



UNIVERSITY OF GOTHENBURG



# **Extending Sports Broadcasts**

Designing a Second Screen Interface for Live Sports Broadcasts

Master's thesis in Interaction Design and Technologies

## ALEXANDER KARLSSON & MATTIAS JOHANSSON

Department of Computer Science and Engineering CHALMERS UNIVERSITY OF TECHNOLOGY UNIVERSITY OF GOTHENBURG Gothenburg, Sweden 2019

MASTER'S THESIS 2019

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Cover: Illustration of the SVT Duo Ice Hockey World Championship application in front of an ice hockey broadcast.

Extending Sports Broadcasts Designing a Second Screen Interface for Live Sports Broad-casts ALEXANDER KARLSSON & MATTIAS JOHANSSON Department of Computer Science and Engineering Chalmers University of Technology and University of Gothenburg

## Abstract

The purpose of this paper was to research the use of second screen applications for live sports broadcasts as well as providing guidelines for how to design such applications from a UX perspective. In this study, a prototype of a second screen application was developed and tested live during the 2019 IIHF Ice Hockey World Championship broadcasts by Sveriges Television (SVT) in Sweden.

In this project a background study was made researching current studies within the area. Furthermore user studies were conducted, which were used in order to produce several different prototypes. User data was gathered with the help of the final prototype that was released to the general public, and was analyzed with the help of web analytics tools, providing insight in user needs and behaviour during and between live sports broadcasts.

The project was done in close collaboration with SVT utilizing their already existing knowledge of their viewers, extensive technical platforms, widespread outreach and user base for second screen applications.

Keywords: second screen, live sports, companion application, UX, broadcast synchronization, ice hockey.

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Alexander Karlsson and Mattias Johansson, Gothenburg and Mexico City, June 2019

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# 1 Introduction

A phenomenon that is growing in popularity is the use of a second electronic device while watching television programs, referred to as a second screen. Using a second screen while watching sports broadcasts is on the rise, but there is currently a lack of understanding of its use (Cunningham and Eastin, 2017). There are many current attempts of second screen applications for sports, such as live score applications and league specific applications, but generally these are not synced with the broadcast the user is watching, as any broadcast or stream has delays which the apps usually do not. As a result these apps can cause issues such as the user receiving information before it appears in their broadcast, which spoils the pleasure of the viewer (Nakamura and Komatsu, 2012). Sveriges Television (SVT) offers a second screen app, SVT Duo, which does sync with the broadcast and adjusts for any delays that occurs during televised broadcasts or streams. This app is now in use for various programs broadcasted by SVT mainly focused on entertainment shows, but does not currently offer a second screen interface for sports broadcasts. This project aims to develop a synced SVT Duo based second screen interface for use during sports broadcasts, in order to raise the viewer experience and engagement during live sports broadcasts.

## 1.1 Research problem

Second screen interfaces during sports broadcasts are becoming more and more popular, however according to Cunningham and Eastin (2017) understanding of its use and engagement is currently lacking. This project aims to define guidelines and develop a prototype for a second screen interface which will be evaluated during live sports broadcasts, with a focus on Ice Hockey in particular. The reason for the specific focus is due to SVT broadcasting the 2019 IIHF Ice Hockey World Championship, allowing for the prototype to be tested with a large amount of users. For this, the type of information suitable for such an interface will have to be defined and evaluated. Furthermore it would have to be examined how this information can be presented in such a way that the user does not feel distracted from the main broadcast while still offering a meaningful information source which improves the viewer experience.

#### 1.1.1 Viewers and users

While many projects within the field focus on the user experience, this project aims to enhance the viewer experience. This distinction is made to clarify that the aim is not just to create a good experience when using the application, but rather to enhance the TV viewing experience as a whole. The application should be a complement tying to the broadcast giving the viewer a better experience in the context of watching the game, rather than just being a separate tool, albeit well designed.

## **1.2** Research questions

- What design guidelines can be recommended when designing a second screen interface for sports broadcasts in order to improve the viewer experience?
  - What type of information suitable for a second screen interface are viewers of sports broadcasts currently interested in acquiring, and what is their motivation for acquiring such information?
  - What design guidelines can be recommended for balancing the attention between the primary and second screen so that the second screen does not negatively impact the experience of the primary screen?

## 1.3 Stakeholders

#### 1.3.1 Sveriges Television

This project will be done in collaboration with SVT, which is the national public service television broadcaster in Sweden. SVT offers a second screen application, SVT Duo, which can be used for various popular programs and provides a way for the viewers to be involved in a broadcast. The app can be synchronized to the broadcast via audio synchronization, meaning that no matter if you watch the broadcast live or not, you will be able to sync what is happening in the broadcast to what is presented in the app. As the current services in SVT Duo mostly focuses on gamification of different shows, they now want to explore the possibilities of offering a second screen experience for sports broadcasts.

#### 1.3.2 SVT Duo developers

The current developers of the SVT Duo app are responsible for the base application used in this project and as such any modifications to the application. In this project they will be the main advisors when discussing the technical platform, as well as providing guidelines for current SVT Duo modules and how these can be applied to this project. Any modifications necessary for the project in the base application will be performed by the SVT Duo developers.

#### 1.3.3 Viewers of ice hockey broadcasts by SVT

Both viewers with and without the second screen application are potential stakeholders, as it is possible that SVT will choose to move certain information from the TV broadcast to the second screen application. While this is not guaranteed, the possibility of it means the viewers not using the second screen application should be considered as stakeholders as they might miss out on information due to the application.

## 1.4 Purpose

To investigate the role of second screen applications for sport events and how it can enhance viewer experience with respect to providing additional information and further interactivity, trying to cover the needs of multiple types of viewers.

## 1.5 Scope

In this project a second screen application will be developed for mobile devices. This application will be tested live during the 2019 IIHF Ice Hockey World Championship games which will be broadcasted live by SVT. The project will focus on a design for smartphones, with no specific tablet interface developed apart from minor adjustments. An interface will be created for the client application within the SVT Duo platform, which will be communicating with a hosting server providing the application with data gathered from third party data providers. The hosting server might also be manually handled as an editorial tool for providing the application with custom content, such as polls.

The ambitions are that the product could be adapted to other future sport events not limited to ice hockey, however in the scope of this project only an application for ice hockey will be developed. The foundation application, SVT Duo, as well as the audio recognition technique that is used within the application for synchronizing with the broadcast will not be further modified by the writers in this project. As the final product of this project will be added as a module within the already existing application, any modifications done to SVT Duo will be performed by the developers of the application. Furthermore the application will mostly focus on information flow, where some social aspects may be included such as polls during the game and also a competition for guessing the outcome of individual games. This could include a social aspect where the user would compete against friends and various TV profiles within SVT.

## 1.6 Ethical issues

Since the project will be done in collaboration with SVT, the result of this project will have to take into consideration all stakeholders that will be affected by the final product, such as the producers. Additionally, the developers of SVT Duo will have to be considered for further development and maintenance of the product.

As the project result introduces an application which will be used in a context where tablets and smartphones has not been used traditionally, a new dependency is introduced for using these products. Our reliance of such products in our daily lives and how it can affect our attention spans is a highly discussed topic (Carr, 2011), and as such this will need to be considered during the project.

Considering that the evaluation throughout the project will be made with real users in collaboration with SVT, it is important that the handling of that data will be done with respect to the integrity to the testers and within the rules of GDPR (European Union, 2016).

Due to SVTs role as a public service provider special consideration will have to be taken to ensure that the developed design falls within the public service mission outlined in SVTs broadcasting permission (SVT, 2014). This means special focus will need to be taken to ensure that the design helps SVT in providing products for a wide range of users, with democratic and humanisitic values and available to all users regardless of their background.

# 2

## Background

## 2.1 Second screen applications

#### 2.1.1 Definitions

Research of previous works involving second screen applications has provided several definitions for what second screen applications actually are and their use (Geerts et al., 2014; Tussey, 2013; Cesar et al., 2008; Cunningham and Eastin, 2017). Certain definitions such as the one given by Cunningham and Eastin (2017) and Cesar et al. (2008) simply includes using a handheld device while watching TV:

"A second screen is defined as a second electronic device used by audience members while watching a television program" (Cunningham and Eastin, 2017, p. 1)

"In this article, we consider the sphere of the user as a television set, connected to a personal video recorder or a set-top box, and his handheld device. The handheld device acts as a secondary screen providing both rendering and interaction capabilities." (Cesar et al., 2008, p. 169)

In other definitions, second screen applications are also called companion applications, where a central aspect is that they are synced with what is displayed on the primary screen. A central aspect is that it aims to add information that for some reason do not have a place in the primary screen, and are often socially motivated in the sense that it invites the viewers to engage with each other. The definition provided by Holmes et al. (2012, p. 397) is as follows:

"Second-screen applications are intended to enhance the viewer's experience by providing additional show-related information, access to social networks to support "social viewing," and interactive experiences synchronized to program content such as polls or quizzes."

In this project we wish to include such companion applications. We do however want to emphasize certain aspects, such as the synchronization to the broadcast and the content acting as an extension of the primary screen. Furthermore aspects such as social media, which is included in certain definitions will be omitted in our definition of a second screen application. Although it is common to include social media, it is not considered a rudimentary part of what could be considered second screen applications by the writers of this report. Based on this we have defined the following definition of what second screen applications are in relation to this project:

"A second screen application is an application for handheld devices that aims to enhance a televised broadcast through synchronized content which allows for extended information flow and provides interactive viewing experiences."

### 2.1.2 SVT Duo

SVT Duo is a mobile application owned by SVT which is used as a second screen application for various TV shows aired by SVT, such as the game show På spåret. SVT Duo as of now mostly focuses on gamification of different supported SVT programs, as can be seen in figure 2.1 and 2.3, or as a means for participating in polls for different events, as can be seen in figure 2.2. For example, since På spåret is a game show it is therefore rather intuitive to include the user as another participant, competing both against friends and the participants in the broadcast.

The application syncs to the program with audio recognition, meaning that you can play the different games anytime you want as long as you have access to an episode of any of the supported shows in the SVT Duo application. Furthermore it is possible to sync the application both to a televised broadcast and an online stream.



**Figure 2.1:** A game synced with the quiz show På spåret in the SVT Duo application

Figure 2.2: Voting for athletes nominated for a prize at Idrottsgalan (Swedish Sports Award)

Figure 2.3: A game based on the musical quiz show Så ska det låta in SVT Duo

## 2.2 Live score applications

A type of application that will share many similarities to the application developed in this project will be live score applications. The purpose of these applications, unlike the application that will be developed in this project, is mainly to follow matches the user is not currently watching and find information about previous and future matches. Apart from live scores these applications often feature statistics for each match, as well as statistics for each team and player. Certain such apps aim to cover multiple sports and leagues, whereas other applications aim to deliver content only for a certain sport or league.

These apps are in general not considered second screen applications using the definition defined in this project, as they are not generally synchronized with a broadcast. This causes issues such as important information like goals reaching the user before it appears in the users broadcast, which spoils the pleasure of the viewer experience (Nakamura and Komatsu, 2012). This is because broadcasts and streams has delays that these apps do not, meaning a broadcast is never truly live. Two examples of such applications will be described in the sections below.

#### 2.2.1SofaScore

SofaScore is a live score application designed for multiple sports and leagues, including ice hockey and IIHF's competitions. The app delivers live scores and statistics for matches (see figure 2.4), as well as statistics such as league tables and point leagues. Each match features detailed statistics for the game (see figure 2.5). These statistics include information such as amount of shots, tackles and penalty time. The application includes player profiles (see figure 2.6), with information such as games played in different seasons, shots made, minutes played, and physiological information such as length, weight and age. The app also features schedules for future matches, results from previous matches and video highlights for certain matches.

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from SofaScores match overview

Figure 2.4: Screenshot Figure 2.5: Screenshot Figure 2.6: Screenshot from SofaScores match statistics overview

from SofaScores player overview for one season

#### 2.2.2 2019 IIHF

The 2019 IIHF application is the official application for the 2019 IIHF Ice Hockey World Championship amongst other championships hosted by IIHF such as the IIHF World Junior Championship. The application provides information about the different teams, their players, statistics, the team's previous medals, and highlights from previous games from the current competition. Additionally, it offers some indepth information about individual players and their careers (see figure 2.7). The application also provides a calendar for games played and future games that are going to be played, both team specific and universal for the whole tournament. Further they have integrated social media into the application and it is possible to connect your social media in order to be able to guess game results, which they can receive points for (see figure 2.8). As the user connects via a social media account, they compete both against their friends but also globally against all other users that participate in the result guessing game.







