped together based on similarities and categorized. Then a second round of grouping was done, and the categories from the first grouping round were grouped and labelled.

If there were notes that fit better in categories that emerged later in the grouping process, the notes were moved to the category that fit them best. If the sentence was deemed to represent multiple different ideas, it was duplicated and placed in multiple categories. If there were some notes that contradicted others, they were added next to the notes they contradicted and the contradiction was marked using a lightning shaped arrow. Initial notes from the sessions can be seen as white, first level categories as yellow, second level

categories as bright yellow and third level categories as pink. An example of the groups that were gathered can be seen in Figure 14.

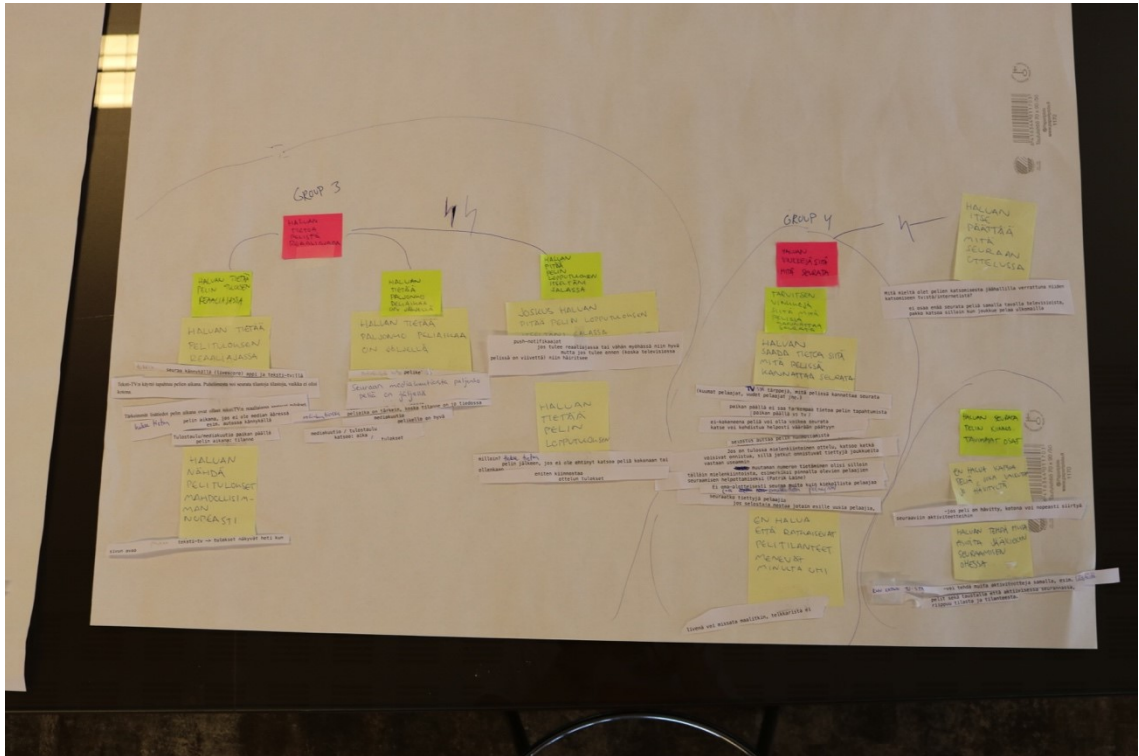


Figure 14. An example of the grouped-up affinity notes.

The images of the grouped up notes can be seen in the appendixes. Because of poor readability, the categories were typed up. The notes can be seen in Table 4. After each category, a number was added to represent the amount of notes that were initially grouped up in that category. This number represents the weight of the category when compared to other categories. There were some categories that did not get a lot of notes, but still were perceived important by the researchers. Contradicting notes were emphasized with red colour, and notes concerning television or internet broadcast viewers were emphasized with blue colour.

4.4 Design validation

Design validation was done using an internet questionnaire which gathered demographic data of the users, open feedback of the application and it used the UEQ to gather quantitative data about the usability of the application. The participants were recruited from Tappara fan page on Facebook¹. The UEQ was chosen because of the convenience and because it provides a benchmarking tool to compare results against. It is quick to fill out, average case takes approximately 10 minutes, so it suits well for gathering data online.

¹ <https://www.facebook.com/sinioranssit/>

5. RESULTS

The priority of this research was to gather user data to aid development of an application to support ice hockey spectators' live viewing experience. This section presents the results of the conducted research. Section 5.1 presents the results of competitor review using SWOT. In section 5.2, the results of the user research is discussed. In section 5.3 the implemented solution is presented. In section 5.4, process and results for the validation questionnaire are presented. The results are presented in the same chronological order as in they were performed in the development process.

5.1 Competitor review

The results for the competitor review are presented application by application. A SWOT analysis was performed on three distinct competitors. All three are indirect competitors, and they share some of the core functionality and some user group for the proposed solution. Since no direct competitors using similar technology exist, the evaluations were performed on three applications that share some functionalities that the proposed design solution proposed to include. These applications were HIFK mobile application¹, Yonoton² and Wolt³. The extent of evaluations was decided by the designer on case-by-case basis. Solutions were selected based on discussion between product management, development team and the judgement of the author of this thesis.

First, a verbal description of the application is presented. Then, a SWOT strengths and weaknesses table is presented for every analysed solution. Then based on the strengths and weaknesses, opportunities and threats for the Tappara application are presented.

¹ <https://play.google.com/store/apps/details?id=com.starcut.taskupeto&hl=fi>

² <https://www.yonoton.com/>

³ <https://wolt.com>

HIFK is a Finnish ice hockey team that has released their own application for the team. HIFK application is available for both Android and iOS operating systems. The application is constructed of 5 main views: front page (next upcoming game, feed of released news stories), matches (list of results of past games as well as listing of upcoming games, with links to ticket purchasing for games that are played in HIFK's home arena), HIFK TV (video interviews and video news stories), league table (rankings between teams for the ongoing season) and team (listing of players on HIFK roster, as well as individual players' career information and their role in the team). The functionalities of the application indicate that it is meant to be used by the fans of HIFK. The application could be described as "general ice hockey team fan application". The SWOT analysis for the application is presented in Table 9.

Table 9. *SWOT analysis for HIFK application*

Strengths	Weaknesses
Mobile friendly navigation Easy access to news content Listing of upcoming games Links to ticket purchasing Video content Statistics for SM-liiga Information about the players	Navigation model not consistent with material design guidelines Inconsistent information hierarchy Application has links that lead to external applications (browser)

Opportunities	Threats
Make navigation clear by following guidelines Incorporate all functionalities inside the application Adhere to guidelines and make information hierarchy and views of the application consistent	Content has to be presented well and be interesting to compete with standards created by competitor

Yonoton is a food and drink ordering service that operates on stadiums during various events, such as football games and concerts. The main value of the application is to make getting food and drinks more effortless for spectators. When launching the application, users are presented with a list of events Yonoton can be used on, your distance from the

venue and the time and date of the event. After choosing an event, users are prompted to choose the delivery method of the order. During the testing, only take-away orders were available. After choosing the delivery method, users have to choose the restaurant they want to order from, and after that the product catalogue for chosen restaurant is displayed. Users add products to shopping cart, and after paying by credit card, the order is placed to the selected restaurant. Users can choose different delivery/pick up times for the order, such as “immediately” or “next intermission”. At the check-out counter users present a QR code they received in the application when placing the order, display it to a code reader and a cashier gives them their order. The results for SWOT analysis on Yonoton can be seen in Table 10.

Table 10. *SWOT analysis for Yonoton*

Strengths	Weaknesses
Mobile friendly navigation Novel solution in Finland Already in use in stadiums Mobile purchasing Eliminates queuing Easy to keep track of the status of the order Presents directions to restaurants Ability to order food to your seat or to pick up Ability to change the time of pick up of order (immediately or at half time)	No additional functionality besides food ordering Users have to install application only for the food ordering function

Opportunities	Threats
Provide interesting additional content besides food ordering Interesting content can make users download the application	Existing user base, market penetration may be difficult Good overall user experience

Wolt is a mobile application designed for ordering food. Wolt’s business model also includes delivery agents who pick up and deliver the purchased goods to users. Users may

choose between eating in the restaurant, ordering take away or to order the food to their location.

Users are onboarded with a 6 screen tutorial that teaches the basics of the user interface. After the last screen of the tutorial, users are prompted to login. Logging in is required to continue to the actual application. On the front page users are presented with a card view of suggested restaurants. Users can browse restaurants based on the delivery method. Users order the food using a credit card and after payment is complete, users can check the status of their order and receive notifications when their order advances in the process. If the selected delivery method was order in, users can track the location of the delivery person through the application. The results for the SWOT analysis for Wolt can be seen in Table 11.

Table 11. *SWOT analysis for Wolt application*

Strengths	Weaknesses
<p>Mobile friendly navigation</p> <p>One of the market leaders in mobile food ordering services</p> <p>Great onboarding</p> <p>Suggestions for popular restaurants and menu items</p> <p>Customizable orders</p> <p>Magic link makes registering easy</p> <p>Visually pleasing</p> <p>Great interactions</p> <p>Trustworthy impression</p> <p>Following the status of order adds to sense of security that order was successfully received</p> <p>Map view of restaurants makes choosing a restaurant easy</p>	<p>No additional functionality besides food ordering, users have to install application only for the food ordering function</p> <p>Delivery to the stadium requires stepping out of the arena during the game</p>

Opportunities	Threats
<p>Delivery to your seat or pick up from the restaurants inside</p> <p>Add delivery times that are suitable for the ice hockey game context</p> <p>Additional content besides food ordering</p>	<p>Users familiar with the solution</p> <p>Service is easy to learn</p> <p>Outstanding user experience</p> <p>Vendors already using the service</p>

5.1.1 Summary of competitor review

All of the reviewed solutions are applications that have been designed primarily for mobile use. The competitors' applications have adequate or good user experience. The solutions are already implemented and have an existing user base. Competing with Yonoton

means that the application has to provide a service with similar functionality with some extra functionalities that make arenas use our solution instead of theirs. HIFK application presents team related news and the statistics of SM-liiga in an easily accessible way. Wolt has created a high standard for user experience standard in mobile food ordering solutions.

