# INF5261

Development of mobile information systems and services


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# Table of Content

# 1. Introduction

In this project we have explored the possibility of making a mobile application for cross-country skiing. By reviewing previous studies concerning similar topics, and gathering data from potential users, we made an interface prototype. In our paper we will present the project itself, what research methods we have used and describe our findings and summarize our experiences in the conclusion.

## 1.1 Group members

Our group consists of Anniken Josephsen, Johanne Oskarsen, Mathias Källström, Cornelia Hensen and Pierre-Yves Ponsonnet. We are five master students, three of us from the *Informatics: Design, Use, Interaction* program, and two exchange students with background in *Information Systems* and *Computer Science.*

## 1.2 Project motivation & idea

In Norway there is a long and proud tradition for cross-country skiing. Most Norwegians consider themselves as somewhat experienced when it comes to skiing and winter sports. However, there are very few that have good knowledge about the technical aspects surrounding cross-country skiing. Being semi-experienced to inexperienced skiers we believe it would be helpful to create an application based on user-built information. This way users can share information regarding snow conditions such as temperature/density/humidity etc. as well as information on what wax you should use and what tracks are difficult due to for instance lack of snow.

During the last years we have seen an emergence of GPS and context awareness technology being used for health/tracking applications, such as Runkeeper and MapMyRun to mention a few. These applications are mostly used to track parameters such as where, when, speed, duration and in some cases bodily information such as pulse, although they usually require some wearable equipment. One could argue that these apps can be used for cross-country skiing. However, they do not provide any information about the conditions or how you should prepare.

By focusing on user input we want to investigate how social collaboration can increase users' knowledge about the technical aspects of cross-country skiing.

## 1.3 Research question

Our research question is therefore:

*How can social collaboration through mobile technology increase users' knowledge about the technical aspects and conditions of cross-country skiing?*

## 1.4 Target group

Our target group consists of everyone who enjoys cross-country skiing, and would like to know more about the technical aspects surrounding this activity. Because the information database will be user-built it is important that our target group is rather broad, in order to recruit enough users.

## 1.5 How to investigate

Our plan is to have a user-centered design process. Therefore, we think it is necessary to perform interviews with skiers of different skillsets to help us establish what information the users might need, and what should be our main focus. These interviews will be conducted early in the process and are an important foundation for the design process.

In order to establish some guidelines of how the information should be presented, we need basic knowledge about different technical aspects regarding cross-country skiing. We believe it will be useful to have information about the different types of wax and how temperature affects snow density and humidity.

# 2. Related work

In this chapter, we will present articles that can relate to our project.

## 2.1 Collaborative user feedback

During an experiment within a project called OurWay (Harald Holone G. M., 2008) the researchers found out that users rarely consider the benefits for other users when they provide feedback on a given track, and that they are in most cases selfishly driven. From this they found that rating and user input acts as a by-product of using the application, and that the main activity is finding information relevant to the user's «there-and-then» situation. They also learned that in most cases, the user would not be aware of the other previous or future users of the system. They propose a solution where awareness of other users and addressing issues are related to trust and reputation. This is most certainly a valid point, considering it helps users to assess the importance and relevance of the given information. In addition, it might also lower the threshold of contribution by giving the user a feeling of recognition or accomplishment.

For our project we have taken this into account when designing the user input interface. We want the threshold of contribution to be as low as possible, and we also want to sort the information based on ratings, so that user get the best information rather than having to scroll through many pages and assess it themselves. Because the information is user-built we need to make it easy to share information, and we need it to be welcoming.

## 2.2 Space and place

Harrison and Dourish define *space* and *place* as "space is the opportunity; place is the understood reality" (Steve Harrison, 1996). The interesting aspect of this article for us is what they call "place as cultural phenomenon" and more precisely the model of "complex forms: Space-less Places" because it has no physical space. They develop the idea of discussion and navigation without physical space. In our case the "navigation without physical space" or social navigation is exactly our objective with people sharing information about the snow conditions. Moreover, in our case we want the application to be a place or a space with personal adaptation

and appropriation because we need some information from the user. If the user use our app as a "place" then the user will put personal information that we can use for the app and share information.