## 2.3 IIHF Ice Hockey World Championship

The International Ice Hockey Federation (IIHF) World Championship is an annual international tournament in men's ice hockey. In the tournament 16 countries com-

pete in the highest division, with the winner being titled world champions. The tournament consists of a group phase and knockout stage. In the group phase the teams are divided into two groups of eight teams where all teams in the group play each other once. The top four in each group proceed to the knockout phase where teams face each other starting in a quarter final, and winners of each match proceed to the next stage until the final is played. Furthermore the losers of the semi-final face off in a bronze medal match (IIHF, 2018b).

The Swedish broadcasting rights for the competition is currently shared between SVT and Modern Times Group, with each company broadcasting alternating biannually. The competition in 2019 will be broadcasted by SVT (Tolén, 2017).

## 2.4 Current information flow in ice hockey broadcasts

The following section will describe the information currently presented on the TV screen during a typical ice hockey broadcast. The information gathered here will be based on observations from the 2019 IIHF World Junior Championship (IIHF, 2018a) broadcasts by SVT and the 2018 NHL matches broadcasted by Viasat in Sweden.

#### 2.4.1 During gameplay

Throughout the match the current time and score are always displayed, along with possible power play timers. Other than that, the flow of information often comes when events occur, such as when a player gets penalized. The information provided is often quite narrow, which opens up room for extension in a second screen application. The table and figures below specify what type of information is currently often shown during certain events.

| Event                   | Graphics display                        | See figure |  |  |  |
|-------------------------|---|------------|--|--|--|
|                         | Animation indicating goal scored        |            |  |  |  |
|                         | Player and team who scored goal         |            |  |  |  |
| Cool                    | Player who assisted the goal            | 20.210     |  |  |  |
| Goal                    | Time of goal                            | 2.9; 2.10  |  |  |  |
|                         | New score                               |            |  |  |  |
|                         | Replay                                  |            |  |  |  |
|                         | Current time remaining of period        |            |  |  |  |
|                         | Current score                           | 9.11       |  |  |  |
| During general gamepiay | Current period                          | 2.11       |  |  |  |
|                         | Time remaining of any current penalties |            |  |  |  |
|                         | Player getting penalty                  |            |  |  |  |
|                         | Time of penalty                         |            |  |  |  |
| Penalty                 | Reason for penalty                      | 2.12; 2.13 |  |  |  |
|                         | Power play and box play statistics      |            |  |  |  |
|                         | Replay                                  |            |  |  |  |
| Pulling goalie          | Text showing that net is empty          | 2.14       |  |  |  |



Figure 2.9: Animation of goal event for Finland



Figure 2.11: Graphic displaying that Kazakhstan has a power play and how long time remains of it



Figure 2.13: Graphic displaying the name of a player getting a penalty, with the reason for the penalty and time of the penalty



Figure 2.10: Graphic displaying the recent goal, its scorer and the time of the period it was scored



**Figure 2.12:** Graphic displaying Kazhakstans powerplay statistics



Figure 2.14: Graphic displaying that the net is empty for Finland

## 2.4.2 Before, after and during breaks of the match

During breaks and before and after the game in the broadcast a studio discussion is often held, often discussing the current game, previous games and tournaments, and the teams' strategies. Furthermore interviews and player profiles are common, which could both be directly connected to the match and be more general player presentations. Discussion regarding the current table and possible effects of the outcome of the game is often discussed, and other relevant games can be highlighted.

Before the game the players of each team are presented, showing which player plays in which line (consisting of five players) and highlighting any injuries or suspended players. During power breaks and period breaks an expert analysis of the current game is often made, which could include discussion about strategy or rule interpretation. Discussions during power breaks are often short and focused around a certain player or event, whereas period breaks often includes a more general analysis of the game. Furthermore at the start of period breaks and after the game has ended player and coach interviews are often held regarding the outcome of the game or period.

## 2.5 Ice hockey statistics

In ice hockey, players are often divided into skaters and goaltenders, and the way of measuring their performance is different. For skaters, their goals and assists are accumulated into so called points, while a goaltender has a save percentage, measured by the amount of saves in relation to the total amount of shots on goal by the opposing team. Further, skaters are also measured by the amount of penalty inflicted minutes that they have received when committing a rule breaking action. However, this statistic is independent of the amount of points, and thus does not regulate the points league. If two players share the same amount of goals and assists, then they are internally compared where the player with the least amount of played games is benefited. In case they have played the same amount of games, a further comparison is made on when the players scored their first goal.

Many different types of statistics exist on a team based level. Some of these are aggregated values of the personal statistics discussed above such as total save percentage and goals, while other statistics are purely team based. Such statistics include statistics relevant to the calculation of the winner in the tournament, such as won games and gathered points, while other values that are recorded are purely for statistical purposes. These statistics include power play percentage, which is a calculation of the amount of goals scored per power play, with a corresponding box play percentage which calculates the amount of box plays where no goal was conceded.

These statistics are often presented in tables where the statistics can be compared between teams and players. Common tables includes point leagues for skaters, save leagues for goaltenders and the total table comparing teams' power play statistics. All the mentioned statistics and leagues are recorded by many sources, including official statistics by IIHF during the World Championship (IIHF, 2019).

# Theory

## 3.1 Design theory

In this section, design theories will be presented where the aim is to have a humancentered design focus, which we base on the definition provided by International Organization for Standardization (2010):

"Human-centred design is an approach to interactive systems development that aims to make systems usable and useful by focusing on the users, their needs and requirements, and by applying human factors/ergonomics, and usability knowledge and techniques. This approach enhances effectiveness and efficiency, improves human well-being, user satisfaction, accessibility and sustainability; and counteracts possible adverse effects of use on human health, safety and performance."

Oviatt (2006) further argues that users historically have been the ones who have had to adapt to a technology-driven system, rather than the system being designed for the users. Human-centered design aims to create a system where the design of the interfaces are intuitive, and does not in most cases require a steep learning curve.

#### 3.1.1 Affordance and pliancy

When designing an interface, it is important that elements clearly communicate how they can be interacted with. Cooper et al. (2014) speaks about the term *affordance*, which should communicate the properties of an element and how it could be used, while *pliancy* refers to communicating visual feedback to the manipulation of that element. Cooper et al. (2014) further describes affordance as a cognitive concept, and that affordance comes from a mental connection to an object. The action of interacting with that object may not be what is expected, but as long as the user understands how to use it, it has successfully communicated its affordance. To better communicate the action of an object, sometimes supplementary information needs to be provided. For example, a user might understand how to interact with a button, but its effect likely needs to be complemented with an explanatory text. When a user has decided to perform an action, it is its pliancy that communicates its state and possible manipulations. Introducing the term direct manipulation which is helped by pliancy, Cooper et al. (2014) explains that an object should show visible results of an action. In the case of a drag-and-drop action, its pliancy is to visually indicate its drop candidates in order to communicate to the user where an object can be dropped, and the appropriate system response should occur. Certain tools for pliancy can be a challenge to include when designing touch-based interfaces as many options such as cursor hinting and tooltips are not available in the same form (Cooper et al., 2014).

#### 3.1.2 Designing companion apps

Second screen applications that are synced with broadcasts, also called second screen companion applications, are on the rise according to Geerts et al. (2014). Likewise, not much is known about their use and place. Geerts et al. (2014) has made an attempt of defining guidelines for how to design a successful second screen application. One of their findings was that while these sort of applications raise the viewer experience, it also acts as a distraction from the primary broadcast. Further, they conducted user tests with several different second screen applications, and evaluated several categories of the design. The first category that they tested was ease of use, which mostly focuses on how easy the application can be discovered and accessed. Another category tested was timing, in which they could identify different related issues, where a reoccurring theme was that the test subjects found well synchronized content on the second screen important and got easily annoyed by poor synchronization. Further, the feature to go back and review content during the broadcast was something that the test subjects found important. However this lost relevance after the broadcast had ended. As for social interaction, studies conducted by Geerts et al. (2014) showed that interaction in the home, for example with a partner or friends, were more appealing than remote interactions through platforms such as Twitter or Facebook, as they often lose relevance to the broadcast. Rather, the interaction through social media lied more in the interests of the producers rather than among the viewers, based on their interviews with both parties.

One of the more central question to this might be whether it adds any value. The studies conducted by Geerts et al. (2014) are centered around TV shows, and thus every aspect of it that were tested may not be applicable to sports broadcasts. What they did find however was that information that did not directly relate to the primary broadcast was still of interest. Additionally, the introduction of polls were tested, which viewers mostly found uninteresting. For others, it sparked debate. All in all the viewers mostly reported that they felt the answers provided by them in the polls did not matter, as it did not influence the primary broadcast.

#### 3.1.3 Research through design

Problems can be categorized as tame and wicked (Rittel and Webber, 1973), where the former is falsifiable and the latter is not. A result of this is that solutions to wicked problems may not be inherently correct or false. As such, solutions to a wicked problem could more be seen as a trial, and determining when a solution has been reached depends on external factors such as when the project runs out of time or resources, or when it is considered to be sufficient. The scientific value of design research can therefore be challenged due to the contingent nature of design research, as described by Gaver (2012). Rittel and Webber (1973) suggests that design research seldom offers correct solutions because of its complex nature, similarly to how wicked problems are described. As such, results of a design research can rarely be irrefutably confirmed or rejected, rather the result will always just change one's understanding of the problem at hand.

Zimmerman et al. (2007) argues that the process while performing design research is very important to the quality of the outcome. Like in anthropology, it is not expected that the same process necessarily yields the same result if reproduced, rather the process itself is an important factor when judging the quality of design research. Documenting the process in enough detail to make it reproducible is therefore an important part of design research. Zimmerman et al. (2007) produced a model for research through design which argues for the use of methods often practiced by design practitioners as part of the research process. What differentiates the process between producing an artifact used in research from producing an artifact when practicing design is the intention when producing the artifact. The goal of the artifact when conducting research is to produce knowledge and understanding of the area that is being researched, rather than creating a commercially viable product. Furthermore research artifacts show a significant amount of invention; rather than redesigning existing products, design researchers can invent entirely new categories of products.

## 3.2 Second screen applications

In this section the use cases and possible implications of using second screen applications will be introduced, focusing on different types of motivators and how visual attention between the primary and second screen can be affected.

#### 3.2.1 Motivations for using second screen applications

The different motivations for using second screen applications is a widely researched subject (Vanattenhoven and Geerts, 2017; De Michele and Furini, 2017; Gil de Zúñiga et al., 2015). In this section, various motivators will be introduced, showing the wide spectrum of why the use of a second screen application can raise the engagement and viewer experience when watching a TV broadcast.

#### 3.2.1.1 Social aspects

Watching TV is a social activity, and the use of second screen applications can be a way of supporting that (Vanattenhoven and Geerts, 2017). Further, as mentioned in section 2.1.1, Holmes et al. (2012) underlines the importance of so called social viewing. The studies made by Vanattenhoven and Geerts (2017) shows that second screen applications can add extra value to a TV broadcast, both entertainment wise and socially, as people feel more active when using a second screen application as opposed to regular TV watching.

Aspects such as competition showed to be an important factor which provided more motivation for the participants as well as a social aspect. The users tested in the study also expressed that they preferred to compete against people they know, rather than strangers. Conclusively, the studies by Vanattenhoven and Geerts (2017) showed a connection between having a stronger social experience with higher engagement, albeit only as long as the second screen does not require too much attention.

#### 3.2.1.2 Gamification

Another motivation explored by De Michele and Furini (2017) is gamifying the content in order to enhance the viewing experience by adding an interactive layer to the content. They found that this strategy can be used in order to raise engagement during commercial breaks where users often turn to a second screen for other applications, losing focus of the broadcast. Further, studies made by Vanattenhoven and Geerts (2017) shows that viewers were more attentive than they would normally be when having an interactive layer, and that it contributed to a positive experience as it both requires the viewers to more closely follow the events and that they could compare themselves to others.