These analyzed competitors' weakness and strength at the same time is that they cater to one specific need. This creates an opportunity. If our solution caters to multiple needs at once, it is easier for users to use just a single application. Ice hockey teams may also be more interested in one-in-all solution. With Älykiekko, our solution can provide interesting data no competitors can provide at the moment. Competitors also create threats. Existing services in the desired marketplace may prevent upscaling. Users are accustomed to existing solutions' good UX. The application has to have enough interesting content to keep users using the application

5.2 User research

This section presents the results gathered in the user research phase. The user research included a background questionnaire, interview and a prototype testing session. The results are presented in their own sub sections in the order which they were completed during the design process. First, experience goals are presented, then created personas and lastly the context scenarios created based on the personas.

5.2.1 Experience goals

This section presents the experience and end goals of users. Experience and end goals were constructed based on the findings from interviews and prototyping sessions. The goals are based on theory (literature review, user research), empathy (user research) and available technology. Cooper suggests that end goals and experience goals are the most important when designing a new service. Therefore, experience goals and end goals of spectators are presented. The derived goals were used in constructing personas to function as their motivation. The summarized experience goals are presented in Tables 12 and 13. The full list of experience goals can be found in Appendix 6.

Table 12. *Summarized experience goals of spectators*

Summarized experience goals of spectators		
Occasional visitor	Avid fan	Home viewer
Wants to have a good time at the arena	Wants to know everything about the game	Wants to follow games with as little effort as possible
Wants to feel the atmosphere of the arena	Wants to feel the rush of winning	Wants a comfortable viewing environment
Wants to spend time in company of friends and family	Wants to focus on the game	
Wants the errands he has to run at the arena to cause no hassle	Wants to be part of the (fan) community	

Table 13. *Summarized end goals of spectators*

Summarized end goals of spectators		
Occasional visitor	Avid fan	Home viewer
Wants to spend time with family and friends	Does not want to miss (important) game events	Wants information about the ongoing game's events
Wants to eat and drink at the arena	Wants statistical data about their favorite team	Wants to engage in other activities while following the game (does not mind if misses some game events)
Wants to find the services in the arena (menus and locations of the restaurants)	Wants to support his/her favorite team	Does not want to follow games that already seem lost
Wants to know what to follow in game	Wants to cheer on their favorite team	Wants to hide the end result of the game until can view the game
	Wants to control what he/she focuses on when viewing the game	

5.2.2 Personas

Three personas were constructed based on the data gathered during user research. The found personas were in line of the initial persona hypothesis. The aim was to construct the personas so that they could be easily glanced through, and that they would benefit the design team. The finalization of the personas was done after the author of this thesis left the project, and the finalized persona images were constructed by designer Lauri Inkeroinen [67]. The personas include a general description of the depicted person, their needs, technological skills and goals. The personas can be seen in Figures 15, 16 and 17.

Tero "Tepa" Tiilikainen - Male, 46 years old
A true Tappara fan



General:

Tero is an active Tappara fan, and goes watch every game in the arena when it's possible. Following Tappara is an important part of Tero's free time activities. Tero supports Tappara by going to the games and seldomly buying fan gear. Mostly Tero goes to the games with his friends, but going alone is no obstacle. He usually finds fellow fans he's acquainted with from the arena. Tero knows almost all the basic functionalities of a smartphone. He took to himself to learn a few applications that are important to him.

Needs:

Wants to know everything about the game
 Wants to converse about the events in the game during breaks and after the game
 Wants to focus on following the game
 Wants to control, what he follows in game

Skills:

Basic skills with a smartphone
 Uses internet for reading news and email

Goals:

Wants to see all game events
 Wants accurate statistical information
 Wants to support Tappara
 Wants to follow players' personal lives
 Wants to feel the atmosphere of the arena and participate in it

General goals:

Wants to be a part of the fan community
 Wants to feel the rush of winning
 Wants to upkeep and progress Tappara's operations

Figure 15. Persona of an avid fan [67]

Kalle "Kale" Koskinen - Male, 36v

An occasional visitor



General:

Kalle is the father of two children and follows ice hockey occasionally, if there is nothing else he has to do. Kalle goes to watch a game live in the arena a couple of times a year. For Kalle, ice hockey is a conversation topic amongs others. He wouldn't watch a game alone, he only does in the company of friends and family. He owns a smart phone, and uses it mainly to take pictures and instant messaging. Kalle uses a few applications, and only if they are time savers.

Needs:

Wants to spend time with friends and family
 Wants to eat and drink at the arena
 Wants to find the services in the arena easily (restaurants, parking, toilets)
 Wants to spend his free time efficiently
 Wants that running errands in the arena is effortless
 Wants to enjoy his time at the arena

Skills:

Basic skills with a smartphone
 Uses internet for watching videos irregularly

Goals:

Wants tips on what to follow in game
 Wants to know what is happening in game
 Wants to see replays and slow motion replays of important game events

General goals:

Wants topics for conversation
 Wants to upkeep social relationships
 Wants pleasurable experiences

Figure 16. *Persona of an occasional visitor [67]*

Kimmo “Kyllö” Kyllönen - Male, 24 years old

Watches from home



General:

Kimmo lives alone and follows ice hockey regularly mostly via tv. Kimmo doesn't have time to watch all games, but he is interested in the end results. Kimmo follows games alone and with friends. When watching alone, Kimmo usually does something besides watching the game. When with friends, Kimmo follows the game actively and comments the events in game. During the games, Kimmo checks up on the results of other games, mainly from teksti-tv. Kimmo feels its important for him to be in control of his phone, and he doesn't want any extra notifications or messages.

Needs:

Wants to spend time with friends
Wants a comfortable viewing environment
Wants to know the end results of games
Doesn't want to watch games that already seem lost
Wants to keep the end results a secret from himself on certain games, wants to see the events himself

Skills:

An advanced smart phone user
Gets frustrated on advertisements and intrusive push notifications
Uses the internet a lot for running errands and making purchases

Goals:

Wants to be in control on how actively he follows the game
Wants to see plays from multiple angles
Wants to know what's happening in game
Wants to see (slow motion) replays from important game events

General goals:

Wants to spend his free time efficiently
Wants to spend time with friends
Wants quality entertainment

Figure 17. Persona of a home viewer [67]

5.2.3 Context scenarios

For every persona, a context scenario was written in collaboration with the thesis author and Lauri Inkeroinen. The goal of constructing scenarios was to invoke empathy towards users in the design and development teams.

Occasional visitor

While getting home from work, Kalle remembers that he has not been in touch with his friend Jukka for a while. When they were younger, they used to watch ice hockey together and hang out. Using the Tappara application, he sends Jukka an invitation for next week's Tappara-Ilves match and starts preparing dinner for his wife and his child.

Next day while at work, Kalle gets a notification saying that Jukka has accepted his invitation. The system automatically reserves tickets for both of them.

Three hours before the game, the application notifies Kalle of the fastest route to Hakametsä, and suggests a parking area, which is reserved only for customers who bought the ticket in advance from the application. Kalle decides he will not take the car today, and instead boards the bus that the application suggests.

While in the bus, Kalle calls Jukka and asks if he is hungry. They both agree that it would be nice to eat something, and Kalle says he'll take care of ordering food. From the application, Kalle decides to order a set of wings and a beer for both of them. He places an order, and chooses for the food to be ready before the game.

Kalle sees Jukka at Hakametsä, and takes a look at the application. It tells Kalle that their order is ready to pick up from Siipikellari. Kalle is not sure where the restaurant is nowadays. The notification for the order displays also a map displaying the location of the restaurant.

When getting near the gates of the arena, Kalle and Jukka both get a notification asking, to display the tickets. Both of them accept, and show the ticket to the reader at the gates and get in.

When getting in to the restaurant, Kalle and Jukka go to the self-check out lane, which has no queue at all. They display the code for their purchase to the reader. The cashier checks their ID because of alcoholic beverage purchase, and accepts the order when seeing that it is all in order. Both of them get a receipt to their phone.

After the games start, Kalle is a bit unsure about the team composition nowadays. He checks the application for up to date rosters and sees that his favourite player is on the starting line-up. The application gives out pointers for hot players for Kalle to follow during the game.

At the game Kalle and Jukka start talking about what has been going on with their lives, and get into an intense discussion. Meanwhile, there has been a major incident involving an injured player and the game has been stopped. Jukka and Kalle check Kalle's phone for replays, and get video feed of the incident.

A Tappara-fan

This evening Tappara faces off Ilves and Tero would not miss this classic Tampere match up for the world. Him and his friends have a seasonal pass for Tappara games, and he's pretty sure they will be at the match also.

One hour before the game the application gives a notification: tonight's game's rosters have been published, and Tero is pleased to see upcoming rookie Ville Lehtikäinen is on the line-up again after an injury.

At Hakametsä, Tero greets his friends and sits to their usual spots. They chat about the upcoming game and about Lehtikäinen's return. After the game starts, they all focus on the game intensively, not saying much to each other during plays.

During an intermission in the game, Tero and his friends chat about the progress of the game. They are appalled that Tappara is down 2-0. Tero's friend Juha suggests that it's because Tappara's defence formation is not correct. From the application, they check the number of shots on goal, and see indeed that Ilves took twice as much shots on goal as Tappara during the first period. They also check the locations of the shots taken, and see that the left defence is leaking.

During the period break, Tero and his friends go over some of the plays that happened during the first period using the application's position tracking, and they see that the left defender Lauri Hotakainen has not been tagging his man during defence situations. Tero says he will keep an eye on Hotakainen during the two remaining periods, and hopes that coach will notice the same thing and give Hotakainen some advice for the rest of the game.

On second period, Tappara scores, and Tero and his friends raise their phones up in the air: the application plays the sound of a horn as a sound of victory. Other fans do this as well, and the arena is illuminated by flashing screens and sounds of horns.

During the second period break, Tero briefly checks what his favourite players have been writing on social media. He's interested to see that two important players are going to have children this season, and wonders with his friends if this will affect their performance.

After the game, Tero checks the statistics for this evening's game, and can see that even though they lost, statistically the game was really even. Considering the shots taken, he's impressed with Tappara's goaltenders performance. He's sure, next time Tappara will win.

Home viewer

Kimmo knows that Tappara has a game tonight, and he invited a couple of his friends over. Both of them had other plans for tonight, so Kimmo thinks he'll spend the night by himself, watching ice hockey and cooking.

While first period starts, Kimmo watches the game, while browsing internet on his mobile phone. While he attends to cooking in the kitchen, he checks the scores of ongoing matches in SM-liiga. He stays up to date on every game without having to switch to teksti-tv on his television.

As Tappara is winning 5-1, Kimmo decides that the game is over and no longer worth watching. In case of a miracle, he however turns the application's notifications on for the game.