## 2.3 Direct and indirect contact to get information

Bilandzic et al. wrote a paper which describes the development of *CityFlocks*, a "mobile system enabling visitors and residents in a city to tap into the knowledge and experiences of local residents" (Mark Bilandzic, 2008). The authors studied different ways to get information from users: direct (via voice call and text messaging) as well as indirect (location based comments and recommendations) contact between the users who give and those who want the information. They investigated that the users "mostly prefer gathering information following the indirect approach" (Mark Bilandzic, 2008). Furthermore, they found out that the users are uncomfortable voice calling a stranger for information even if they know that this person consented to give advice on this way. They liked the direct contact to local residents via text messaging much more (Mark Bilandzic, 2008).

This article is relevant for us because we want users to tap into knowledge of other by sharing information. The users of our application will give feedback about a track in form of comments. Knowing that this is the preferred way of contact is important to know while developing it.

## 2.4 Context-aware mobile systems

Tamminen et al. describe in their article a study they executed where they dealt with the question "how context-aware computing might make its place in mobile activities" (Sakari Tamminen, 2004). They wanted to explore how external factors influence the use of context-aware systems. Even if the study dealt especially with navigation in urban environment the characteristics of mobile contexts as well as the findings and the design implications can be adopted to our project because our app is meant to be used at home to plan a trip as well as outside while skiing. For example, if you are taking a long trip for several hours you maybe want to check if the wax you

are using (and need to renew) is still the right one or if it has changed because of new user recommendations.

The study emphasizes especially context changes that occur while moving. As said above the context of our app will change continuously because of user updates. Furthermore, the authors were interested in the majority of people. Regarding this point, the participants in the study consisted of all kinds of people. Our target group also consists of all kinds of people as long as they ski. Some of the given design implications can be adapted to our project. For example, they recommend using vibration to indicate that one's bus is approaching the bus stop. We could also use this concept to inform the user that the recommended wax for his/her track has changed.

## 2.5 Visualization of complex information

Karstens et al. investigate how existing techniques of visualization of complex information "can be adapted or redesigned for mobile pocket-sized devices" (Bernd Karstens, 2003) with limited resources. The screen of a mobile device offers very limited space so that they wanted to identify new techniques for searching and finding information that avoids spacious scrolling. The paper states techniques that address different requirements we also have to deal with in our project. For example, they describe a few techniques regarding information hiding that can also be very interesting for us. Our application will show an average of the user recommendations regarding the wax based on user data. If the user wants to get more detailed information about how many recommendations each wax got he/she should get the opportunity to get this hidden information. In this representation "only interesting parts of the hierarchy remain visible in the display" (Bernd Karstens, 2003).

## 2.6 Motivational affordances for using a system

Hamari and Koivisto (2013) investigated "how social factors predict attitude towards gamification and intention to continue using [...] services" (Juno Hamari, 2013).
The results of the study showed that "social factors are strong predictors for how gamification is perceived and whether the user intends to continue using the service and/or recommending it to others" (Juno Hamari, 2013). Furthermore, they showed that the degree of dependency on other

users has positive effects on these relationships. They also found out, that the amount of recognition users receive indirectly affects the attitude due to the "concomitant increase in perceived reciprocal benefits" (Juno Hamari, 2013). Received recognitions as rating or 'liking' increases the attitude of a user as he/she convinces that "receiving and giving recognition [raises the perceived] [...] benefits from using the service" (Juno Hamari, 2013). This refers to receiving feedback as well as exposing to attitudes from others. As a significant design implication the authors state, that it is important that the users are committed to the same goals and therefore build a community to accomplish this goals. Furthermore, the service should be created in such a way that it provides a participating usage culture.