#### 3.2.1.3 Information and discussion seeking

Gil de Zúñiga et al. (2015) conducted a study of second screen use during news broadcasts and identifies two main motivations for such second screen use, namely seeking further information and discussion with other viewers regarding the news stories and politics presented in the broadcast. In the context of news the source for this information currently is often social media such as Twitter or Facebook. A study by Sezen (2014) investigates the type of information that people seek in a second screen when watching soccer. Almost half of the respondents reported that they seek match related information beyond what is provided in the broadcast, where the type of information that they mainly seek is mostly information and statistics about a player or a team. The study further shows that a majority of people was looking up three or four different types of information.

The study also shows that a significant amount of the respondents looks up information before the match starts, where most people use two different sources of information, coming mostly from various mobile apps and sports portals. It could be noted that social media was not so popular, along with the rather weak interest in other people's comments about the match. This conflicts with the findings of Gil de Zúñiga et al. (2015) and might indicate that social media integration or other functions such as chat rooms are not that integral to second screen experiences for sports broadcasts as compared to news broadcasts.

#### 3.2.2 Visual attention between primary and secondary screen

Several studies have explored the division of the visual attention when using a second screen application while watching TV. One such study by Holmes et al. (2012) studied the visual attention while using synchronized companion applications in particular. The study was performed in a lab and examined the eye-movement between a tablet with a second screen application and the television while watching a drama show and a documentary. The study found that users spend approximately 2/3 of the time looking at the television and around 1/3 looking at the second screen, furthermore 7% of the time the focus was completely off both screens. The study further showed that the attention of the second screen is increased when content is pushed to the second screen; an increase was also observed during commercials on the TV screen. Furthermore the study found that the average gaze time on the TV screen is lower when a second screen is present than previous studies have shown for gaze times without a second screen present.

Findings from the studies conducted by Geerts et al. (2014) further examined the attention between the both screens, and additionally the attention between the companion app and other apps in the second screen. The studies showed that the viewers were very engaged with the companion app and actively looked for updates, and after a while the viewers started to recognize the events from which they would expect to receive an update in the companion app, and in fact felt disappointed when it did not arrive. Further, if there were no recent updates, the viewers after a while switched to other apps, such as social media apps. Something that the producers interviewed in the study conducted by Geerts et al. (2014) believed was that a good second screen experience may in fact prevent viewers from having this behavior and instead keeping the attention to the broadcast.

Neate et al. (2015) has studied how to efficiently mediate the attention between the two screens and steer the user towards the second screen when information is pushed. This turns out to be quite difficult. Their findings show that the most efficient way of calling peoples attention to the second screen is through audio cues. Furthermore using audio icons (audio cues related to the primary screen content) was perceived more positively than using earcons (unrelated musical cues). However their interviews also found that many viewers found audio distracting and preferred more discrete notifications; this is further confirmed by the studies conducted by Geerts et al. (2014) finding that most viewers had the sound on their second screen device turned off when watching TV, making audio cues a less appropriate choice. Furthermore Neate et al. (2015) examined the effect of having visual cues on the primary screen to notify the user of pushed content to the second screen. While this lead to less content being missed on the second screen, it also lead to a delay between the content appearing and the user watching it on the second screen.

It's difficult to foresee the implications on the attention when introducing a new device within this context. Carr (2011) spoke about the implications of adding what he calls hypermedia to the web, where not only text were displayed anymore on a web-page, but also images, sounds and moving pictures. He argues that this strains the cognitive abilities and can hinder the learning and understanding. While this might not be a direct comparison, it's telling for that we rarely know much about the implications of introducing new elements, or in this case devices. Thus it

needs to carefully be taken into consideration how the attention is affected by the introduction of a second screen when watching sport broadcasts.

## 3.3 Information visualization

Information in sports consists of a large number of datasets that are often abstract, and as team sports increase in complexity, it becomes more difficult to understand (Page and Moere, 2006). A way of solving this problem is through visualizing information. Page and Moere (2006) argues that aspects of team-sports become more comprehensible with the help of visualization. They mention the importance of displaying a variety of statistical information which can be either showing historical data in a graph, or the use of a heat map to indicate the typical position of a player on the field. This type of information is shown to help humans understand the different type of information provided in various team sports, and also enables them to easily obtain key events and game summaries.

#### 3.3.1 Preattentive processing

Another aspect covered by Page and Moere (2006) is the use of colors when differentiating between teams, which helps the preattentive processing of information. Preattentive processing is a subject which is covered by Ware (2012), who describes it as the information that is easy to find upon fixation. He also explains that the time taken to detect information is dependent on the number of so called distractors, indicating that the use of distinct elements should be used carefully. The distinctive properties of elements are many, but the ones that seem to have the strongest effect are properties such as size, orientation, motion, color, and contrast.

#### 3.3.2 Visualizing tournament structure

Perin et al. (2018) has conducted a study regarding the state of the art in visualizing sports data. In their research it is notable that classical ways of visualizing tournament structures is still very common. Results of ranking based tournaments where teams or players play each other one or more times which is common in team sports. are often gathered in a vertical table summarizing teams' or players' indicators of success, such as wins, losses, and points. Apart from classical rankings, tournament trees is the most common way to structure a tournament. These are applicable in tournaments where two teams face off and only the winner progresses to the next stage. Often tournaments combine these structures, and begin with a preliminary phase where teams or players in a group play against each other first, to later progress to a tree-based tournament phase such as in the IIHF World Championship (IIHF, 2018a), the IIHF World Championship however has a seeding process as the teams enter the semi-final, breaking the classical tree-structure. These tournament trees are often visualized in a simple form, historically on paper. Although this an inefficient use of space, it provides a clear overview both of individual matches and the different stages in the tournament using the same visualization, a typical play-off tree can be seen in figure 3.1.



Figure 3.1: A typical play-off tree involving eight teams

## 3.4 Broadcast synchronization

Several services provides the possibility to synchronize to live broadcasts using the technology of audio identification algorithms. The two most common techniques used for broadcast synchronization is fingerprinting, where the audio signal is ingested and processed into files that can be used for audio comparison, and water-marking as described by Wen-Nung Lie and Li-Chun Chang (2006) and Khaldi and Boudraa (2013) where an audio signal is added to the broadcast on frequencies that can not be heard by the human ear.

Mufin (mufin GmbH, 2017) is a company with a patented solution for audio recognition using fingerprinting (Fraunhofer Gesellschaft zur Forderung der Angewandten Forschung eV, 2001). This solution both works for pre-recorded shows where audio is ingested and processed beforehand as well as for live broadcasts where audio is ingested and processed on the fly. Although interviews made with producers by Geerts et al. (2014) reported that the technology for live broadcast audio synchronization was insufficient at the time, the fingerprinting solution for pre-recorded shows is now widely used in the SVT Duo app, which uses Mufin's solution for all their synchronized applications (P. Wissmar, personal correspondance, 21st February 2019).

## 3.5 Web analytics

Web analytics is a process where users actions and behaviour online is automatically logged for analysis, and analysis tools are described by Sharp et al. (2007) as a method for evaluating user traffic. Beasley (2013) discusses how web analytics can be used as a tool for UX-Designers, as it enables the designer to analyze a large scale of users and their real world behaviour allowing the designer to quantify data in a way that is difficult during methods such as usability testing and interviews. Web analytics allows the designer to answer questions about what the user does, but not why the user does it. For example, it is easy to track what button is the most used on a particular page but finding out why a certain button is less popular is more difficult using web analytics, and requires rephrasing the question you are trying to answer with a what-question (Beasley, 2013).

Further Beasley (2013) discusses two approaches to web analytics, log tracking and page tagging. Page tagging is the most common technique used where a short piece of code is inserted to the website, often with the help of external tools for page tagging. The code then tracks information such as which page the user is on, where the user came from, and technical details such as which device the user is using. Although this is the most commonly used approach it comes with its caveats such as requiring the user to have Javascript enabled. The other approach is analyzing logs generated from the server, where all requests to the server can be tracked as long as the user isn't fetching cached copies of the website. However analyzing this data is usually much more complex than using page tagging due to the unstructured nature of the gathered data.

## Method

## 4.1 User research

#### 4.1.1 Interviews

In order to gain insights about the target group, several interviews will be held throughout the project. The guidelines and definition of the different types of structure of interviews will be based on the descriptions by Sharp et al. (2007). There are mainly three types of interviews, ranging on the level of structure depending on what type of data that is desired. Structured interviews are conducted in the way that pre-determined questions are asked in a standardized way, offering several answer options. This helps to gather quantitative data and usually does not require much time, and might be fitting when exploring already known goals. The opposite of a structured interview is an unstructured interview, which focus has a more exploratory nature. It aims to collect more quantitative data, and often the questions are not pre-determined, but rather on the direction of the answers from the interviewee, which might help to identify issues that has not yet been considered. As both types has their advantages and disadvantages, there is the option of combining these features in the form of a semi-structured interview. While a structured interview has a clear goal of what questions needs to be answered, it usually does not leave room for options that are not already included. Rather, the questions are more open and allows for follow-up questions that may arise.

In this project, the goal of the interviews will be to define behaviour patterns when watching sports broadcasts, in order to try to cluster the various behaviours so that different aspects can be identified of which the concept will be developed upon. While there are some pre-defined questions that needs to be considered, the form of the answers will remain open, and thus semi-structured interviews will be the most suiting alternative.

#### 4.1.2 Focus group

Sharp et al. (2007) describes a data gathering method called focus group. As interviews often are held with one interviewee, an alternative is to make use of a focus group, where a group of up to 10 people participates in an activity led by a facilitator. The aim of focus groups is to gather users' ideas and spontaneous reactions when performing activities in order to gain insights about how the product will actually be used. The aim is to create an environment where everyone can express their

opinions and discuss matters that might have gone unnoticed, where the facilitator tries to guide the discussion.

## 4.2 Personas

Working with personas is a widely used tool within user interaction, and more specifically, user focused design (Nielsen, 2012). A persona is representing a typical user and is used as a reference for the different design decisions made when creating the interface in order to cover the different user needs. The user needs are based on user research and often scenarios are developed in order to cover the common use cases for the product. In this project, several personas will be developed both from interviews with different types of users along with already existing knowledge about users within SVT. This will allow for the design process to easier keep in consideration of the different types of users in order to produce a design that is inclusive and thus cover more use cases.

## 4.3 Prototyping

A way to explore and develop the form and design of a product is to make use of prototypes. For this project, the definitions and guidelines provided by Sharp et al. (2007) will be followed.

Prototypes can come in various forms, ranging from drawings on a piece of paper to something digital and interactive. The purpose can vary from presenting the product to stakeholders, being a tool for discussing design ideas, to being a means of testing with users. Low-Fidelity prototypes does not necessarily aim to look like the final product, but the simple nature allows for changing the prototype easily in order to explore different ideas. In this project, paper sketches will be used in order to determine the flow of information and where it will be accessible. Further, as the application will contain relatively high amount of different type of data, different ways of displaying that data and the placement of it will need to be explored.

When the general form and content have been determined, a high-fidelity prototype will be developed in order to better demonstrate how the final product will look like. It also allows for responsiveness which will greatly benefit user testing. As there are plenty of stakeholders in the project, more time will go into having an extensive high-fidelity prototype, in order to better demonstrate the conceptual model.

## 4.4 Think-aloud testing

In order to test the application, several scenarios will developed which will represent the general usage of the application based on the developed personas and their use cases. Further, usability testing helps to test the hypothesis made about the users and how, where, and when they will look for different types of information. Gatherings from the usability testing will also be a means of further developing the conceptual model, as the context is relatively specific and thus needs to be tested accordingly.

The usability testing will be done with the concurrent think-aloud protocol, following the definition provided by Martin and Hanington (2012). It works as such that the user is encouraged to articulate what they are doing and how they feel as they perform a set of tasks. This method helps to bring forth the emotional response of the user performing various tasks which will provide insights about the cognitive process in different parts of the application. This will be done with several different types of users in order to asses the design for the different personas described in section 4.2.

## 4.5 Web analytics

During the live test of the application web analytics will be used to examine the users' behaviour when using the application. The analysis will mainly be based on the methods described by Beasley (2013, ch. 7). The analytics will use page tagging with the help of Adobe Analytics and Google Analytics. Adobe Analytics is an established tool for visualizing data collected within an application. It tracks user actions and tasks, as well as gathers data, such as when users are active within the application, and the length of the sessions. Further it allows you to see the browsing behaviour of the users, which pages that are most frequently visited, and how the user have moved in the application (Adobe, 2019). Google Analytics offers similar functions, but is in this project only used to read live data about the current users, in order to asses the behaviour as games are played. The analysis aims to assess which types of content the user looks for and compare these to the findings in the user research, trying to assess if the information users reported searching for is easily accessible.