The unexpected happens, and Kimmo gets 4 notifications on his phone in a row: Ilves is now tied with Tappara with only 2 minutes remaining on the clock. Kimmo gets the remote and tunes in for the most exciting part of the game.

After the game, Kimmo checks the videos of the goals from the application to get a better understanding on how Ilves managed to tie the game.

5.3 Resulting implementation

This section presents the resulting Tappara application¹ that was launched in October 2017. The launched application includes statistical match calendar and ticket purchasing (Figures 19 and 20), player information (Figure 21), news content about SM-liiga & Tappara (Figure 22), statistics of SM-liiga (Figure 23), previews and reports of games (Figure 4 and 25), Älykiekko data of players' performance on ice (Figure 26), and food ordering at the stadium (Figure 27). The images presented have been fetched in February 2018, but no major updates in applications' functionalities been made between October 2017 and February 2018. Table 14 presents the functionalities and the UX goals they support.

¹<https://play.google.com/store/apps/details?id=fi.tappara.Tappara>

Table 14. *Functionalities and UX goals they support*

Functionality	Supported UX goals
Match calendar & Ticket purchasing	Wants to follow games with as little effort as possible, wants the errands he has to run at the arena to cause no hassle
Statistics of SM-liiga	Wants to know everything about the game, wants statistical data about their favorite team
News of SM-liiga & Tappara	Wants to be part of the (fan) community, wants to know everything about the game
Älykiekko data of players'	Wants statistical data about their favorite team, wants to know everything about the game, wants information about the ongoing game's events
Food ordering at stadium	Wants to have a good time at the arena, wants the errands he has to run at the arena to cause no hassle, wants to eat and drink at the arena
Previews and reports of games	Wants to know what to follow in game, wants to know everything about the game, wants to follow games with as little effort as possible

The navigation hierarchy of the application is presented in Figure 18. When users open the application, they land on the news view. Users can move between screens only through routes portrayed with arrows. If an user is deeper in the navigation hierarchy (level two or higher), they need to return to level one to be able to switch between level one views. Users can move between level 1 screens by navigating from the bottom navigation bar. Inside navigation levels, users can navigate through sibling views by using tabs on the top of the screen. The sibling views inside a navigation level are portrayed in blue (Figure 18).

In matches view, users first select a match from the match calendar. After that, they can view a single match. If the match is upcoming, users can purchase tickets for the match, display the match line-up or read a match preview article. If the match has already been played, users can view the game events of the match and read a report article. In the shop, users first choose their desired products and add them to the shopping cart. Then they can review and modify their order in the shopping cart. After reviewing the order, users move to the checkout where they choose a desired pick up time for the order and pay the order.

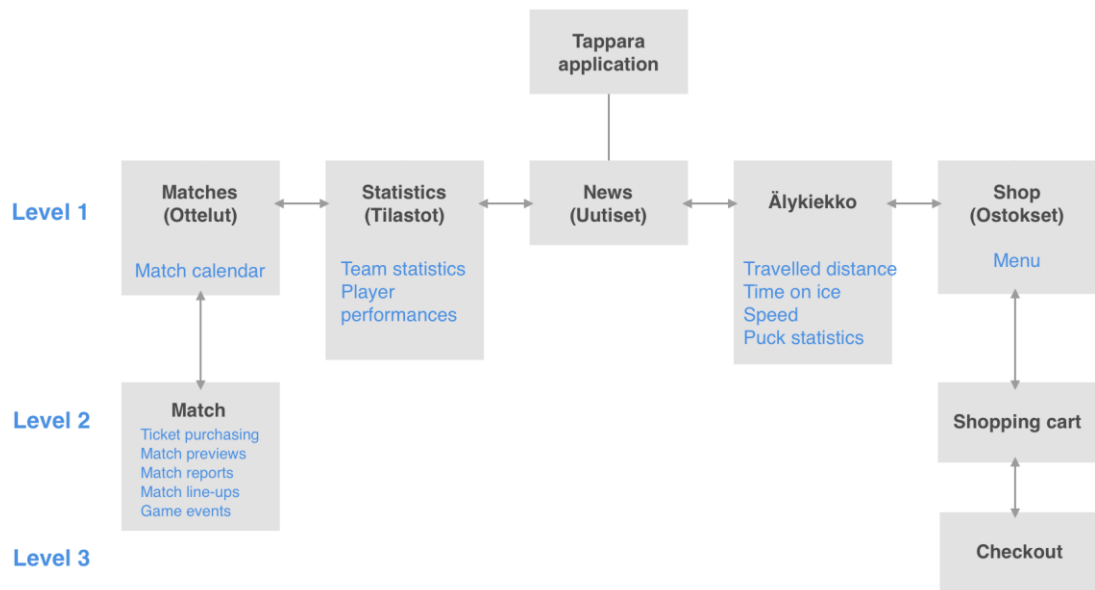


Figure 18. *Navigation hierarchy of Tappara application*

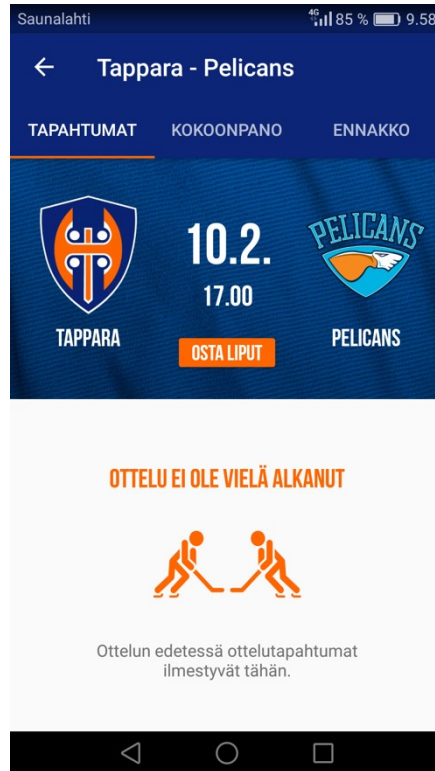


Figure 19. Ticket purchasing



Figure 20. Match calendar

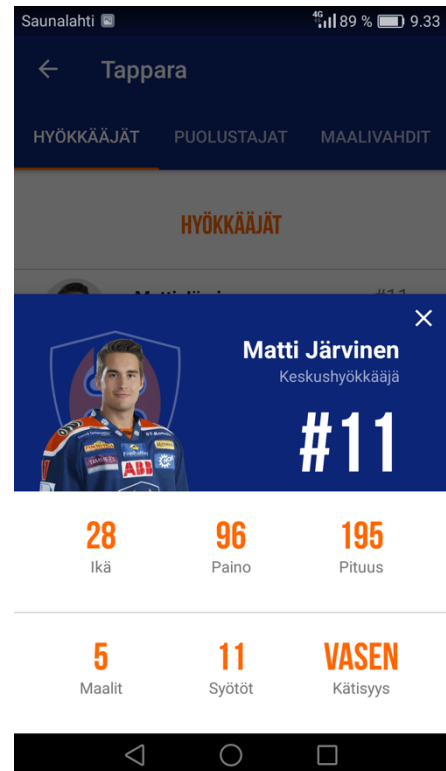


Figure 21. Player information

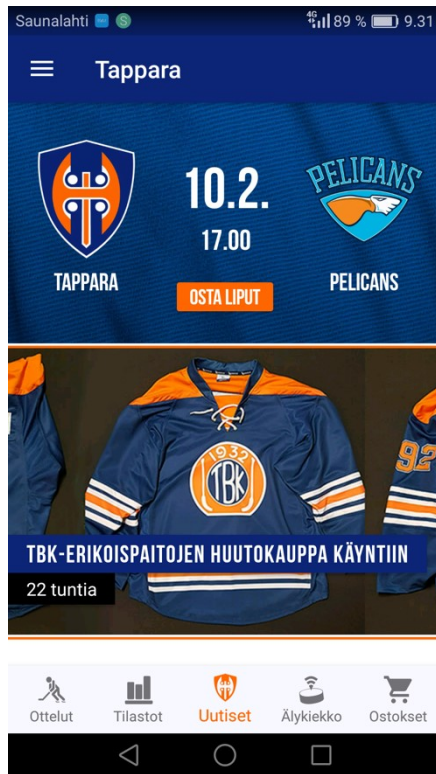


Figure 22. News view

	O	V	TV	TH	H	P
1. Kärpät	51	30	8	5	8	111
2. TPS	50	25	5	7	13	92
3. Tappara	51	21	11	7	12	92
4. JYP	49	26	3	4	16	88
5. HIFK	50	22	6	8	14	86
6. Lukko	50	19	7	4	20	75
7. KalPa	50	19	6	6	19	75

Figure 23. SM-liiga statistic



Figure 24. Game previews (not yet published)