Even if the goal of our project is not to create a gamification service the findings described in this article deal with a concept that is interesting for us. To make the app work well we need the users to give feedback regarding their trip (conditions, wax…). Obviously the users of our app have the same goals: learn about the technical aspects of cross-country skiing and prepare as best as possible for a trip. Therefore, we need to create a service where the users are part of a community and have a high motivation of sharing their experience to increase the benefit of the app for others as well as themselves. Using the idea of rating or likes seems to be an interesting and well-working approach to create motivational affordance especially because our actual target group is familiar with these concepts owing to online-shopping and social networks.

## 2.7 Universal design

Universal design is important to focus on in order to develop an application many people can benefit from even if they have disabilities. Schulz et al. therefore formulated guidelines that "should help in creating apps that are accessible to other people with [...] disabilities" (Trenton Schulz, 2015). They mention that there are already assistive technologies existing such as screen readers and the capability for users to change text size. Furthermore, they give additional guidelines that can improve the accessibility of an app for users with disabilities based on best practices. For example, they state that it would be an important first step to include people with disabilities in the research and investigation at the beginning of the project. Another

comprehensible point is to choose good color contrast to make it possible for users with low vision to use the application without many errors (Trenton Schulz, 2015).

Even if we have not used this concept in our project until now it is important to think about it with respect to further development. It is conceivable that also people with low vision or elderly people show interest in our application and that the target group will be expanded in this direction. Our project currently focuses on a defined target group without disabilities (see chapter 1.4) but regarding further development it is important to have a look at universal design.

## 2.8 Privacy

Because our application is based on social collaboration, and uses GPS tracking, privacy is an issue we need to address. We will most certainly respect laws and rules regarding personal privacy and publication. However, there are certain ethical issues related to privacy and publication as well. Holone et al. discuss three boundaries, developed by Altman, when negotiating information disclosure (Harald Holone J. H., 2010). The first boundary is *disclosure boundary* which is what information should be shared or revealed, and what information should be hidden. The second boundary is the *identity boundary* which is defined by the role taken on by the user. For instance, if the user is representing him- or herself personally, someone else, or if he or she represents a group such as a company or organization. The third boundary they discuss is the *temporal boundary* which is the information that is left behind or temporarily stored, and can be read by unintended recipients at a later time.

When designing technology for social collaboration it is important to prevent information leaks, to ensure the privacy and safety of the users. Altman's insight is that privacy is not a static set of rules, rather a dynamic process and a constant negotiation depending on the context (Harald Holone J. H., 2010). From our context we find that the disclosure boundary and the temporal boundary are issues we need to investigate when designing our application.

# 3. Methods

In this section, we will present the methods for our data collection. First, we will introduce our data collection by explaining the methods and analysis, before presenting a summary of our key findings.

## 3.1 Data Collection

After brainstorming ideas, we had an initial idea for an app, but we had a lot of different thoughts on what the app should do, and what our main focus should be. We needed to collect data from our target group to narrow our focus, and to gather information on what issues the user group encounter while planning or during a skiing trip to make sure our prototype would address their needs.

We had some overall goals for our data collection; we needed to know what the typical user needs from an app like this, if they are motivated to collaborate in social communities, and what information they were most interested in getting while planning a skiing trip. To make sure our app was not trying to address a need that is already being covered, we also wanted to investigate what apps people in our target group are already using. The main concepts we wanted to look into was in what way users are interested in real-time information from other users, and if they have any constraints on what they would like to share themselves. We also touched upon the gamification aspect and thoughts on GPS-tracking. To get the information we needed, we chose to triangulate different data collection methods. We decided on using two methods; questionnaires and interviews.