## 4.6 Technology

The functional prototype will built as a web application which will be integrated into the existing Duo app. The application will be built using a React.js based front-end and Node.js back-end. As the application will be built as a web application, tools available in the current Duo platform will be used for functionality tied between the web application and the native applications (Android iOS). Further, to allow for the audio synchronization to the broadcast, existing techniques will have to be used with reservation to eventual modifications.

#### 4.6.1 React

React is a JavaScript library for building user interfaces owned by Facebook. The library allows the developer to easily create components that can be reused through-

out the application. Each component has separate states, and automatically rerenders the page upon state changes, making updating of live data simpler (Facebook, 2019).

#### 4.6.2 Node.js

Node is a Javascript library for back-end systems allowing the developer to write servers in pure Javascript. The library uses an event driven concurrency model, meaning it works in a single CPU thread but is able to handle many connections as asynchronous calls are only fired upon callback (Node.js Foundation, 2018). In this project this allowed for a structure which could easily be scaled using the cloud, with the possibility to serve as many users as needed.

#### 4.6.3 SVT Duo platform

The SVT Duo app is built native for iOS and Android, with web views used for each subapplication in the app. In order to access certain functions in the native app, such as hardware functions and the audio sync system a JavaScript library, Duo-communication, has been developed that can communicate to the native app from the subapplications. This enables the subapplications to interact with both platforms (iOS and Android) without any platform specific instructions, as all instructions from Duo-communication is handled natively by the base application. In this project the writers did not make any modifications to the base application, however some modifications necessary for the subapplication such as upgrading the audiosync for live broadcasts (see 4.6.5) were made by the developers at SVT in connection to the project.

#### 4.6.4 Data sources

As the application was being prepared for a live launch test, it was important to have sources for all statistics that could be delivered in real time. In the application three main sources of data was used. These were each responsible for its own category of information, live data, historical data and editorial data. The live and historical data was gathered from two different paid sources outside SVT, the live data being delivered by a Polish company and historical data from a Swedish company. The editorial data such as team facts and news, were delivered by editors at SVT.

#### 4.6.5 Audio synchronization

The functional prototype uses the same fingerprinting technique provided by Mufin that is used in other Duo-subapps. However a variant of the product not used previously by SVT was used, adapted for live broadcasts rather than prerecorded shows. This required setting up a physical server ingesting the live broadcast signal. Furthermore modifications to the base application was necessary as the fingerprinting comparison was made serverside rather than clientside (mufin GmbH, 2017).

Although watermarking techniques claim to be not hearable by the human ear,

interviews conducted during the project have showed that audio technicians at SVT disagree claiming that the watermarking technique distorts the audio to a point where they don't want to broadcast this signal. Watermarking techniques were therefore not possible to use in this project.

## 4.7 Graphical profile

For the application to have a feeling of extending the broadcast it is important that it follows the same general graphical profile as the one used in the broadcast. SVT has a well defined graphical profile, both for general use and for sports, although it has a strong emphasis on broadcast television, making adjustments necessary for use in mobile applications. Some of the core elements of the profile are described below.

#### 4.7.1 The font Publik

The font Publik is developed specifically for SVT and is used in all written communication (SVT, 2019a). The font includes multiple weights and variants, apart from regular variants such as bold and italic, the typography also includes the font Publik Display Italic, used to emphasize names of events in sports broadcasts. The versions "regular" and "Display Italic" are displayed below in figure 4.1 and 4.2.

## Publik regular

ABCDEFGHIJKLMNOPQRSTUVXYZÅÄÖ abcdefghijklmnopqrstuvxyzåäö

1234567890

!"#€%&/()=?©@£\$§:;

Figure 4.1: The Publik Regular font

## PUBLIK DISPLAY ITALIC

#### ABCDEFGHIJKLMNOPQRSTUVXYZÅÄÖ 1234567890

Figure 4.2: The Public Display Italic font

#### 4.7.2 The slash

The SVT logo hides a slash in the  $\mathbf{v}$  of the logotype. This slash can be used independently to claim ownership of a category without displaying the entire logo. This is for example used to show that SVTs news section is news by SVT, rather than just news in general (SVT, 2019a), see example below.


Figure 4.3: The slash hidden in the SVT logo



Figure 4.4: The slash used to claim ownership of SVTs news section

## 4.7.3 Colors

The colors used within SVT are used as a tool to enforce the identity of the organisation. With the use of colors follows certain accessibility guidelines. SVT uses a palette of seven colors with different tints along with an accent color (SVT, 2019a). The different colors are used partly based on which division the content belongs to, which in this project will be the sport division, mainly using the blue palette as can be seen in figure 4.5.

| Extra Light Blue | #d2e6f5 |
|------------------|---------|
| Light Blue       | #7dbeel |
| Regular Blue     | #2891c8 |
| Dark Blue        | #le69aa |
| Extra Dark Blue  | #Of418c |
| Accent Blue      | #0091ff |

Figure 4.5: The blue palette used in SVTs graphical profile

### 4.7.4 Accessibility guidelines

SVTs accessibility guidelines are formed for ensuring the accessibility for all users. It covers mostly the formatting of text, the contrast to its background and how different elements should be displayed, such as headers and links. Furthermore, it covers the transition between content, and that elements has sufficient affordance and availability (SVT, 2019a).

# 4.8 Data handling

The data collected during the interviews and user tests will be handled anonymously and saved until the end of this project. The test subjects are aware that their answers are recorded and handled anonymously. The data gathered through web analytics will be stored anonymously with only metadata such as device and general location being used to track each user, and saved indefinitely by SVT for further analysis. The users have consented to this by accepting SVT Duos terms of agreement, which outlines that SVT has the right to collect such information (SVT, 2019b). It should be noted that since SVT is covered by a journalistic exemption, most rules in GDPR does not apply to their digital products (European Union, 2016).

# 4.9 Time plan

A time plan was developed in order to better plan the project in a structured manner. The project can be divided into five phases: research, concept development, implementation, application release, and evaluation. The research phase both consists of researching previous knowledge about second screen applications but also user research in terms of current usage of a second screen while watching TV. The background research will be a basis for the development of the concept and a lowfi prototype, which in turn will be the tool for usability testing and evaluation of the concept. Having defined the concept and design, an implementation phase will be initiated in order to be able to release the application which will potentially be used by a large number of users in conjunction with the 2019 IIHF Ice Hockey World Championship. In order to facilitate the evaluation phase, several techniques for analyzing user behaviour will be implemented (see section 4.5) in order to gain quantitative data, along with the possibility for the user to provide qualitative feedback using a feedback form. The evaluation phase will consist of both analyzing the quantitative and qualitative data. This will be used as the foundation for the development of design guidelines for second screen applications for live sports broadcasts. See figure 4.6 for a Gantt scheme of the time plan.

| Week  | 1 | 2 | 3 | 4 | <br>5 6 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
|---|---|---|---|---|---------|---|---|---|---|----|----|----|----|----|----|----|----|----|----|----|
| Analysis of research and current applications     |   |   |   |   |         |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |
| Concept development and lo-fi prototype           |   |   |   |   |         |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |
| User testing and evaluation                       |   |   |   |   |         |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |
| Development and implementation of hi-fi prototype |   |   |   |   |         |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |
| Defining requirements                             |   |   |   |   |         |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |
| Writing planning report                           |   |   |   |   |         |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |
| Writing final report                              |   |   |   |   |         |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |
| Presentation and opposition planning              |   |   |   |   |         |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |
| IIHF Ice Hockey World Championship                |   |   |   |   |         |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |
| Development of design guidelines                  |   |   |   |   |         |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |
| Application release                               |   |   |   |   |         |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |

Figure 4.6: Gantt scheme of the time plan  $\mathbf{F}$ 

# 5

# Process

# 5.1 Interviews

#### 5.1.1 SVT employees

As the project was done in close collaboration with SVT, several interviews were held with different divisions of the company. This was both done as a means to further develop on the existing knowledge of users when developing the concept but also to make use of the already existing graphical profiles and resources.

In order to align with the graphical profile of SVT, and in particular the graphical profile of the sports division, interviews were held with the lead art director at SVTi (SVT interactive). Further, during most of the project, weekly meetings with the sports interactive division were held with the purpose to keep a close contact to designers working within the relevant division. It was both a means for input about the design process of the project but also to provide continuous feedback about the concept development and the general design. Regular interviews were also held with the sport editorial division to ensure that the content in the application aligns with what the editors know users request. Furthermore, these contacts were maintained in order to get well adjusted editorial content for the developed concept.

As the project was done in close collaboration with the Duo team at SVT, regular meetings were held with the team working on the Duo app to ensure that the app designed in the project adhere to the style of other Duo apps. This was important in order to allow the users to feel comfortable within the already existing Duo ecosystem. Furthermore the team assisted with the more technical aspects related to integrating the application within the Duo platform.

#### 5.1.2 Viewers

Semi-structured interviews were held in the beginning of the project in order to profile the users and their needs while watching hockey broadcasts. A full list of the questions can be seen in Appendix A.1. During the interviews, current habits regarding ice hockey viewing was examined, both relating to how they watch the game, as well as how and what type of additional information they look up during the broadcasts.

The interviews showed that habits can vary greatly between regular league games

and national team games. The more regular hockey viewers often follow a team and watch many of their games, and as such get a good knowledge about the players both in their favorite team but also the star players in the rest of the league. Despite this, the most common theme discussed when asked about their information gathering process was finding information about players. The information the interviewees were mostly interested in was basic information about the players history, such as which previous clubs he has played for and how he has performed previous seasons. When looking for information about players they tend to do so in breaks of the game and usually finds this information through various search engines or websites such as Eliteprospects, with one interviewee even reporting a lack of a gathered information source regarding the game being played as an issue. However it was also expressed by interviewees that they often want to avoid using their phone during ongoing games, both due to the fact that they found it distracting but also for fear of spoilers that may be caused by notifications from various applications, ranging from live score applications to social media applications.

The more regular viewers do report that this type of information is more often looked for during national team games. Most interviewees reported that they have very limited knowledge about the players in other club leagues than the one they follow. They further expressed that most players in the national teams are unknown to them as well. Additionally, some interviewees expressed that despite following the Swedish league, even most players in the Swedish national team are unknown to them as they usually play in American or Russian club teams. On this theme, one interviewee stated that he used to have good knowledge about the Swedish team, but as players tend to switch so often in modern ice hockey, he could no longer keep good track of the players in the team.

Whereas the regular viewers use smartphones and tablets for information about the match, more casual viewers tend to use smartphones and tablets during the games for purposes unrelated to the game. A common platform to use was social media, which the interviewees reported that they used both during breaks as well as during slow periods of the game. These users motivation for watching club matches was often not related to their own ice hockey interest but rather driven by a more interested person watching the game with them, such as a partner or a friend. However when national teams play a higher interest in following the games was reported, mostly to follow how their own country is performing in the tournament.

# 5.2 Concept development

### 5.2.1 Bodystorming

After having performed interviews with viewers, a bodystorming session was held in order to get a more detailed sense of the structure of a hockey broadcast and mind set while watching it, following the instructions provided by Martin and Hanington (2012). This was done in order to evaluate the current ideas regarding how viewers could interact with the broadcast and information around it, and the concurrent

use of a phone and how that can affect the attention. In particular, the flow of the broadcast was investigated in order to better estimate the timing of events, such as votes, which could be pushed in the application.

#### 5.2.2 Feedback sessions

After each major iteration of the concept, feedback sessions were held with relevant departments at SVT. The people attending these sessions varied depending on what part of the concept needed to be evaluated, but usually consisted of members in the Duo team, the sports editorial division and the sports digital division. During the sessions a presentation was held with a following QA session, with questions both from and to the participants.

### 5.2.3 Workshops

Two workshops were held with employees from SVT while developing the concept of the application. One was held early in the process in order to define the user needs and get insights regarding the viewers mindset while watching sports broadcasts today. The other workshop was held in a later stage during the concept development in order to get input from stakeholders revolving the social aspect in the application.