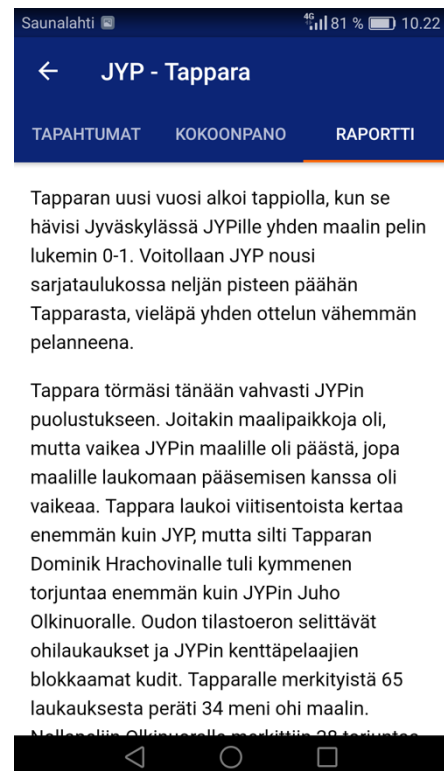


Figure 25. Match report

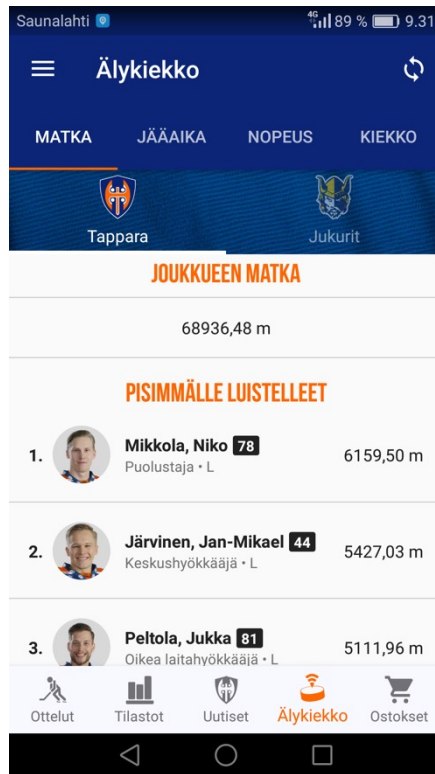


Figure 26. Älykiekko data of players' performances

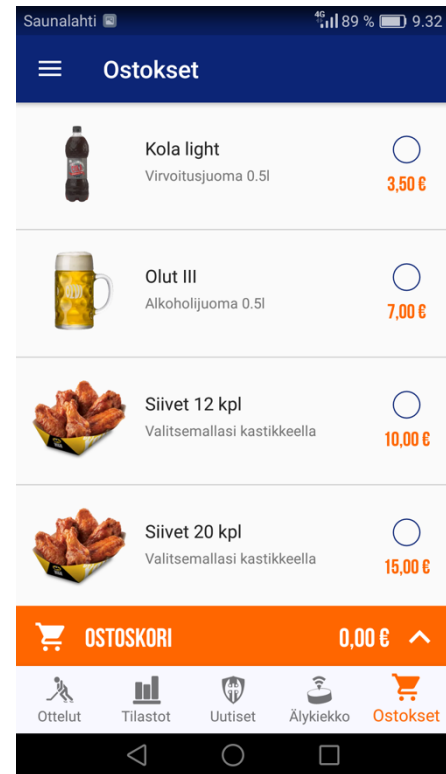


Figure 27. Food ordering

5.4 Design validation results

This section presents the results of the online questionnaire that was used to validate the success of the implementation (presented in Section 5.3).

Three of the users who answered the questionnaire had used the application two to five times, seven of the users six to ten times and 13 had used the application over ten times. Two of the answerers had used the application within 5 hours of filling out the questionnaire, four had used it during the same day, seven within 3 days and the had used it longer ago. Data about the last time of use was gathered for determining the accuracy of UEQ, since it is most accurate when used immediately after using the service the questionnaire tests [51]. Five of the users had spectated one to five ice hockey games live last season (2016-2017), seven users had spectated six to fifteen games and eleven users more than fifteen games.

Most answerers have used the application enough to have formed an opinion about the usage. The answerers range from fans watching a lot of live games to occasional visitors, but weighing on the fan side. This was expected, as the site from which answerers to questionnaire were gathered, is focused on fandom of Tappara.

In Figures 28 and 29 the influence of the application in the overall experience and the areas of improvement are displayed according to questionnaire's answers. Most answerers (12 out of 23) said that as is, the application did not influence their experience. Two answerers said that it was exciting and three answerers said that Älykiekko statistics were interesting. Four out of 23 answerers wanted more specific Älykiekko data and three out of 23 answerers wanted Älykiekko data visible even if they are not present in the arena.

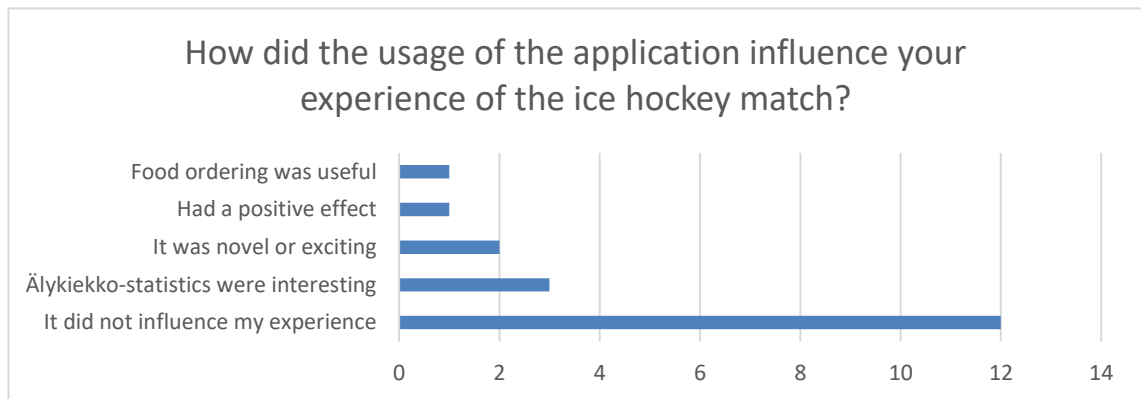


Figure 28. *Tappara application's influence on the overall experience of the hockey match*

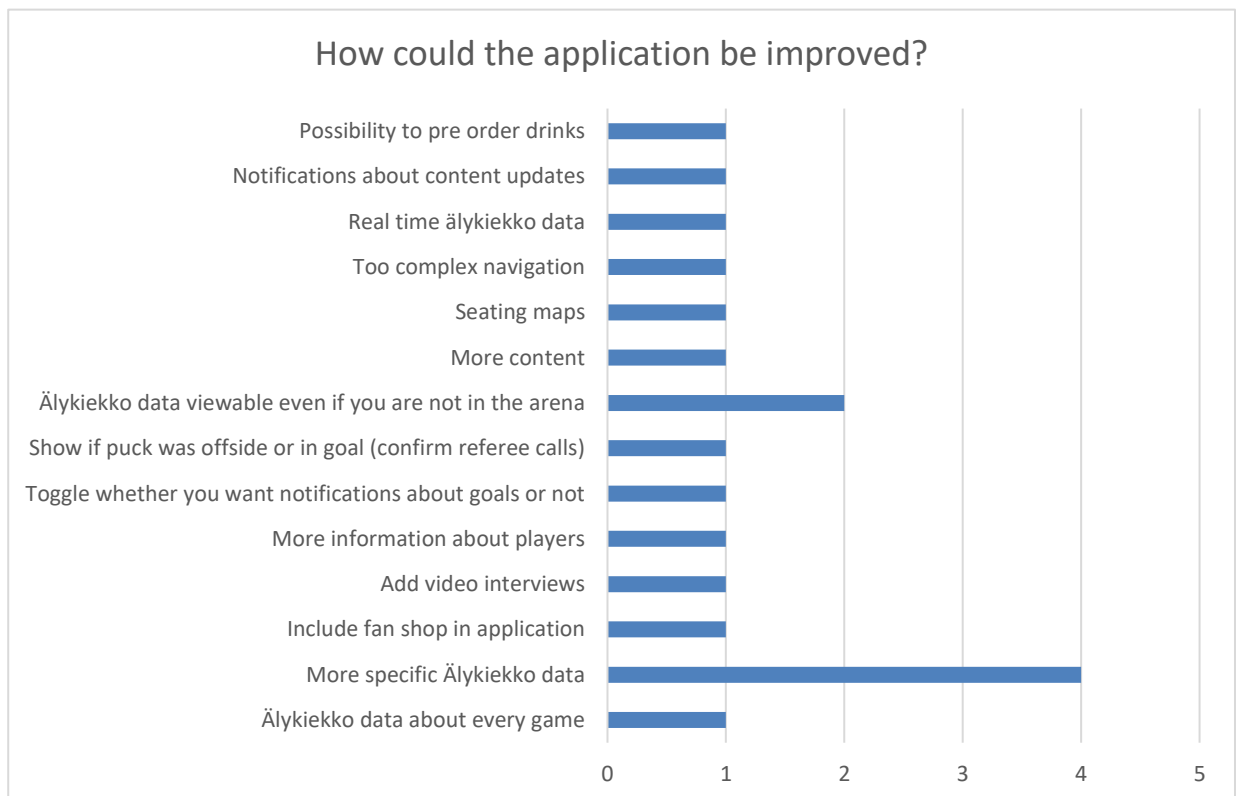


Figure 29. *Areas of improvement in the Tappara application*

The second part of the questionnaire used the UEQ to map the current user experience of the application. Figure 30 depicts the calculated means of the individual scales gathered by the user experience questionnaire.

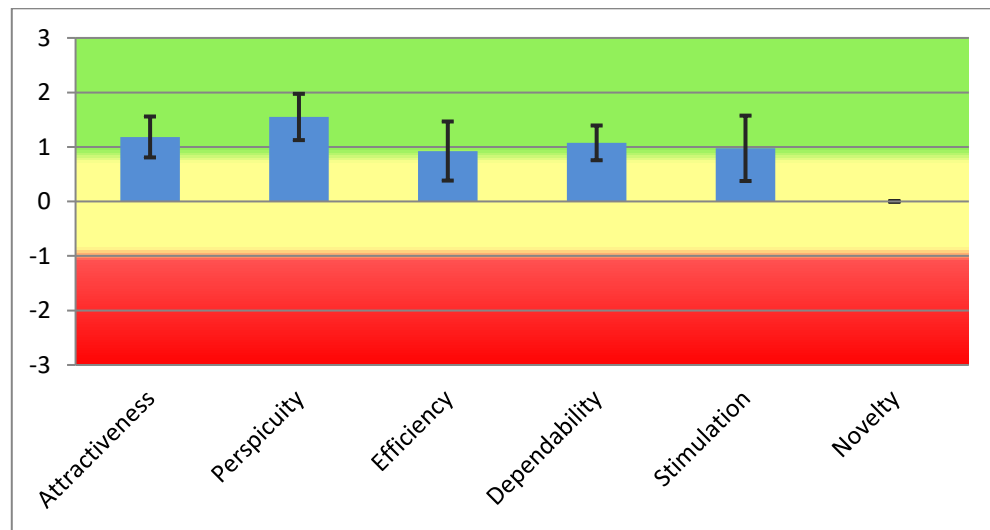


Figure 30. Results from the UEQ data analysis tool

As can be seen from Figure 15, novelty has no score. Novelty scale was left out because it was decided within development team that novelty should not be a factor and instead, actual usability and experience enhancing was prioritized. It was also left out to shorten the questionnaire to avoid deterring users from finishing answering the questionnaire. The gathered data was also compared against a benchmark provided within the UEQ toolbox. The results can be seen in Table 15 and Figure 31.

Table 15. Results against UEQ benchmark.