### 3.1.1 Questionnaire

We created the questionnaire to get an overview of people's motivation to go skiing, what information they are interested in before and during a skiing trip and if they are willing to share information about their own trip. We decided on doing a questionnaire mainly because of the time constraints. By conducting an online questionnaire, we were able to get data from a fairly large amount of people in a short period of time. This way, we were able to get an overview of our potential users and to narrow our focus based on key findings in our questionnaire. With a

short amount of time and our need to get information quickly we wanted to form a questionnaire that did not require too much from the user by making it short and concise. From experience we know that by using yes/no questions, scales and checkboxes, more people will do the questionnaire and the analysis of it will not be as advanced. We can assume that only those who likes cross-country skiing would use our application, so our first question was to exclude those who do not like cross-country skiing. By asking this we can know that our data will be from our potential users. The questionnaire was shared on Facebook, and that will limit the age range for the participants since most of our Facebook-friends will be around the same age as ourselves.

### 3.1.2 Interviews

We conducted several interviews to get a deeper understanding of the users' motivation and what issues they encounter in relation of planning or going on a skiing trip. Our main goal for the interview was to gain a better understanding of the user needs and to explore the problem space further.

The participants we chose for the interviews are all people we know to be active, and who likes to go cross-country skiing in the winter. We chose to do unstructured interviews with open-ended questions. Since several of the group members can be said to be part of the target group, we did not want our previous knowledge to create biased data. By using an unstructured type of interviews, we thought the users would be more likely to present their thoughts and needs, instead of just confirming our beliefs. We wanted the participants to speak freely of the subject, but we made sure the conversation did not trail off during the session.

## 3.2 Analysis

For our analysis, we grouped the data into categories to get a better understanding of the main concepts we wanted to investigate. For both the interviews and questionnaire, we focused on the user's motivation both to go skiing and to use an app like ours, challenges they face while planning or being on a skiing trip, and the aspect of social collaboration - if they are interested in others' experiences and if they are willing to share information themselves.

From our questionnaire, we mostly got quantitative data that we can use to guide us in the development of the app, to make sure we address the user needs. We have based our analysis of the questionnaire on the 48 valid responses we got. In the introduction, we asked how often the participants went skiing during the winter, and the analysis shows that we have reached a variety of people - both those who do not ski often, and those who ski frequently. Most participants were grouped in the middle of these two categories - which fits well into our intended user group.

The analysis of the interview data is based on five unstructured interviews. From the interviews, we got qualitative data, which we grouped into the three categories to extract the main findings in an orderly manner. The interviewees that participated in our studies are all on approximately the same skiing level - they all ski occasionally or often during the winter, but are not active athletes.

### 3.2.1 Motivation

Before this questionnaire we wanted to focus on those who uses cross-country skiing as exercise and those who go skiing to enjoy the nature. Our results shows us that these are the main reasons for people to go cross-country skiing.

Regarding the motivational aspect of our focus for the data collection, the interviews corresponds well with the data from our questionnaire. The interviewees were also motivated mainly by the fact that they can work out while being out in the nature.

### 3.2.2 Challenges

From our questionnaire, we identified several challenges people have while preparing to go ski. What most people try to find out before they go skiing is what weather conditions they need to prepare for, track status and temperatures, and how they can prepare their skis for these conditions. Out of the 48 respondents we have based this analysis on, 82 % said that they are

interested in getting real-time information about condition in the tracks, which shows that they find this difficult.

The participants in our interviews told us that what they find the most challenging when planning their trip is choosing what kind of wax they should use. Even though some of them go skiing 3-4 times a week through the season, they still find it hard. They might not have this information wherever they go skiing and they admit the difficulties of choosing wax by themselves. It can be hard to know how the track is that day, if it is icy, not enough snow or if it is wet, then it will be harder to choose wax even though the wax is based on temperature. By having this information before they choose wax will help them choosing the right one.

One of the main findings from the interviews was the fact that several of the interviewees mentioned that they already have some kind of community to help them prepare for skiing. Some of them said that they mostly ski while at their cabin in the mountains, and there, the community surrounding them often talk about the skiing conditions and what kinds of wax is appropriate. There is always someone to ask, and they find this very helpful. However, when they are at home, this community is missing, which makes knowing how to prepare a lot more difficult. The fact that the conditions often vary more between city and the forest, makes predicting the conditions in the ski tracks difficult.