#### 5.2.3.1 Defining user needs and current behaviour

The initial workshop was conducted with employees from different branches of SVT, ranging from editors at the sports division to developers from the SVT interactive branch responsible for the IT development at SVT. The main portion of the workshop revolved around brainstorming various questions that potential viewers may have while watching sports broadcasts in mixed professional groups of 2-3 people. In total 10 people attended the workshop.

During the workshop it became apparent how different types of viewers may ask different types of questions and how these can vary based on the viewers previous knowledge about the sport. Furthermore it also became apparent that SVT may attract a different type of viewer than that of niche sports channels. More casual sports viewers are more likely to stumble upon broadcasts televised at SVT due to their status as a big free channel rather than paid sports channels where viewers are more likely to actively look up the content they intend to watch. This is especially true for events involving Swedish national teams, where the more casual viewers often follow the Swedish team regardless of their previous knowledge about the sport.

#### 5.2.3.2 Developing a concept for social interactivity

When ideas for the concept were roughly developed a workshop was held in order to get input regarding specific portions of the concept. Specifically the workshop focused on ways to engage viewers through social interactivity while watching the broadcasts.



Figure 5.1: Result of the workshop identifying user needs



Figure 5.2: Some of the ideas produced during the second workshop

The workshop was held with employees with different professions working within the SVT Duo branch at SVT. During the workshop a brief presentation of the concept ideas not involving social interactivity was initially held, followed by a variant of the 635 method as described by Lowgren and Stolterman (2004, p.73). The 8 participants were divided in groups of 2-3 and asked to brainstorm different concept ideas, after about five minutes all but one participant in each group were asked to switch groups and then expand or modify the ideas of their new groups. This was repeated three times and lastly each group was asked to present their two favorite ideas from the last group.

During the workshop many concepts were produced, some more feasible than others. Many of the ideas presented revolved around interactivity with friends and a common theme was competition based concepts, such as betting on aspects like which team will win and who will score the next goal. Other common themes revolved around interactivity with the studio, such as chats or sending in questions to be discussed in breaks of the game. Another common theme was interactivity with the audience as a whole with ideas such as commenting events and meters showing the audiences current impressions of the game.

#### 5.2.4 Focus group

When the functional prototype was ready for testing, a focus group was held with 10 participants, the participants were employees at the SVT Duo-team. During the focus group the participants were asked to freely explore the app which was being synced to a recorded SHL match. While exploring the application the participants were asked to point out any information or features they felt were missing or not working as expected. Many smaller paths of accessing content was pointed out, such as a way to access player profiles through the event feed and not only via the team view. Furthermore sorting of certain lists was discussed and some bugs were pointed out.

### 5.2.5 Personas

Two personas were produced based on interviews both with users and stakeholders within the company who has knowledge regarding the viewers and their profiles. Furthermore scenarios were developed based on the user interviews, and attached to relevant personas. The personas developed differ mainly in their interest in sports and their motivation for watching sports broadcasts. In addition to the two main viewer groups described as personas below a third group was identified, namely the viewer which is entirely uninterested in sports and may not have watched Ice Hockey at all previously. Although this is a group of viewers that does occasionally find their way to the broadcast in events such as the World Championship, the decision was made to focus on the two personas described below in order to create an appealing application for a wide range of viewers, while still allowing the app to be focused for the needs of these specific users.

#### 5.2.5.1 Alex

Alex watches ice hockey more as a TV program rather than a sports event and likes to follow her national team mainly for social reasons. Things that Alex can wonder about during an ice hockey match is more basic information about players such as where they come from. Alex usually uses a second screen while watching TV for reasons unrelated to the broadcast, but a social aspect is often involved.

As Alex is not a regular ice hockey spectator she might not be familiar with rules regarding the sport and the structure of the tournament. Neither does she know where to look up such information and therefore does not actively try to look for it. Furthermore, Alex might not be confident about how a game will impact the rest tournament for the relevant teams, and the prerequisites of advancing further in the tournament.

Alex is aware that her national team is traditionally good at ice hockey and recalls

that this is a discussion topic at work, and thus would be interested in gathering more information about the team, its players and how the team has performed in previous tournaments, had she known where to find it.

#### 5.2.5.2 Robin

Robin watches ice hockey regularly both in regular club tournaments as well as national team tournaments. Robin follows her favorite team in the SHL very closely and watches almost every game they play. She has a very good knowledge of the players in her favorite club team and good knowledge of the players in the rest of the league, but limited knowledge about players and clubs in other leagues.

In national team tournaments Robin often finds herself wondering about where players which she does not recognize play and how they have performed during their club season. She sometimes find this information by googling or checking hockey websites, but often finds it too distracting to do during the matches and as a result doesn't look up the information at all.

During matches Robin sometimes find herself wondering about certain statistics of the game, such as shots on goals. However she usually avoids livescore applications with this information while watching a broadcast as it introduces a risk of spoilers since it is not synced to the broadcast she is viewing. She therefore doesn't have a safe source to look this information up and is restricted to the statistics presented in the broadcast.

# 5.3 Visualizing ice hockey statistics

When visualizing statistics much inspiration was taken from how similar apps, such as the apps described in section 2.2 displays similar type of data. This was aligned with the graphical profile of SVT and user tested to ensure the data was simple to understand and relevant for the viewer. A general theme was the use of simple graphs displaying performance and relating this data to comparable statistics.

### 5.3.1 Live data

When visualizing the live data the app was designed with an aim to enhance the viewer experience, by adding additional information that was not presented in the broadcast. This made the event feed more verbose than many live score applications, as the app intended to add more information to each event than what is usually seen in live score applications. Furthermore the design aimed to visualize the data users reported to seek in relation to the events, such as a player's performance in the tournament and his current club team. The historical data presented in the application was mostly tied to player related career statistics. The data chosen aimed to answer questions raised during the user research. Most importantly questions such as, which club team a player represents and his current season performance, which teams he has previously represented and where he comes from. The team

data chosen aimed to give a basic understanding of the team's performance and an overview of the players in the team. Furthermore the team based data aimed to supply simpler text-based editorial content, targeting the viewers that were not comfortable with raw ice hockey statistics.

# 5.4 Think-aloud testing

During the end of the design phase an interactive prototype was developed in order to test the navigation and information flow within the application. For this, users were asked to perform a set of scenarios while being asked to think aloud. This allowed to both evaluate the expectations of where users think that they will find certain information, and whether the information displayed is interesting and clear.

The setup of the usability tests was to make use of a room available in the SVT building that was meant to represent a typical living room. This room consisted of a couch, some chairs, a table, and a TV. On the TV, an ice hockey game was active and the scenario was based around that game. During different periods of the game, users were asked to perform tasks such as voting for who they think will win before the match started, as well as finding different information such as who scored the latest goal and thus testing that the information is located where they expect it to be. The results showed that the general structure of the information was sufficient, but that certain functionality was needed such as filtering the leader boards by countries. In full, users thought that the information was clear and covered most of their needs, and expressed that there was a need for this type of application which to their knowledge did not previously exist.

# 5.5 Prototyping

Two main prototypes of different fidelity was produced, these were later tested and modified before moving on to a higher fidelity prototype. In this section the two first prototypes are presented, one consisting of paper sketches and one digital interactive prototype created in Sketch (Bohemian B.V., 2019). For a description of the final functional prototype see section 6.2.

## 5.5.1 Paper sketches

In the early stage of the project, paper sketches were made in order to establish the general navigation and placement of information. These were furthermore used to describe the concept during interviews held in order to evaluate the base concept before constructing the interactive prototype. Some of the views produced in the paper sketches are presented in the figures below.



Figure 5.3: Paper sketch of game event feed



Figure 5.4: Paper sketch of player info



Figure 5.5: Paper sketch of player career



Figure 5.6: Paper sketch of team overview

Figure 5.7: Paper sketch of bet view

### 5.5.2 Interactive prototype

Having defined the structure of the information, an interactive prototype was developed in order to better be able to evaluate various concept aspects and the look and feel of the application. Further, the interactive prototype was used to user test the navigation given scenarios based on the personas. A selection of the views produced in the interactive prototype are presented in the figures below. 5. Process



Figure 5.8: Game event feed in the digital prototype

Figure 5.9: Player info view in the digital prototype

Figure 5.10: Player career view in the digital prototype



Figure 5.11: Team overview in the digital prototype

Figure 5.12: Bet view in the digital prototype

# 5.6 Graphical design

While most of the graphical resources has been available through SVT, some of the graphical design has been created in this project, such as the menu icons (see figure 5.13 and 5.14). These were created with the graphical profile in mind, mainly aligning with the sports division but also the rest of the content in the application. The icons were created in Adobe Illustrator (Adobe, 2019) with continuous feedback regarding motive, style, and color from design professionals at SVT.



Figure 5.13: Navigation menu containing the first version of the created icons



Figure 5.14: Navigation menu containing the final version of the created icons

# 6

# Results

# 6.1 Concept

The final concept was developed based on the results of the interviews, workshops and user tests that were held throughout the project. In this section each part of the concept will be described, as it was defined before producing the final functional application.

#### 6.1.1 Landing screen

The view that the user meets upon entering the application will consist of an introductory text about the purpose of the application, along with the possibility of synchronizing to a match. See figure 6.1.



Figure 6.1: Sketch design of the landing screen

#### 6.1.2 Live data

The part of the application which will contain match-related data will be gathered within the match view. Once a user has synchronized into a match, the user can find various match-related information such as an event feed (figure 6.2). The type of events that will continuously grow into the event feed as the match progresses can vary between goals, penalties, period events (such as a period start or ending) and similar. Additionally, in order to bring in a social aspect, match-related polls appears during breaks in the game (see section 6.1.3). The idea of the goal and penalty events is to provide additional information that might not be shown on the primary screen, such as the teams' power play and box play statistics. If a goal has been scored, the assist provider(s) will be shown and further information about how the player has previously performed in the tournament will be shown, and the user is provided the possibility of navigating to the player's profile, as will be described in section 6.1.7. As the background research (see section 5.1.2) revealed that viewers often wonder about information such as where players come from and which club they play in, it is important that such information is easily available when relevant and to provide a natural path to such information.

Live statistics during the game will also be provided in the statistics tab (see figure 6.3), where statistics such as shots on goal and shooting percentage will be continuously updated as the game progresses.





Figure 6.2: Sketch design of the match event feed

Figure 6.3: Sketch design of live match statistics

The user can also find information about the teams' different formations and players in the formations tab (see figure 6.4), which will be visually presented on an ice hockey rink. Finally, a live group table for the relevant group will be shown (see figure 6.5), displaying the positions of both teams as the game progresses, along with an informative box explaining the prerequisites of advancing from the group stage to the play-offs.



Figure 6.4: Sketch design of match formations

Figure 6.5: Sketch design of match-related group table

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Tāvla

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#### 6.1.3 Social interactivity

The concept includes two main functionalities for social interactivity during the game. The first is context based polls appearing in the match feed, asking the audience about their opinion about how the game will progress, how the teams have performed in the game, and similar.



Figure 6.6: Sketch design of event feed with an active poll

Figure 6.7: Sketch design of event feed with a poll the user has participated in

The other functionality is a guessing game, where the users can guess who wins each game and compete with friends and TV-profiles. The current game is highlighted for the user, but the user is allowed to make guesses for upcoming games as well, as the user may not watch all games but still want to participate in the game. However the user can only guess the upcoming games in the current round of matches (meaning one match for each team in the group stage, and one phase in the playoffs), to encourage the user to return to the application regularly. Additionally, the user can compare their guesses to friends within the Duo application, as well as experts.



Figure 6.8: Sketch design of the guessing game, before participating



### 6.1.4 News fetching revolving the tournament

A simple news feed has been added (figure 6.10) displaying news from SVT regarding the current championship as a way of providing more information regarding the tournament. Figure 6.11 shows an example of a news article.

#### 6. Results



Figure 6.10: Sketch design of the overview of SVT articles tagged with Ice Hockey World Championship

Figure 6.11: Sketch design of a news article selected from the articles in the news overview

Tavia

#### 6.1.5**Tournament information**

The tournament views provide information on a tournament wide basis. This includes:

- Tables for both groups, updated live for each goal in the tournament (figure 6.12).
- A playoff tree updating as soon as each advancing team is confirmed (figure • 6.13).
- A schedule including times and TV channels for each game (figure 6.14). •
- Point league for the tournament (figure 6.15).