Scale	Mean	Comparison to benchmark
Attractiveness	1,18	Above average
Perspicuity	1,55	Above Average
Efficiency	0,93	Below Average
Dependability	1,10	Below Average
Stimulation	0,98	Below Average

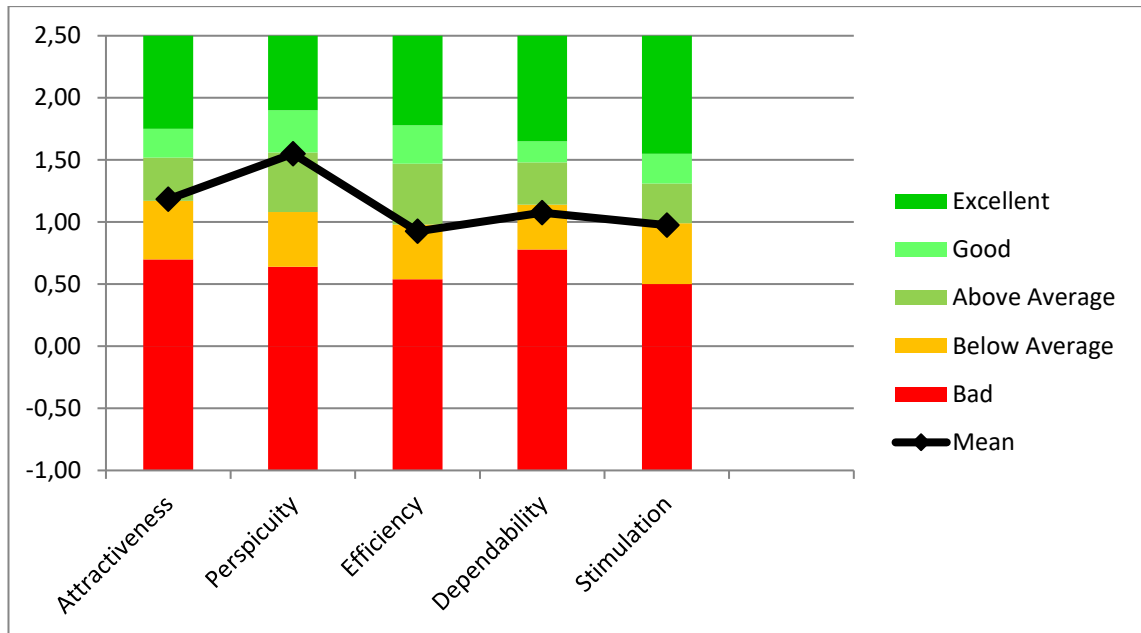


Figure 31. Results against UEQ benchmark.

As can be seen from figures, the test results are mainly average within the benchmark dataset, with the exception of perspicuity (ease of use), which is ranked higher than average.

6. SUMMARY AND CONCLUSIONS

In this chapter, first the results of the user research phase are summarised. Then, validity of the results is discussed. Last, future work regarding the project is suggested.

6.1 Summary of the results

For creating a solution to enhance the ice hockey viewing experience of spectators, literature review of existing theory was performed, competitors were researched using SWOT analysis, user research through interviewing and prototype testing was performed and experience goals, personas and contexts were constructed based on user research data. Then implemented solution was presented and validated using the User Experience Questionnaire.

The results produced by the user research gave out two kinds of results. First, qualitative knowledge about the nature was acquired. Secondly, qualitative data about desired features and success of the designed ones was gathered. Results of the validation questionnaire provided qualitative open feedback data about the existing implementation, as well as quantitative data about the impressions when using the application.

User research results corroborate with the SPEX model [56]. The spectatorship is heavily focused on the atmosphere and social interaction. For spectators that are not avid fans of hockey, the event itself provides an opportunity to spend time with friends. The hockey game is seen as a form of entertainment and a possibility to spend time with friends and family.

The most important results from the interviews and prototype testing can be divided into 4 categories. The categories and findings supporting those statements can be found in Table 16. The findings are gathered from the user research phase: interviews, prototype tests and the validation questionnaire. These findings also answer to research question 1: “What are the user needs that affect experience design for a mobile application for ice hockey spectators in the arena?”.

Table 16. *Categorized user needs that affect experience design*

Social nature of the viewing experience	<ul style="list-style-type: none"> • Nearly all visitors prefer watching games in company of others • The game is a socializing event, where majority of the users socialize with their friends and family • Viewers come to the arena to feel the unique atmosphere • The atmosphere depends on the company
Helping novice viewers get into the sport	<ul style="list-style-type: none"> • Novice viewers want help on directing their attention. They necessarily do not know what game events are important
Additional information of the ongoing game	<ul style="list-style-type: none"> • Viewers, who know a lot about hockey would like to confirm referees calls with Älykiekko data • Viewers would like (slow motion) video material from multiple angles from important game events • Heavy users want to read reports and statistics of the game after it has ended • Heavy users would like to see additional data about the individual performances of players • Viewers would like to get information about new, interesting players • I want to tie the game into a bigger picture
Creating an effortless viewing experience	<ul style="list-style-type: none"> • Viewers want the arena experience to be as effortless as possible. This includes getting to the arena, buying tickets, finding seats, ordering food and finding services in the arena. • Viewers do not want to waste time by queueing to restaurants or other services

The user experience questionnaire for the existing application yielded similar results. Avid fans are more interested in the statistical data of ice hockey, and would like a singular place where they could go to fetch their data. During feedback gathering, there was significant desire for more detailed and more interesting Älykiekko data.

Novice viewers and avid fans alike both described the atmosphere of the arena as a big reason for viewing games live. Both groups also described keeping up social relationships as on reason of spectating games live with company.

To answer the second research question, 23 participants answered the validation questionnaire. Second research question was “Does the implemented service affect the spectatorship experience?”. The validation questionnaire results indicate that at the moment, design has a minor positive impact. In open feedback the application was described as interesting and “having potential”, but requiring additional content and functionalities to actually provide a meaningful impact to the stadium experience. The UEQ yielded similar results, and the Tappara application was rated slightly above average the benchmark as it is at this moment.

6.2 Validity of the results

The results of the interviews give similar results about viewership as the SPEX model [56]. Spectators view the ice hockey match as a social event besides enjoying the sport. Spectators meet friends and fellow fans during matches. Atmosphere of the arena is an important factor when choosing whether to view the match from home or at the arena. Spectators also want to eat and drink when they spend an evening at the arena, just like they would in a bar or in a restaurant. Avid fans want to deepen their knowledge about the sport itself. Spectators also want to tie the events in game into a bigger picture. This small scale study corroborates SPEX model’s applicability for Finnish ice hockey fans. The found need for socializing during the event, and wanting to fit a single game or a play into a bigger picture were also found on Esbjörnsson’s earlier study [2].

The validity of the user research may suffer from factors regarding the sample of participants. The sample was relatively small (8 interviewees), and 5 of the interviewees were employees of Bitwise, the company the product was being developed for. Where it is not likely that answers would be skewed because of the employer, all the interviewees work for an IT company, and may not give best representation for example of the smart phone usage skills or mindset of the target audience.

The validation questionnaire was constructed using the UEQ, which has been tested in various countries and with various different projects. The questionnaire was however translated to Finnish by the author of this thesis. While the general translation was verified by peers, there might be slight errors in the nuances of the descriptive words of the UEQ. The sample size for the validation was 23 responses, which should be large enough to yield reliable results. The test users were however recruited through a social media fan page of Tappara. The respondents may therefore be more likely to know about ice hockey, and therefore have different needs for the application, than an average occasional visitor. Also, the questionnaire gives most reliable results, if it is filled right after using the researched solution. This was not the case for majority of the respondents. However, most

of the answerers had used the application during the same day as they answered the questionnaire.

6.3 Future work

At the moment, the application does not create other possibilities for co-experiences besides experiencing ice hockey and eating and drinking together. There may be a need to put more emphasis on creating a features that brings fans together.

The Älykiekko data presented by the application was described as interesting and having potential. Studying what the system is capable of and displaying that data in an interesting format will be a challenge for the future. Also, if possible, the Älykiekko data should be presented in real time. Video material was also a widely requested feature, and might be worth looking into in the future.

REFERENCES

- [1] A. Sahami Shirazi, M. Rohs, R. Schleicher, S. Kratz, A. Müller, A. Schmidt, Real-time nonverbal opinion sharing through mobile phones during sports events, Proceedings of the SIGCHI Conference on human factors in computing systems, ACM, pp. 307-310.
- [2] M. Esbjörnsson, B. Brown, O. Juhlin, D. Normark, M. Östergren, E. Laurier, Watching the cars go round and round, Proceedings of the SIGCHI Conference on human factors in computing systems, ACM, pp. 1221-1224.
- [3] J. Hallberg, S. Svensson, A. Ostmark, P. Lindgren, K. Synnes, J. Delsing, Enriched media-experience of sport events, Sixth IEEE Workshop on Mobile Computing Systems and Applications, IEEE, pp. 2-9.
- [4] J. Dewey, *Art as Experience*, The Berkeley Publishing Group, 1934.
- [5] M.M. Bakhtin, *Toward a Philosophy of the Act*, University of Texas Press, 2010.
- [6] M.M. Bakhtin, M. Holquist, V.W. McGee, V.W. McGee, *Speech Genres and Other Late Essays*, University of Texas Press, Austin, 1986.
- [7] P. Wright, J. McCarthy, L. Meekison, Making Sense of Experience, in: M.A. Blythe, K. Overbeeke, A.F. Monk, P.C. Wright (ed.), *Funology: From Usability to Enjoyment*, Springer Netherlands, Dordrecht, 2005, pp. 43-53.
- [8] ISO DIS 9241-210:2008. Ergonomics of human system interaction - Part 210: Human-centred design for interactive systems, 2010, pp. 1-32
- [9] ISO 9241-210, (2010). Ergonomics of human-system interaction - Part 210: Human-centred design for interactive systems. International Standard.
- [10] D. Chesnut, K. Nichols, Chapter 1 - Defining UX and the Process, in: Anonymous (ed.), *UX for dummies*, 2014.
- [11] Is beautiful really usable? Toward understanding the relation between usability, aesthetics, and affect in HCI, in: *Computers in Human Behavior*, 2012, pp. 1596-1607.
- [12] E. Law, V. Roto, M. Hassenzahl, A. Vermeeren, J. Kort, Understanding, scoping and defining user experience, Proceedings of the SIGCHI Conference on human factors in computing systems, ACM, pp. 719-728.
- [13] ISO 9241-11:1998: Ergonomic requirements for office work with visual display terminals 1998, 1-22 p.
- [14] K. Battarbee, Defining co-experience, Proceedings of the 2003 international conference on designing pleasurable products and interfaces, ACM, pp. 109-113.
- [15] J. Forlizzi, K. Battarbee, Understanding experience in interactive systems, Proceedings of the 5th conference on designing interactive systems, ACM, pp. 261-268.
- [16] V. Roto, Y. Lu, Towards meaning change, Proceedings of the 8th Nordic Conference on human-computer interaction, ACM, pp. 717-726

- [17]. E. Kaasinen, V. Roto, J. Hakulinen, T. Heimonen, J.P.P Jokinen, H. Karvonen, T. Keskinen, H. Koskinen, Y. Lu, P. Saariluoma, H. Tokkonen, T. Markku, Defining user experience goals to guide the design of industrial systems: *Journal of Behaviour & Information Technology*, 2015, Volume 34, Issue 10, pp. 976-991.
- [18] I. Michailidou, C. von Saucken, S. Kremer, U. Lindemann, A User Experience Design Toolkit, in: A. Marcus (ed.), *Design, User Experience, and Usability. Theories, Methods, and Tools for Designing the User Experience: Third International Conference, DUXU 2014, Held as Part of HCI International 2014, Heraklion, Crete, Greece, June 22-27, 2014, Proceedings, Part I*, Springer International Publishing, Cham, 2014, pp. 163-172.
- [19] D. McDonagh, I. Storer, Mood boards as a design catalyst and resource: researching an under-researched area, *Design Journal*, The, Vol. 7, Iss. 3, 2004, pp. 16-31.
- [20] W. Quesenbery, K. Brooks, *Storytelling for user experience*, Rosenfeld Media, Brooklyn, NY, 2010.
- [21] I. Michailidou, U. Lindemann, C. von Saucken, Extending the product specification with emotional aspects: *Introducing User Experience Stories*, 2013, ICED, Seoul, Korea.
- [22] J.L. Thompson, *Strategic management*, Chapman and Hall, London, 1994.
- [23] T. Adlin, J. Pruitt, *The Essential Persona Lifecycle: Your Guide to Building and Using Personas*, 1st ed. Morgan Kaufmann, Burlington, Mass, 2010.
- [24] A. Cooper, R. Reimann, D. Cronin, *About face 3*, [3. ed.], completely rev. and updated ed. Wiley, Indianapolis, IN, 2007.
- [25] *Metaphor design for user interfaces*, Conference Summary on Human Factors in Computing Systems, 1998, ACM.
- [26] C. von Saucken, I. Michailidou, U. Lindemann, Emotional mental model, 2013 IEEE International Conference on Industrial Engineering and Engineering Management, IEEE, pp. 802-806.
- [27] J.M. Carroll, Scenario-based design: Envisioning work and technology in system development, in: Anonymous (ed.), Wiley, New York, 1995, pp. 37-58.
- [28] I. Michailidou, C. von Saucken, U. Lindemann, How to create a user experience story, Springer, pp. 554-563.
- [29] U. Lindemann, *Methodische Entwicklung technischer Produkte*, 3 ed. Springer, Berlin, 2009, 309 p.
- [30] G.S. Altschuller, *Erfinden - Wege zur Lösung technischer Probleme*, in: Anonymous (ed.), Verl. Technik, Berlin, 1986.
- [31] C. von Saucken, J. Reinhardt, I. Michailidou, U. Lindemann, Principles for User Experience Design – Adapting the TIPS Approach for the Synthesis of Experiences 2013, pp. 713-722.
- [32] Buchenau, M., Suri, J.F, Experience prototyping. In: *Proceedings of the 3rd Conference on Designing Interactive Systems: Processes, Practices, Methods, and Techniques*.
- [33] U. Lindemann, T. Braun, M. Maurer, *Structural complexity management*, Springer, Berlin, 2009.

- [34] Why Does your Mobile App Idea Need a SWOT Analysis? <https://theappsolutions.com/blog/marketing/swot-for-mobile-app/> (Accessed January 10 2018)
- [35] 50MINUTES.COM, 50 minutes, The SWOT Analysis : Develop strengths to decrease the weaknesses of your business, Primento Digital, Brussels, 2015.
- [36] S. Khan How to check out the competition, <http://www.uxbooth.com/articles/how-to-check-out-the-competition/> (Accessed January 10 2018)
- [37] T. Hill, R. Westbrook, SWOT analysis: It's time for a product recall, Long Range Planning, Vol. 30, Iss. 1, 1997, pp. 46-52. <https://www.sciencedirect.com/science/article/pii/S0024630196000957> (Accessed January 11 2018)
- [38] B. Martin, B. Hanington, Universal Methods of Design, 1. publ. ed. Rockport, Beverly, MA, 2012.
- [39] A. Cooper, The inmates are running the asylum, 1. print. Sams, Indianapolis, Ind, 2004.
- [40] A. Cooper, About Face, 4. ed., Wiley, Indianapolis, IN, 2014.
- [41] A. Cooper, R. Reimann, D. Cronin, About face 3, 3rd ed., Wiley, Indianapolis, IN, 2007.
- [42] John S. Pruitt, Tamara Adlin, The Persona Lifecycle, 1st ed., Morgan Kaufmann Publishers Inc, US, 2006.
- [43] A. Cakir How To: Create A User Persona, <https://xtensio.com/how-to-create-a-user-persona/> (Accessed July 9 2017)
- [44] J.M. Carroll, Making use, MIT Press, Cambridge, Mass., 2000.
- [45] H. Beyer and K. Holtzblatt, Contextual Design: Defining Customer-Centered Systems. San Francisco (Calif.): Morgan Kaufmann, 1998.
- [46] K. Holtzblatt, J.B. Wendell, S. Wood, Rapid contextual design, Elsevier, Amsterdam, 2005.
- [47] D. Cox, S. Greenberg, Supporting collaborative interpretation in distributed Groupware, Proceedings of the 2000 ACM conference on computer supported cooperative work, ACM, pp. 289-298.
- [48] F. Geyer, U. Pfeil, A. Höchtl, J. Budzinski, H. Reiterer, Designing reality-based interfaces for creative group work, Proceedings of the 8th ACM conference on creativity and cognition, ACM, pp. 165-174.
- [49] B. Laugwitz, T. Held, M. Schrepp, Construction and Evaluation of a User Experience Questionnaire, in: Anonymous (ed.), HCI and Usability for Education and Work, Springer Berlin Heidelberg, Berlin, Heidelberg, 2008, pp. 63-76.
- [50] Hassenzahl M., Burmester M., Koller F. (2003) AttrakDiff: Ein Fragebogen zur Messung wahrgenommener hedonischer und pragmatischer Qualität. In: Szwillus G., Ziegler J. (eds) Mensch & Computer 2003. Berichte des German Chapter of the ACM, vol 57.
- [51] M. Schrepp User experience questionnaire handbook, http://www.ueq-online.org/#pkg_1367 (Accessed January 18 2018)

- [52] Suomen jääkiekkoliitto, <https://www.finhockey.fi/info/> (Accessed August 20 2017)
- [53] Finnish ice hockey leagues, <http://www.finhockey.fi/kilpailutoiminta/> (Accessed August 20 2017)
- [54] I. Suomen Jääkiekkoliitto ry: Jääkiekon virallinen sääntökirja 2014-2018, http://www.leijonat.fi/files/Jaakiekkosaannot/Jaakiekon_virallinen_saantokirja_2014-18.pdf (Accessed August 21 2017)
- [55] R. Laukkanen Suomesta oppia maailman jäähalleihin, <http://www.studiolumi.com/koke/uaitkn/jhallit.html> (Accessed August 21 2017)
- [56] M. Ludvigsen, R. Veerasawmy, Designing technology for active spectator experiences at sporting events, Proceedings of the 22nd Conference of the Computer-Human Interaction Special Interest Group of Australia on computer-human interaction, ACM, pp. 96-103.
- [57] G. Crawford, Consuming sport, 1. publ. ed. Routledge, London, 2004.
- [58] K. Battarbee, Co-experience: the social user experience, CHI '03 Extended Abstracts on human factors in computing systems, ACM, pp. 730-731.
- [59] M. Ludvigsen, Designing for Social Use in Public Places – a Conceptual Framework of Social Interaction, Proc., pp. 389-408.
- [60] S. Fairley, In search of relived social experience: Group-based nostalgia sport tourism, Journal of sport management, Iss. 17, 2003, pp. 284-304.
- [61] R.E. Rinehart, Players all, Indiana Univ. Press, Bloomington, 1998.
- [62] J. Clarke, Football and working class fans: traditions and change, Ingham, R. (Ed.), Iss. Football Hooliganism: The wider context, 1978, pp. 37-60.
- [63] S. Redhead, Post-fandom and the Millennial Blues: Transformation of Soccer Culture, Routledge, 1997.
- [64] R. Likert, A technique for the measurement of attitudes, Univ, New York, 1932.
- [65] K. Pernice UX Prototypes: Low Fidelity vs. High Fidelity, <https://www.nngroup.com/articles/ux-prototype-hi-lo-fidelity/>
- [66] J. Nielsen Thinking Aloud: The #1 Usability Tool: <https://www.nngroup.com/articles/thinking-aloud-the-1-usability-tool/> (Accessed September 6 2017)
- [67] L. Inkeroinen, Personas for Tappara application, 2017.

APPENDIX 1: BACKGROUND QUESTIONNAIRE

1. Gender M F

2. Age 18-22 []
 23-29 []
 30-35 []
 35-40 []
 40-45 []
 45+ []

3. Occupation

4. How comfortable do you feel when using a smartphone?

Very uncomfortable Comfortable

1 2 3 4 5

5. During the last (2016-2017) season, how many ice hockey games did you watch live in a stadium / outdoors?

0 1 2 3-5 6-9 10-15 15+

6. During the last (2016-2017) season, how many ice hockey games did you watch from TV or online?

0 1 2 3-5 6-9 10-15 15+

7. On a scale from 1-5 from not interested to hardcore fan, how would you describe your relationship with ice hockey?

Not interested Hardcore fan

1 2 3 4 5

8. Do you feel you know fully, what's happening in the game when watching it live?

Never All the time

1 2 3 4 5

9. How often do you purchase food/drinks at the stadium?

Never Every game

1 2 3 4 5

10. Have you used the previous TapparaApp mobile-application?

Yes

No

11. Have you participated in existing stadium games (such as Tapsupeli in Hakametsä ice hockey stadium)?

Yes

No

If yes: Which games, where?