Figure 6.15: Sketch design of tournament leaderboard

18:00 HOCKEY-VM Spelscheman Poängliga

MA

12 1

4 7

7 1

1 6

1 2

0 1

Ρ

13

11

10

9

8

7

3

1

Tävla

Figure 6.13: Sketch design of the playoff tree

| -            | -  |                     |           |    |
|--------------|--|---------------------|-----------|----|
|              | Grupp A  | Grupp B             |           |    |
|              | Lag  | SM                  | +/-       | Р  |
| 1            | Sverige •  | 8                   | +6        | 13 |
| 2            | Ryssland .   | 8                   | +5        | 11 |
| 3            | Tjeckien   | 8                   | +4        | 10 |
| 4            | Schweiz  | 8                   | +2        | 8  |
| 5            | Norge  | 8                   | +0        | 6  |
| 6            | Lettland   | 8                   | -3        | 5  |
| 7            | Österrike  | 8                   | -5        | 2  |
| 8            | Italien  | 8                   | -9        | 0  |
|              | Förutsättni  | ngar                |           |    |
| • De f       | yra bāsta lagen ur varje gri                             | ipp går till kv     | artsfina) |    |
| * Om<br>av r | tva lag slutar på samma pö<br>esultatet från inbördes mö | ang avgors p<br>ten | Hacennge  | 11 |

Figure 6.12: Sketch design of the group stage tables

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svt

Nyheter

Livetabeller

Norge - Frankrike Grupp B

Sverige/Ryssland - Kanada Kvartsfinal 1

Finland - Sverige/Ryssland Kvartsfinal 3

Schweiz - USA Kvartsfinal 4

Turnering

svt2 Sverige - Ryssland Grupp A

svt2 Norge - Tjeckien Kvartsfinal 2

| I HOCKEY-VM                 | -         | ×            | I HOCKEY-                        |
|-----------------------------|-----------|--------------|----------------------------------|
| Slutspel Spelscheman        | Poangliga | Livetabeller | Slutspel Spels                   |
| ldag                        |           |              | Spelare                          |
| Frankrike                   | 14:00     | 1 😡          | Rätti Målinen<br>Finland         |
| - Ryssland                  | 17:00     | 2 👩          | Couqt Me Breux                   |
| Imorgon                     |           | 3 🧿          | Elias Lindholm                   |
| /Ryssland - Kanada<br>nal 1 | 14:00     | 4 🔘          | Cêch Lirare                      |
| Tjeckien                    | 17.00     | 5 🧕          | Hans Schüssmeister               |
| Söndag 18 maj               | 17.55     | 6 🧟          | Vladimir Stolpiskott<br>Ryssiand |
| - Sverige/Ryssland          | 14:00     | 7            | Preben Tuborg                    |
| - USA                       | 17:00     | 8 🚱          | Inge Bra<br>Norge                |
| nai 4                       |           |              |                                  |
|                             |           |              |                                  |
| ering match Lag             | Tavia     | reyneter     | lurnering Match                  |

Figure 6.14: Sketch design of TV schedule



### 6.1.6 Team information

In the team information view, information for each team is displayed, highlighting their current performance, statistics in the tournament and key players for each team (figure 6.16). Tournament wide statistics such as power play percentage and save percentage are displayed, furthermore this information is supplemented with text-based information about the team on a "Did you know?" form suited for users with less knowledge about ice hockey. Additionally, information about the teams' upcoming and previous games are displayed. The team view also consists of an overview of the squad for the tournament (figure 6.17) and a news feed for team specific news.



Figure 6.16: Sketch design of team overview

Figure 6.17: Sketch design of team squad

## 6.1.7 Player information

Similarly to the team information there is information about each player in the tournament. This includes basic information about the player such as position, age and birthplace, and information about the player's point performance in the current tournament (figure 6.18). The idea of the radar chart is to visualize the general performance of the player regarding various attacking attributes, summarizing in an overall attacking point indicator. The player view also provides an overview of a player's career, including information about the player's club history, previous tournaments, and finally the player's personal merits (figure 6.19).



Figure 6.18: Sketch design of player overview

Figure 6.19: Sketch design of player career

# 6.2 Functional prototype

#### 6.2.1 System components

The system is built using the components described in section 4.6. The application consists of a React based front-end serving the user with the actual pages, mean-while this site gets its data from a Node.js based back-end which communicates with the different data suppliers and timestamps the data, allowing for the audio sync to function.

The audio sync systems consists of an MPEG-encoder which receives the broadcast signal from the control room before it reaches the actual channel being broadcasted ensuring minimal latency. The MPEG stream is then processed by a server which ingests the audio and generates fingerprint files that is sent to the Mufin back-end in Germany. When the application listens to the audio on the users television it generates fingerprint files which is sent to the Mufin back-end for comparison which returns a relevant timestamp and channel if a match is found.



Figure 6.20: The technical components in the application system

#### 6.2.2 Application

#### 6.2.2.1 Landing screen

As described in section 6.1.1, the purpose of a landing screen is to provide information about the purpose of the application, and what the user can expect from it (see figure 6.21). Contrary to what was developed in the concept design, the user is not limited to only synchronizing to a match as the user for various reasons might not be able to synchronize to the match. Instead, the user can choose to follow the match without synchronizing, which will open a modal window (see figure 6.23) including a descriptive text about the potential risks of not synchronizing, along with a list of ongoing matches. Additionally, an overview of the matches being played the current day is provided where the user can find information such as when the matches start and which channels that they will be broadcasted on (see figure 6.22).



Figure 6.21: The landing page in the finished application

Figure 6.22: The overview of matches in the finished application

Figure 6.23: The modal window displayed if the user chooses not to sync to a game

#### 6.2.2.2 Feedback form

Qualitative data was gathered from the existing feedback form (figure 6.24) provided in the Duo platform. The user could choose to report a problem, or give general feedback. Additionally, the user had the option of entering their email address in case they would be interested in a follow-up answer, or leave it blank in case they wanted to be anonymous.

#### 6. Results

| × | ISHOCKEY-VM  |   |
|---|--|---|
|   | X<br>Vad tycker du om Ishockey-VM?   |   |
|   | Är det något som krånglar eller har<br>du tips på förbättringar. Vi vill gärna<br>höra dina åsikter! |   |
|   | Välj ämne 👻  |   |
|   | Skriv ditt meddelande  | I |
| L | Fyll i din e-postadress  | I |
| L | Enhet: SM-G935F Android 8,0.0  |   |
| l | Skicka   | I |
|   | TOGGLE CLÉAR EXPORT  |   |

Figure 6.24: In-app feedback form

#### 6.2.2.3 Tournament-related news

As described in section 6.1.4, a news feed of tournament related news is provided in the application. The content of the articles ranges between expert analysis, video summaries of the game, to highlights from various events in the game, such as a goal. As can be seen in figure 6.26, an article about a goal can be seen where the user can see a video highlight of a goal.



Figure 6.25: News feed for SVT articles related to Ice hockey World Championship



Figure 6.26: News article accessed within the application

#### 6.2.2.4 Tournament standings and schedule

Identically to the concept design of the tournament view described in section 6.1.5, the application contains both group tables, seen in figure 6.27. An addition to the original design is the addition of providing an overview of the current day's matches (figure 6.28) along with an overview of the results of the previous day's matches (figure 6.29). This decision was made based on the user feedback both before and during the release of the application. While the information already existed in the individual team views, it was not easily accessible and significantly harder to get an overview of the more relevant matches in connection to the group table.

6. Results

| ×      | ISHOCKEY-                             | VM        | -            | × /5              | HOCKEY-               | /M 📮           | × 15              | HOCKEY-V                 | M .           |
|--------|---------------------------------------|-----------|--------------|-------------------|-----------------------|----------------|-------------------|--------------------------|---------------|
| Tabe   | Slutspel TV-                          | tablá     | Statistik    | Tabeli Siu        | tspel TV-h            | ablá Štatistik | Tabell Sluts      | pel TV-ta                | iblå Statisti |
|        | Grupp A                               | Gn/pp B   |              |                   | Dagens matche         | -              | Sverige           | Grupp B<br>svt2/svt      | Schweiz 🕂     |
|        | Lag                                   | SM        | +/- P        | Danmark           | Q-O.                  | USA            | G                 | irdagens matche          | er.           |
| 1      | + Finland                             | 3         | 3 7          |                   | svt1/svt+             |                |                   | 3.6                      |               |
| 2      | Tyskland                              | 2         | 3 6          | Lettland          | 0-0.                  | Ryssland       | Frankrike         | Grupo A<br>17 maj        | SlovakL.      |
| 3      | e Kanada                              | 3         | 7 6          |                   | svt                   |                |                   |                          |               |
| 4      | Danmark                               | 3         | 9 5          | Kanada            | Idag 16:15<br>Grune A | Tyskland       | Österrike         | 3-5<br>Grupp B<br>17 maj | Norge         |
| 5      | USA                                   | 3         | 4 5          |                   | svt1/svt.             |                |                   |                          |               |
| 6      | Slovakien                             | 3         | 0 3          |                   | Idag 16:15            |                | Finland           | 5-0<br>Grude A           | Storbrit_     |
| 7      | Frankrike                             | 2         | 7 1          | Italien           | Groupo R<br>Viasat    | Norge          |                   | 17 maj                   |               |
| 8      | Storbritannien                        | 3         | 19 0         | -                 | Idag 20:15            |                | Tjeckien          | 8-0.<br>Oropp 6          | italien       |
|        | Förutsättning                         | ar        |              | Storbrit_         | Gnion A<br>Viasat     | Slovaki        |                   | TA treat                 |               |
|        | Do fyra basta lann inge<br>kvartefern | grupp g/u | r Ull<br>mia |                   | -                     |                |                   | -                        |               |
| EB     | 3D-                                   | (Fee      | 2            | E 30-             |                       | P 2            | E 30-             |                          | P. 2          |
| Nyhete | Turnering Match                       | Lag       | Theth        | Nyheter Turnering | Match                 | Long Thyta-    | Nyheter Twinwring | Match                    | Log Tivte     |

Figure 6.27: Group table as shown in the tournament info view

of current matches in the tournament view

Figure 6.28: Overview Figure 6.29: Overview of previous days matches in the final application

Further, a play-off tree is provided (figure 6.30) similar to the concept design, with the exception of the connecting lines between the different stages of play-off. This was due to the fact that the semi finals will be seeded, breaking the regular play-off tree structure and thus making the connecting lines redundant and misleading.

The user can also find a TV schedule of all upcoming matches with information about the channels the matches will be broadcasted on (see figure 6.31).

Different to the concept design of solely providing a tournament wide points league, the application provides additional statistical leagues, namely a penalty inflicted minutes league and save percentage league for goaltenders, seen in figure 6.32. The decision for providing additional statistical leagues was mainly due to the access of such data.

| ISHOCKEY-V                          | M 📮           | ×            | ISHOCKEY-VM                           |           |
|-------------------------------------|---------------|--------------|---------------------------------------|-----------|
| bell Slutspel TV-ta                 | blá Statistik | Tabell       | Slutspel TV-tablá                     | Statistik |
| Kvartsfinaler Semilinate            | Front         |              | Idag                                  |           |
| Torsdag 25 maj 14:15                | svt1/svt>     | svti<br>svti | Danmark - USA<br>Grupp A              | 12:00     |
| 1:a grupp A                         |               | svt          | Lettland - Ryssland<br>Grupp B        | 12:10     |
| 4:a grupp B                         | svt           | svt1<br>svt> | Kanada - Tyskland<br>Grupp A          | 16:00     |
| 2:a grupp B                         |               | Visud        | Italien - Norge                       | 1615      |
| 3:a grupp A                         |               | 1            | Grupp B                               |           |
| Torsdag 23 maj 20:15                | svt1/svt      | svta<br>svta | Sverige - Schweiz<br>Grupp B          | 19:30     |
| 1:a grupp B                         |               | Valent       | Storbritannien - Stovakien<br>Grupp A | 20:15     |
| 4:a grupp A                         |               |              | Imorgon                               |           |
| Torsdag 25 maj 20:15<br>2:a grupp A | svt           | svt1<br>svt+ | Tyskland - USA<br>Grupp A             | 16.00     |
| 3:0 -                               |               | -            | Autor C                               |           |
|                                     | 7 2           | 1            |                                       | T.        |

Figure 6.30: The play-off tree in the finished application

Figure 6.31: The TC schedule as presented in the released application



**Figure 6.32:** The player statistic leagues, as presented in the finished application

#### 6.2.2.5 Match-related information

The most central view of the application, the live data feed described in section 6.1.2, was included in the application with some modifications. Perhaps most importantly, due to lack of time and resources, the social aspect described in section 6.1.3 where the user could vote in polls during the match, was not included in the application. Neither was the assist provider(s) included in the final application as that data was not delivered by the data providers. Another change was the addition of the match time indicator, which pulsates during periods to indicate that it is live. The application also provides information about the arena prior to the start of the game, along with information about when the game is starting (see figure 6.33). The reason for adding this was to keep the event feed relevant also before the game had started. Finally, another change was that instead of showing the different formations, the whole squad of the team was instead listed (see figure 6.34). This was solely due to no such information being available from the data provider, and would be wearisome work for each game to enter manually.