12. What of the following have you purchased from the stadium?

Alcoholic beverages

Beverages (non alcoholic)

Food

Fan items

Tickets

13. What kind of methods have you used for buying your tickets?

Online

From the stadium when you go to the game

From the stadium beforehand

Other, what _____

APPENDIX 2: INTERVIEW QUESTIONS

1. (If has used the previous TapparApp) What do you think about the existing TapparApp? What is best, what could be improved?
2. Have you read/watched statistics about ice hockey games?
(Do you do it often? When do you do it)
3. Why do you go to ice hockey games? (Do you go alone, what is the best feeling?)
4. Have you ever tried to acquire additional information during a live game? (Why? How did you do it?)
5. What are the things that you would've wanted clarified (Depending on the answer to question about if they feel they know what's going on)
6. How do you feel about the ticket buying process?
7. How do you feel about purchasing food and beverages on the stadium? (What's good, what's bad, how could it be enhanced?)
8. What is best about the stadium experience?
9. What is worst about the stadium experience?
10. Does watching a game in company (friends, family, or such) affect the experience? How?
11. What do you do with your friends/company before or during watching the game?
12. What are the best things about watching a game together in company?
13. Are there some requirements for you to enjoy watching a game in company? (For example about the environment, about other viewers, additional services...)
14. How do you feel about the games in stadium environment, is there difference compared to watching from eg. tv?
15. Do you look at the video screen cube during games? What do you think about it? What is the most important information you get from the media cube?

16. Does anything else come to mind about the stadium experience?

APPENDIX 3: STRUCTURE OF THE PROTOTYPING SESSION

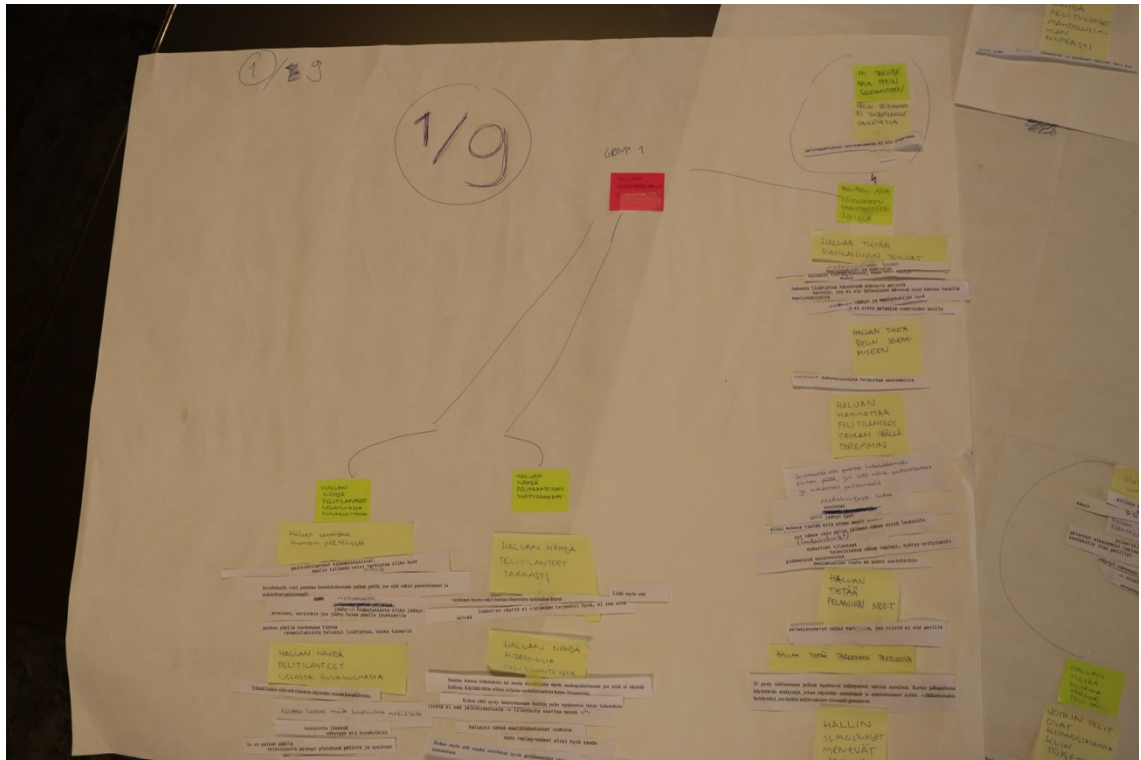
Prototyping using inVision prototype. Used on an iPhone. User completes tasks using think-aloud method.

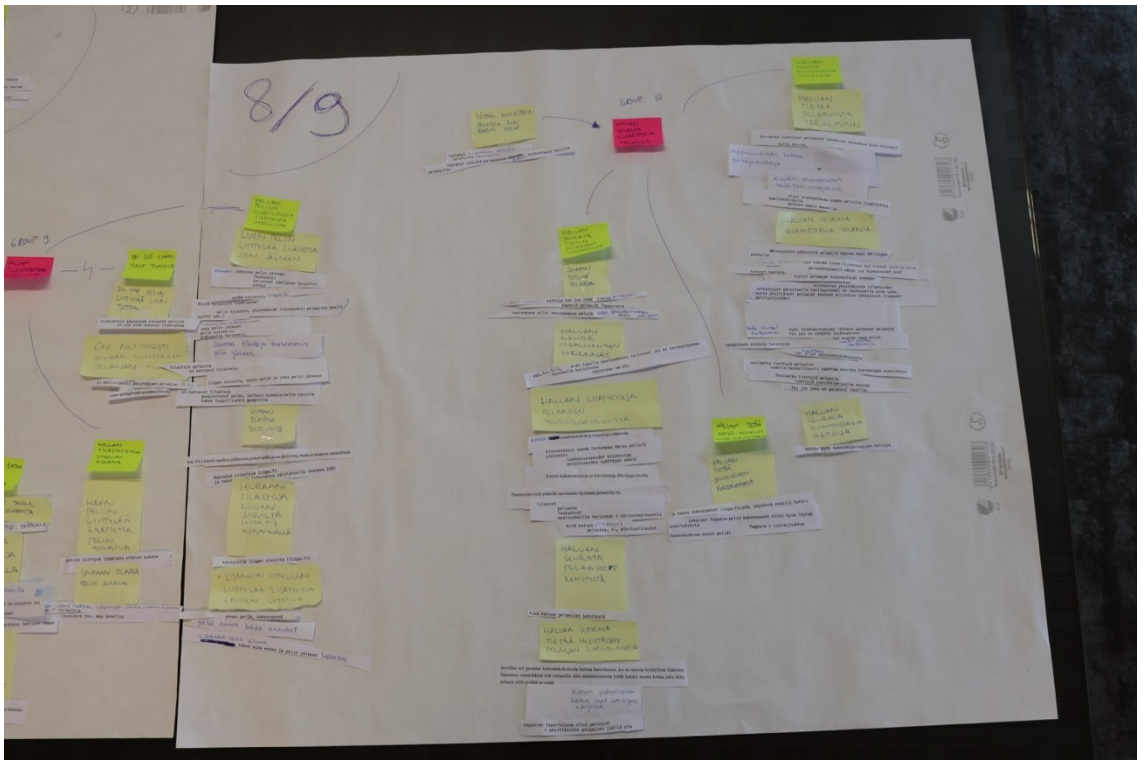
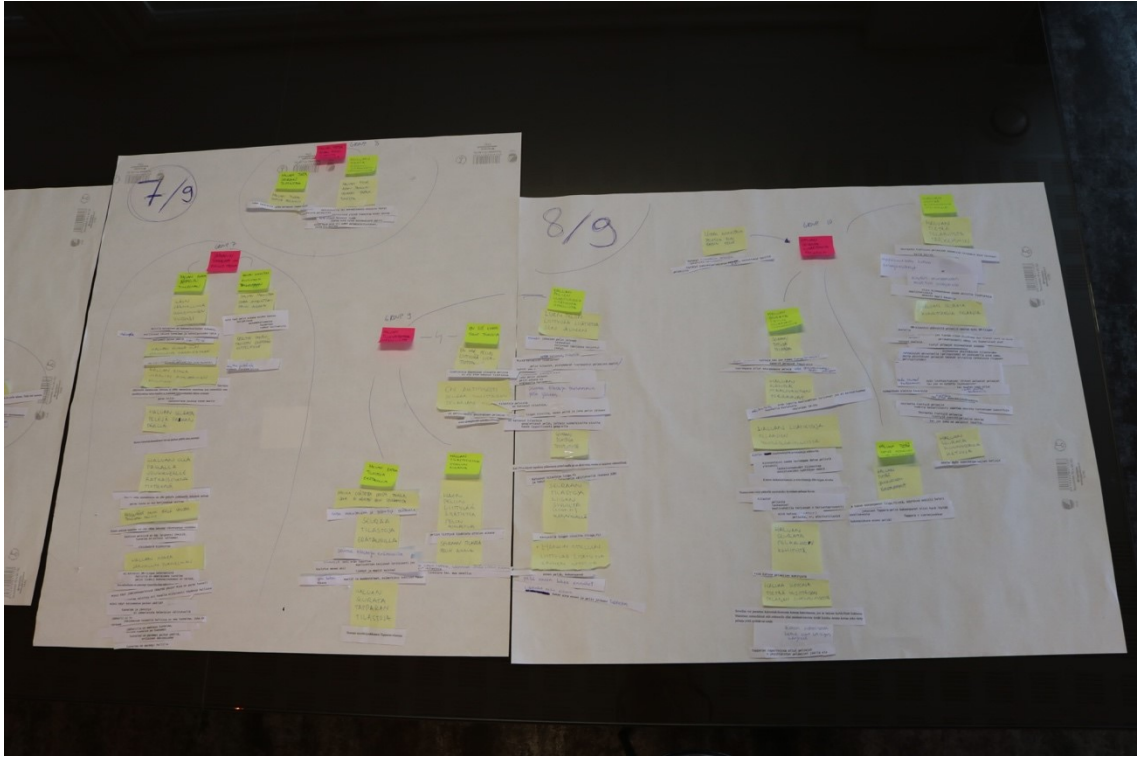
5. Register to the application
6. Order 12 pieces of wings with hotness setting “hot”
7. Find the overall amount of points player Aleksi Elorinne made this season
8. Find the score of ongoing game Kärpät-HIFK
(Now were going to pretend someone just shot the puck really fast on the ice. Here you can see a what kind of notification you would get from the application. [Show screen])

Questions after test:

9. Would you be interested in seeing these kinds of notifications during a game? Why? Why not?
10. Do you feel these kinds of messages would be disruptive during the game? Why?
11. Do you feel this kind of application could enhance your stadium experience? Why?
12. What do you think is best in this application? Why?
13. What do you think was the worst about the application? Why?
14. Would you recommend this application for your friend?