Figure 6.33: The event feed as presented in the final application, showing the initial information about the arena and match start



Figure 6.34: The squads as presented in the final applications match view



Figure 6.35: The event feed showing different events during a game in the final application

#### 6.2.2.6**Team-specific information**

Similarly to what is described in section 6.1.6, the team-specific information can be found in the team view. The overview page (figure 6.36) does not differ significantly from the concept design, with the exception that the teams matches has been moved to its own tab (see figure 6.37), in order to provide a quick overview of the matches without having to scroll through other content.



Figure 6.36: Team overview

Figure 6.37: Overview of a team's played and upcoming matches

Other content that can be found in the team view is the team's squad, listed in the same way as in the match view (figure 6.34), where each element is clickable and will navigate the user to the player's profile. Lastly, the decision to remove team-related news was made and instead replaced with a team based statistics league (see figure 6.39). The reason for this was partly because such work would have to be done manually, but also because it was requested in the usability tests to provide the relevant group table in the team view.



Figure 6.38: The squad overivew in the team view



#### 6.2.2.7 Player-specific information

The player view consists of an overview (see figure 6.40) as described in section 6.1.7, with some modifications to the concept design. Rather than only showing a radar chart over the tournament performance, that information has instead been extracted in order to give a more descriptive summary of the player's tournament statistics (see figure 6.41). More specifically, the number of games played in the tournament is shown along with the number of points and penalty inflicted minutes. The distribution of points is then visualized in the form of a bubble chart, displaying the number of goals and assists made (see figure 6.41). The same information is also shown about the player's most recent club season in order to provide more context about the player's performance coming into the tournament. More of that information can be found in the career overview (see figure 6.42), where an overview of the player's full career can be found, which teams that he has played in and the number of points produced for each season. The same information can also be found for the previous tournaments that the player has participated in. What differs the application from the concept design is the removal of the player's merits, as such information could not be received in Swedish from the data provider.

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profile overview

of player statistics of current tournament

career overview

#### 6.3 **Broadcast** promotions

The application was promoted in live broadcasts before and during games in the tournament. These promotions generated most new users to the application and resulted in spikes in usage, peaking at 14 000 during the first hour after the first promotion in a game with Sweden. The promotions were planned by the editorial staff at SVT and were usually angled to highlight the live statistics features of the application, not mentioning features such as player and tournament info. The promotions were done in most matches played after May 13 where the first promotion was aired and generated much higher peaks during games involving Sweden than games involving other teams. In general, the amount of new users generated by each game with promotions was about 2% of the total amount of broadcast viewers, based on data gathered by the analytic tools and viewer numbers received from SVT.



**Figure 6.43:** TV host Andre Pops presenting the application in the break of the Sweden-Austria game (May 16, 2019)

# 6.4 Evaluation

The evaluation of the finished prototype was made based on free text feedback gathered through the feedback function and web analytics gathered through Adobe Analytics and Google Analytics.

#### 6.4.1 Feedback

In this section the free-text feedback received from users between the dates May 13 and the day of writing (May 17). The dates before are not presented as no data was received before the first mentions of the app in the broadcasts on May 13. In total 190 messages was received through the feedback function. These messages were later anonymized and categorized by the writers in 11 categories, the distribution of which can be seen below.



**Figure 6.44:** The distribution of comments received through the feedback gathered through the feedback function

In the diagram we see that the most common categories of feedback are "Appunrelated comments" and "General positive comments". The app-unrelated comments often consisted of feedback regarding the broadcast itself rather than the actual app, for example commenting the studios expertise or the players' performance. Meanwhile, general positive and negative comments are comments of the actual application, but does not specify any specific features. The chart below presents the distribution of feedback not including the "App-unrelated comments" and "General positive/negative comments" categories.



Figure 6.45: The distribution of comments received, with general comments filtered

In this chart we see that the most common categories are requesting assists on goals and more statistics in general, which together represent over 50% of the total filtered comments. The missing assists was an expected issue, as the data supplier

used simply did not include assists to each goal, and were therefore removed from the concept in the final release. Of the comments requesting more statistics in general, the type of statistics requested varied widely, some of which requesting hard data such as current players on ice and more detailed live statistics, and some requesting more soft data such as info about how the players live during the championship and where the referees come from.

Other notable data categories are the "Incorrect data", "Mismatched data between broadcast and app" and "Too low update frequency" categories representing 16,4% of the total feedback. In these categories it is notable that most comments was regarding minor data related bugs, rather than severely incorrect data. Examples include presenting the incorrect club for a player which recently switched club and complaints about low update frequency on certain data, mostly related to the player based statistics leagues which was updated daily and not live. The category about mismatched data represents comments about different data sets being used in the app and in the broadcast. This is due to the broadcast using official numbers provided by IIHF, while the statistics delivered to the app was entered by hand by the data supplier which could cause anomalies as it can be difficult to judge certain statistics. As an example, what is a shot and what is not is open for interpretation, causing confusion amongst some viewers.

Lastly the two last categories were "Unexpected UI behaviour" and "Bad flag render (iOS)". The flag rendering issue was caused by a bug making flags appear corrupt or in incorrect positions at random times for users of iOS devices. Likewise, many reports in the "Unexpected UI behaviour" category were bug related, and not necessarily pointing towards flaws in the design itself. There were however comments pointing out features missing and flaws in the general UI. The most common issue reported was that users was unable to switch between games when a match was selected or synced to, a feature that was added on May 16. Another common theme was requesting an overview and statistics of finished matches. The application only allowed the user to display statistics for games which was currently ongoing, making the data unavailable soon after the game ended. Similarly users reported it difficult to find an overview of previously played matches at all. Although previous results could be found in each team's view, there were no simple overview of finding all previous games older than those played today. An attempt to fix this issue was added on May 16, where the games of the last day was displayed below the current day in the tournament section of the app.

#### 6.4.2 Web analytics

During the applications live phase user data regarding actions and page views was gathered in Adobe Analytics. Simultaneously, data was gathered in Google Analytics to monitor the page views live as this was not supported by the version of Adobe Analytics used at SVT. This section will describe the data gathered in the period May 13-May 17.

#### 6.4.2.1 Page views

In the analyzed period the app logged 33 497 unique visitors generating 1 066 353 page views. An overview of the generated page views are displayed below. Each entry in the diagram shows which view the user loaded and how the user entered that view in the form source:destination. Note that the labeling of each page is in Swedish.

|                                 | Unique Workers | Courrences    |               |
|---------------------------------|----------------|---------------|---------------|
| SVT Level 3<br>Page 1/1 Rows 30 | -              | 31,497        | 4 1.066,353   |
| t index.                        |                | 3478 1076     | 177,984 16.71 |
| 2 mény match                    |                | 21,042 62.3%  | 130,018 12.24 |
| 3. menyitumering                |                | 21293 036%    | 90.66 8.5%    |
| 4 matchistatistik               |                | 18,092 54,0%  | 67,454 6.3%   |
| 5. menylag                      |                | 18,569 55.4%  | 58,621 5.01   |
| 6. lag tripp                    |                | 73898 23.6%   | 65,817 5.24   |
| 7. metch trupper                |                | 12,474 As (m) | \$2,898. 520  |
| 8 lagoverskt/lagvy              |                | 19,692 3-1.5% | 52,743 -3.91  |
| 9. meny nyfeter                 |                | 16,827 54,4%  | 52,477 -4.15  |
| 10. match handelser             |                | 12,759 38.1%  | 45,582 4.35   |
| It lag matcher                  |                | 80902 29.3%   | 42,005 -4/19  |
| Q menysavia                     |                | 146028 4354%  | 38,043 5.76   |
| 13. match tabel                 |                | 13,885 41.5%  | 33,993 3.27   |
| 14. spilare,kamar               |                | 3,729 0.1%    | 26,063 2.45   |
| 15. tumering slutspel           |                | 46.85 0863    | 2075 2.0%     |
| 16 turnering tv tabla           |                | 6.296 24.8%   | 20286 194     |
| 17, turnering tabel             |                | 7,202 21.5%   | 18,931 1.01   |
| 18. nyheter nyhetsartikai       |                | 5.609 16.7%.  | 18,724 1.61   |
| 19. turnering statusk           |                | 6,843, 20,6%. | 17,648 1.71   |
| 20. lag poingigs                |                | 5,598 16.Ph.  | 15,338 1.41   |
| 25 lag oversite                 |                | 423 11.7%     | 1,199 1.19    |
| 22. spelare oversät             |                | 2.007 63%     | 8,629 itte    |
| 23. turnering statistik spelare |                | 1224 1.7%     | 2385 0.7%     |

Figure 6.46: Table from Adobe Analytics showing an overview of the page views from May 13 - May 17

Here we can see that apart from the landing page of the match view, which is loaded when the user opens the app, the most common views are the tournament tab closely followed by the match statistics view and the team list. It could be noted that the match statistics view places itself very high on the list even though it is only accessible after entering a specific match, but still generates more page views than for example the team overview which is always accessible in the tab bar.

Other notable results include some views ranking highly on generated page views while not being as popular when ranking them based on unique visitors. This indicates that a smaller amount of users enter these views, but the users who do enter them does so frequently. Some of these views include the team overview, the team squad and the player career view. All of the mentioned views are placed in the team section of the application, and does require some navigation to reach.

#### 6.4.2.2 Actions

In addition to page views certain button presses were specifically logged as actions in Adobe Analytics in order to analyse the user behaviour, the summary of the actions can be seen in the table below


Figure 6.47: Table from Adobe Analytics showing an overview of actions from May 13 - May 17

While much of this data such as pressing the back button may not give any big clues on its own as to how the users are using the application, other metrics show more about how the user behaves. Most importantly it can be noted that syncing to a game is about twice as common as following a game without syncing to it. Furthermore it can be noted that only about 14% of the initiated synchronizations are cancelled. Although we don't know how many of these cancellations are caused by accident, it can be assumed that most synchronizations are successful.

#### 6.4.2.3 Patterns of application activity

The data gathered in Google Analytics show when the users are most active in the application. The data show clear peaks in connection with the games, especially during promotions as described in 6.3, see figure 6.48.



Figure 6.48: Chart from Google Analytics showing peaks during the Sweden-Norway game on May 13

However the data shows a clear pattern of users using the application when games are not being played, averaging around 300 users per hour from 7:00 until the first games start (16:15) on a weekday (see figure 6.49). It is notable that the users visiting the application during hours where games are not played are almost exclusively returning visitors, with very few new users arriving during periods where no promotions are held.



**Figure 6.49:** Chart from Google Analytics comparing application activity between May 14 and May 15, note that no games involving Sweden were played during these days

## 6.5 Guidelines for designing second screen applications for live sports broadcasts

Based on the findings throughout this project 6 guidelines have been defined for designing second screen applications for live sports broadcasts. These are discussed in the following section, and are presented in no particular order. Together these guidelines act as a summary to answer the main research question. Meanwhile section 6.5.1 has a special focus on answering the second sub-question while section 6.5.2, 6.5.3, and 6.5.5 focuses on the first sub-question.

#### 6.5.1 Mediate attention with purpose

The studies covered in section 3.2.2 explores different approaches of mediating the attention between the primary and secondary screen. The use of audio cues turns out to be a powerful way of calling for attention while it may also risk of becoming a distraction. Further, users seem to start creating expectations of when to receive content in the companion application, and when content does not appear when expected, users tend to switch to another application. Based on that behaviour, it seems that the approach of calling for attention is related to the context of the broadcast, as the events in a TV show are more fluid, while events in sports broadcast often are more distinctive. As an example, in the context of team sports broadcasts, the user receives both visual and auditory cues on the primary screen when a significant event has occurred, such as a goal, and can expect to find more information about that event in the companion app. Auditory cues on the second screen may therefore be redundant, and cause unnecessary distraction. However, it may be important to also define the type of events occurring that is not necessarily a reflection of the events in the primary screen. As an example, events such as polls or other events requiring input from the user might best be suited during game breaks rather than something occurring arbitrarily. By doing that you both set the expectations of when the user can expect to find different types of events as well as minimizes the interference with the primary screen and thus the risk of the user missing events in the primary screen. Providing extensive statistical live data seem to also help in the way that the user always can find information on demand, rather than waiting for an event to occur. This in turn can help with users not switching to another application in case of a long period with lack of events.

## 6.5.2 Provide extensive statistical data

As can be seen in 6.4.1 more statistics was the most commonly requested feature by the users of the application. This seems to confirm the findings in the study conducted by Geerts et al. (2014) where users expressed a need for reviewing content during the broadcast. However apart from the assists, the type of statistics requested varied wildly, and as such to answer all the requests a huge amount of statistics would be necessary. Indeed it would seem that you can never have too much statistics and while including as much statistics as possible may seem like a plausible guideline it is important to keep the information accessible and easy to find.

Sports tend to have gigantic amounts of statistics available and therefore a selection has to be made where the amount of statistics has to be balanced in a way where as much as possible can be included without causing confusion. An example of this is the player data discussed in 6.4.2.1, here the page views indicate that the data may have been difficult to find and as such passed by unnoticed by many users. Therefore try to assess which statistics is most important for your audience and keep this easy to find.

## 6.5.3 Include information about other relevant events

As was clear from the feedback described in 6.4.1, which further confirmed the studies by Geerts et al. (2014), users are not only interested in following the game they are currently watching. Users want to be informed about previously played games as well as parallel games. Although this breaks the connection of the statistics that exists between primary and secondary screen, users expect to be able to follow other events to the same extent as the ongoing game when exploring the application. It is therefore important to include information about any other events that have a clear relevance to the game being played. In the case of a tournament such as the Ice Hockey World Championship, such events clearly includes parallel games and previous games.

### 6.5.4 Provide possibilities to synchronize to the event

As is discussed by Nakamura and Komatsu (2012) spoiling the result of a game affects the viewer's experience negatively and as such it is important that a second screen application does not deliver information about the game to the user before it is displayed on the users primary screen. This is further strengthened by the interviews described in section 5.1.2 where users report avoiding their phone during ongoing games for fear of spoilers. It is therefore crucial that the application provides a way to synchronize to the primary broadcast, ensuring that data is received at a point when it is safe for the user allowing the user to explore the data without fear of spoilers and further enhancing the experience of the second screen as an extension to the primary broadcast. Although fingerprinting technology for audio based synchronization was used in this project with success, the technology itself is not important for the end result, which is an application that delivers data in sync with the primary broadcast.

#### 6.5.5 Keep information relevant between broadcasts

As was apparent from the user patterns described in section 6.4.2.3 it became clear that the second screen application became used as an information source outside broadcast times, as the included data could be of interest both during and between games. Although most users visited the app during broadcasts, not locking information that could be of general interest that is available in the application to the times where broadcasts are ongoing is important. This includes information such as schedules, news and previous results, that is of interest during the broadcast but may be equally interesting outside the broadcast window. To have a complete application that can be used in this context it is therefore important to include information that is relevant between broadcasts as well as during them.

# 6.5.6 Provide multiple motivations for the use of a second screen application

To capture as many viewers as possible it is important to cater your application to different types of viewer groups. An event such as the Ice Hockey World Championship has large amounts of viewers in countries like Sweden, all with varying interests and knowledge about the sport. Not all viewers are interested in statistics as was found in the interviews described in 5.1.2. For this group of viewers other motivators are necessary for them to visit the application. Adding a social dimension to the application may motivate less regular ice hockey viewers to use such an app, as the interviews points towards the viewer group being less interested in hard statistics often resorting to social media during slow periods of the game. In section 3.2.1 different motivations for the use of second screens are covered, where the social aspect seem to be a rather strong motivator, especially when combined with a gamification aspect. As humans are competitive by nature, it also seems natural that they want to compare themselves to others, and specifically to people they know, as studies by Geerts et al. (2014) point towards. Whether it may be in the form of a competition or general knowledge surrounding the competition or its teams and players. Most importantly providing different motivators for different viewer groups is an important aspect when designing second screen applications for sports, but the motivators may differ based on context and sport.

# Discussion

## 7.1 Methods

Working with design methods, it can be discussed that the choice of design methods is a constant balance between thoroughly investigating the options and resorting to the methods that you are comfortable with. While most methods used in this project are amongst the most popular ones, such as think-aloud and semi-structured interviews, various adaptations had to be made depending on the resources available. Furthermore, most users that participated in the research were people that we either knew or had professional ties to, possibly leading to certain biases during the testing and interviews. As for the idea generation workshop, we compared methods such as 635 and collaborative sketching. While we had to create a variant for the 635 method, we wanted to utilize the different expertise of the participants by grouping them rather than letting them ideate individually, and at the same time minimize the risk of someone having a dominant voice over the rest of the group which could have been a risk with the collaborative sketching method. As for the choice of going with semi-structured interviews, we argue that as our purpose was not to find a large number of quantitative data during that phase of the project, but rather to get to know the users and their behaviour, using semi-structured interviews was the best option. As for the evaluation, we thought that our greatest strength was in utilizing the potentially large user base, having defined hypotheses about the general usage of the application. Additionally, as we had the opportunity to receive qualitative feedback through the feedback form, that we with higher confidence could say would not be biased, did not motivate the need to follow up the users being tested during the research and usability testing phase.

## 7.2 Live test evaluation

The results of the live evaluation showed interesting usage patterns which will affect the guidelines for designing second screen applications for live sports. Although the concept shows good potential according to the user research performed, some tweaks mostly related to what type of information is displayed and how this is accessed would have to be made based on the live test data gathered. Perhaps most importantly, the evaluation found that users will use the application not only for following the current game but in fact expect the application to have statistics for parallel and previous games as well. Although this existed in the original concept, the feedback clearly displays that a stronger focus on these games with more detailed information than only the result is requested by the users.

When discussing the provided statistics for any given game it was clear that the lack of assists to each goal was a huge oversight in the released application. Although this was included in the original concept, it was removed in the final prototype as the data supplier did not supply this information. It was not however expected that this would affect the experiences of the users as much as it actually did. Apart from this, the fact that the second most requested feature was more statistics in general points towards that users expect a very detailed level of statistics in such an application. This does however come with some UX challenges of its own as such a big amount of data becomes difficult to keep accessible. One such example is the player data presented in the application. The page views points towards that users finds this feature interesting as they visit it multiple times if they find it, but the relatively low amount of unique visitors may indicate that this information was not accessible enough and difficult to find. Although the users in the think-aloud tests had no issues finding this information, actual users may not be aware which information is available and therefore do not actively search for it, considering that the users in the think-aloud tests were requested to find player specific information. Furthermore, the angling towards live statistics in the broadcast promotions may have let the users expect more in this area, and less in terms of historical team- and player data.

It is notable that although the application was designed as a second screen application it was often used at times when no broadcast was aired. The users seemed to expect that the information available to them during the games is available between games as well, making it important for a second screen application for sports to include content relevant to the user between games as well. It is however notable that most users following a game did so by syncing to the broadcast. This indicates that the application is in fact used as a second screen application during games, rather than as a general live score application since that would require entering the game without syncing to the game. It would appear that the designed concept not only became a second screen application but rather a hybrid second- and primary screen application, depending on in which context the application was opened.

# 7.3 Further work

In this project a literature review was made in order to assess how the visual attention can be balanced between the primary and secondary screen. Although much research has been done within the area it is often specific to a specific type of TV-show, such as a documentary. Therefore the findings of these studies cannot necessarily be generalized to apply to sports as well, and further research would have to be made measuring the distribution of attention between the screens in a sports context. In sports it is for example important that the viewer does not miss any important events such as goals on the primary screen, which is more crucial than in for example a documentary. Although this project has evaluated a design of a second screen application for ice hockey broadcasts it is difficult to assess how the guidelines specified can be generalized to other sport events. Although other team sports such as soccer and bandy have similar structures as ice hockey which makes a similar design easy to apply, it can not be said if the same information is relevant for each sport. For example, assists was a highly requested feature in the application evaluated in this project, however this could be due to their importance when counting points in ice hockey. In soccer players are more often compared by goals scored rather than goals and assists, which could make this information less important in such a sport. Similarly, individual sports such as biathlon and golf have wildly different structures and types of statistics, which could heavily effect how a second screen application would be designed. Further studies would therefore have to be made in order to assess how the guidelines specified can be applied to other sports than ice hockey.

While the data gathered throughout the project gives us information about how a second screen application for ice hockey can be designed from a UX perspective, it can not be said if such an application actually gives a better viewing experience. For this, further comparisons would have to be made comparing the viewers experience with and without such a second screen application. Furthermore this could once again differ between different sports, and contexts such as where and how the viewer is watching the game.

# Conclusion

Much research has been done within the field of second screen applications, however not many of these studies have examined the context of sports broadcasts specifically. The findings of this study show that while some of the findings of previous research still is applicable for sports broadcasts, some modifications have to be made in order to fully engage the viewer in the context of watching sports.

The user research done within this project show a need for similar applications. Although many sources of sports related data exist today, not many provide the user with a gathered source of information related to the event they are currently viewing. Furthermore the lack of synchronization that regular applications suffer from along with delays caused in broadcasts and streams lead to the viewer risking getting exposed to spoilers when looking for such information today. Because of this, some viewers refrain themselves from looking for such information even though it is of interest for them in the moment.

In this project, several design guidelines for second screen applications in relation to live sports broadcasts has been defined. These guidelines aim to answer the research questions examined in this project. Significant amount of data has been gathered thanks to a large user scale which has provided an indication of what type of information viewers are interested in gathering in this context. While the viewers show a significant amount of interest in a wide range of statistics about the players and the event that they are currently watching, it is notable that they show interest in other related events as well.

Furthermore a behaviour was noticed where second screen applications in this context can become hybrid applications, where users use it as a second screen application, and still visit the application between broadcasts to reach the available information. While this may partly depend on what type of information the application includes it is important to consider that information in a second screen application for sports may not necessarily only be of interest during broadcasts.

While this project has defined guidelines for ice hockey broadcasts that can be applied for sports in general, further research has to be made in order to fully understand how well these guidelines can be adapted for other sports. Likewise, further research has to be made in order to assess how previous research about the visual attention between the primary and secondary screen can be applied to second screen applications for sports.

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# A Appendix 1

A.1 Interview questions

# **Interview questions**

#### Interest in ice hockey

How often do you watch ice hockey?

Are you following any leagues?

- If yes:
  - Do you usually follow a specific team?
    - Do you feel that you keep track of the players in your team?
    - Do you feel that you keep track of the players in other teams playing in the same league?

Do you usually follow country based tournaments?

Do you feel that you keep track of the players in your national country?

To what extent do you keep track of the players in other teams playing in the tournament?

Does it occur that you want to know more about players such as which club they belong to or their tournament statistics?

#### Mobile phone habits during games

Do you usually use your phone or other device while watching ice hockey?

- When?
- What type of device?
- What do you usually use it for?

#### General habits during broadcast

Do you usually watch the buildup and breakdown of the match in the broadcast?

Do you usually leave the TV or switch channel during breaks, or do you stay to see what the studio has to say?

Does it occur that you during the broadcast want more information about the game, teams, or players?

Does it occur that you during the broadcast also look up such information?

- If yes:
  - $\circ~$  What type of information do you usually seek and how do you usually find it?
  - When seeking information, has it occurred that you have received that information before it is shown in the broadcast?
- If no: Is it because you are not interested in such information or is it because you do not know where to look for it?

#### Questions regarding our concept

Have you heard of SVT Duo?

• Potentially explain the concept of Duo and our concept

If you were to use such an app, would you like to interact with other viewers, or possible the studio?

• If yes: How?