APPENDIX 4: IMAGES OF THE CONSTRUCTED AFFINITY WALL







APPENDIX 5: WRITTEN OUT AFFINITY NOTES

Figure 32. The written out affinity notes

Theme 1	I want video material from the play situations
1	I want to see the play situations from multiple angles a. I want to be sure of the referee's calls (4) b. I want to see the plays from multiple angles (4)
2	I want to see the details of the play a. I want to see the plays accurately (2) b. I want to see slow motion replays of the play situations (6)
3	I want help in understanding the play situations when watching live a. I want to know which players made the decisive plays (5) b. I want support for following the game (1) c. I want to perceive the play situations more clearly when watching live (6) d. I want to know the numbers (on jerseys) of the players (1) e. I want to know more about the tactics (1) f. Sometimes I miss the announcements from the loudspeakers (1)
4	I do not need help when following the game a. Following the game is not difficult for me (1)
Theme 2	I want to tie the current match into a bigger picture
5	I want to tie the match to a bigger picture
6	I want to know how important the match is a. Some games are more interesting than others (1) b. The quality of games varies (from early season to playoffs) (1)
7	I want to know the rankings between teams a. I want to follow statistics between teams (1) b. I want to know the rankings of all teams (3)

Theme 3	I want information about the game in real time
8	I want to know the score in real time <ul style="list-style-type: none"> a. I want to know the situation of the game in real time (5) b. I want to see the score of the game as soon as possible (1)
9	I want to know how much time there is left in the game (5)
10	Sometimes I want to keep the score of the game hidden from myself (1)
11	I want to know the result of the game (2)
Theme 4	I want advice on what to follow in the game
12	I need advice on what to follow ingame <ul style="list-style-type: none"> a. I want to get information about what to follow ingame (8) b. I do not want to miss decisive moments in the game (1)
13	I want to see the most interesting parts of the game <ul style="list-style-type: none"> a. I do not want to watch a game that already seems lost (1) b. I want to do other things while watching the game (2)
14	I want to decide myself, what to follow ingame
Theme 5	I do not want to expend effort to practical issue
15	I do not want to go through trouble regarding the tickets <ul style="list-style-type: none"> a. I do not buy tickets myself (4) b. I want the purchasing of the tickets to be as easy as possible (2)
16	I want to watch the games with as effortlessly as possible <ul style="list-style-type: none"> a. I watch ice hockey from television (2) b. I want to be able to watch ice hockey as effortlessly as possible (4) c. I do not want to go through trouble to watch icehockey (2) d. I want a comfortable viewing environment (4) e. I want viewing ice hockey to be affordable (1)

17	<p>I want good seating in the arena</p> <ul style="list-style-type: none"> a. I want to know what kind of seats are available at the arena (2) b. The location of the seating affects my viewing experience (3)
18	<p>I want running errands at the arena to be as smooth as possible</p> <ul style="list-style-type: none"> a. I want to know the menus of the restaurants in the arena (1) b. I want getting to the arena to require less effort (2) c. The arena gets crowded during intervals (1) d. I do not like navigating in crowds (2) e. I do not want to feel like I'm in a rush during intervals (1) f. I do not want to queue to restaurants or other services (10)
Theme 6	I want the applications content to be up to date and easily obtainable
19	I do not want advertisements in the application (2)
20	I want interesting content in the application (3)
21	I want the player pictures to be up to date (1)
22	I have not used any teams' applications before (4)
23	The existing software have not appeared useful (2)
24	I want the software to be easily learnable (4)
Theme 7	The atmosphere of the arena is important to me
25	<p>I want to feel the atmosphere in the arena</p> <ul style="list-style-type: none"> a. I go to the games because of the experience (in the arena) (3) b. I want to hear the chants (1) c. I want to feel the rush and excitement when a goal is scored (2) d. I want to view the games live (1) e. I want to be present during the decisive moments for the team I'm rooting for (2) f. The amount of spectators affects the atmosphere in the arena (3) g. I want to feel the atmosphere in the arena (10)
26	<p>I want to have a positive effect in the arenas atmosphere (3)</p> <ul style="list-style-type: none"> a. I want to cheer on my favorite team during the game (1)

	b. I focus on chanting more in home games (1)
Theme 8	I want to be up to date about the status of my favorite team
27	I want to support the efforts of the team a. I want to support players I know (1)
28	I want information about the events of my favorite team a. I want to keep up to date with the events of the team (4)
Theme 9	I want statistical data about the match
29	I want to see statistical data during intervals a. I want information about the game in a way that does not affect my concentration when following the game (1) b. I check statistical data during intervals (3) c. I follow statistics of Tappara (1)
30	I want statistical data during games a. I fetch extra information about the game during the game (1) b. I follow statistics about the game during the game (2)
31	I want statistical data about the game before/after the game a. I read information about the game after the game (9) b. I follow statistics from teksti-tv (after games) (2) c. I follow statistics from www.liiga.fi with a mobile device after games (1) d. I fetch data of the game before the match (3)
32	I'm not interested about the statistics a. I do not fetch statistical data about the game (1) b. I do not actively follow any player's statistics (2)
Theme 10	I want to follow interesting players

31	I find interesting new players when I watch games (2)
32	<p>I want to follow a particular player's success</p> <ul style="list-style-type: none"> a. I follow players that I know (3) b. I want to see the amount of goalkeepers saves (1) c. I want to see additional data about the individual performances of players (6) d. I want to follow players progress' (1) e. I want to know about particular players performance in a game (when I ca not attend the game) (3)
33	<p>I want to know, which players are in the line up in a game</p> <ul style="list-style-type: none"> a. I want to know the line ups of the teams (3)
34	<p>I want to find interesting players</p> <ul style="list-style-type: none"> a. I want more details about players (4) b. I want to follow interesting players (11) c. I want to follow interesting lines (1)
Theme 11	For me, watching ice hockey is a social event
35	<p>I want to have a conversation about the game during the game</p> <ul style="list-style-type: none"> a. I ask fellow viewers information about the situation in the game (3) b. I converse about the events in the game during the game (7)
36	<p>I watch the games with others</p> <ul style="list-style-type: none"> a. I want to watch games in company (6) b. I want to discuss topics unrelated to the game during the game (2) c. Besides watching ice hockey, watching the game is a social event (6) d. I do not like ice hockey as entertainment (1) e. I want to spend time with my friends (1)
37	<p>Watching games live in the arena affects my social relationships</p> <ul style="list-style-type: none"> a. I want to meet the players of Tappara (1) b. I meet friends during the game (1) c. I get acquainted with new people during games (1)

38	<p>I do not want my focus to be disturbed</p> <ul style="list-style-type: none"> a. When watching a game in company it may negatively affect following the game (2) b. I want to concentrate following the game (2)
Theme 12	I want to watch the games in pleasing company
39	<p>The company I watch games in affects my viewing experience</p> <ul style="list-style-type: none"> a. My social relationships dictate how much I follow ice hockey (1) b. The atmosphere depends on the company (9) c. Viewing the game in company is a more intensive experience (1)
40	<p>I watch games also alone</p> <ul style="list-style-type: none"> a. I may watch games alone (2)

APPENDIX 6: EXPERIENCE GOALS OF SPECTATORS

Experience and end goals of an occasional visitor

Experience goals

Wants to have a good time at the arena

Problems:

- Is not aware of the arena's schedule for the night
- Has to through trouble with the tickets
- It may be difficult to find a parking spot
- It may be difficult to find seating and to navigate there in the arena

Wants to feel the atmosphere of the arena

Problems:

- Bad seating
- Too much hassle to even go watch the game live
- No likeminded company to view the game (does/does not want to talk during the game, wants/does not want to talk about topics not related to the game)

Wants to spend time in company (friends, family)

Problems:

- Cannot get seating next to each other
- Has to queue to services in arena (ruins for example dinner time)
- Has to queue to bathroom

Wants the errands he has to run at the arena to cause no hassle

Problems:

- Getting and handling tickets requires effort
- Hard to find parking
- It's difficult to find toilets
- Splitting the bill at the restaurant requires effort

End goals

Wants to spend time with family and friends

Wants to eat and drink at the arena

Wants to find the services in the arena (menus and locations of the restaurants)

Wants to know what to follow in game

Wants to know what's happening in game

Wants to see (slow motion) replays about game events

Life goals

Wants topics for conversation

Wants to upkeep social relationships

Wants pleasurable experiences

Experience and end goals of an avid fan

Experience goals

Wants to know everything about the game

Problems:

- Seating with bad visibility
- May miss announcements coming from loudspeakers
- Information has to be gathered from several different locations (websites, teksti-tv)

Wants to feel the rush of winning

Problems:

- Can not get to the arena
- No tickets available
- Viewing company not interested in the game with the same enthusiasm and does not have enough knowledge to hold a conversation
- Crowd is not enthusiastic about the game

Wants to focus on the game

Problems:

- Company wants to talk about topics unrelated to the game
- Phone disturbs viewing (sounds, notifications)
- Hungry or thirsty during the game

Wants to be part of the (fan) community

Problems:

- Only few fans at the arena
- If not already part of the fan community, it may be difficult to join the community for the first time

End goals

Does not want to miss (important) game events

Problems:

- Has to spend time queuing to the services in the arena
- Bad visibility from seating
- Impossible to follow all the events at the rink simultaneously

Wants statistical data about their favorite team

Problems:

- There is not a service where all the important information would be gathered
- No easy access to statistical data

Wants to support his/her favorite team

Problems:

- Does not know how the organization can be supported (besides from cheering)
- Does not know where to spend money (which services actually bring money Tappara)

Wants to cheer on their favorite team

Problems:

- Too few fellow fans attending the game in arena (atmosphere lacklustre)

Wants to control what he/she focuses on when viewing the game

Problems:

- Ca not follow everything simultaneously
- It's difficult to see everything because of bad seating

Experience and end goals of a home viewer

Experience goals

Wants to follow games with as little effort as possible

Problems:

- Services where you can follow cost money
- Not enough energy and/or interest to take action

Wants a comfortable viewing environment

Problems:

- Seating in arena is not comfortable
- Ca not enjoy all beverages or foods during the game

End goals

Wants information about the ongoing game's events

Problems:

- Ca not follow the game from television because he/she has to be elsewhere

Wants to engage in other activities while following the game (does not mind if misses some game events)

Does not want to follow games that already seem lost