### 3.2.3 Social collaboration

One of the most important questions in the questionnaire is what applications people already are using before or during a skiing trip, so that we can get an idea of what needs are being covered today. By taking a look at these applications we could see that something similar to our idea does not exist. Some of the applications they told us about was yr.no, Strava, iMarka and Swix. We could say that our idea is more or less a combination of all these apps. However, none of the above provide skiers with real-time user information the way we imagine our app will do.

Our questionnaire showed us that most people want to get information, but they are not that willing to share it. As many as 47% said that they would not like to share their experience with

others, but 82% wanted to get information. To be able to get input from our users, we have to focus on making the sharing part easy, so that the users will not find the sharing part frustrating.

The data from our interviews gave us a more nuanced picture of the getting/sharing information aspect. The interviewees gave us a deeper understanding as to why they might not be willing to share information. Since the interviewees were all skiing more as a hobby, they were concerned that their information might not be good enough for others to use, hence they were reluctant to share. They also emphasized the fact that if they were to share any information, the app needed to facilitate an easy way of sharing so that it would not feel overwhelming.

While reading about others information and experience, our interviewees wanted to make sure that the information came from someone with the same experience and at the same skill level as them. To get this information it would be helpful if all of the users had their own personal profile with name, age, skill level and this season's distance goal, for example. They also said that it would be important to see the most qualified or recent information first to avoid spending a lot of time looking for what they need.

The last and important information we got from our interviewees was that they are more likely to share information if their skiing trip went well, than if their choice of wax was weakly chosen. If people want to share information with others, it is usually positive and good information they want to share, and they will keep the negative information to themselves.

## 3.3 Key findings

After having analyzed our data, we now present our key findings, which we chose to focus on further in the development.

In our questionnaire we got an overview of why people go skiing and about what kind of information they want before they go out. Our results show that most people go skiing either for exercise or to explore the nature. We could also see that most people want to get information, but are not that willing to share the same information. It will be important for us to focus on getting

people to share information when we start our design process, to make sure that we get user input, which is basically what we build our app on. Also the fact that several of the interviewees mentioned the positive aspects of having some kind of community to rely on when preparing for a ski trip is something we have emphasized in our development.

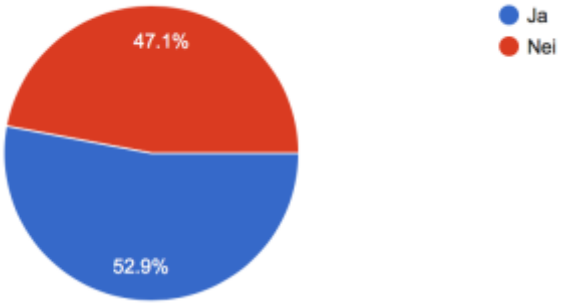


*image 1: Question; Would you like to share information about your trip and the conditions?*

In our interviews we wanted to look deeper into what people find hard about skiing, and we wanted to get a better understanding about their thoughts around this topic. Early on it was clear that no matter what skill level you are at, knowing what kind of wax to use is difficult, and people struggle with this decision every time they go skiing. None of our participants are professional cross-country skiers, but they go skiing every winter. Most of them were at our age (between 20-30), so this means that they are digital natives and uses their smartphones more frequently than digital immigrants. We assume that these will be our early adopters, as our main focus is user-built information, which requires an initial user base who can make the app attractive to more users.

# 4. Prototype and user testing

In this chapter, we are going to present our work with the prototypes. First, we show how we chose to prototype our solution low-fidelity, before we present our user testing and how we proceeded to the mid-fidelity prototyping.

## 4.1 Low-fidelity prototype

After gathering data, we started to develop some sketches and a low-fidelity prototype, using a web service called *Prototype On Paper app*. This service allowed us to quickly make some extent functioning prototype which enables the user to navigate through the different steps of the

application, as well as getting a first impression of the user interface. From this we can perform user tests and get important feedback early in the design process.

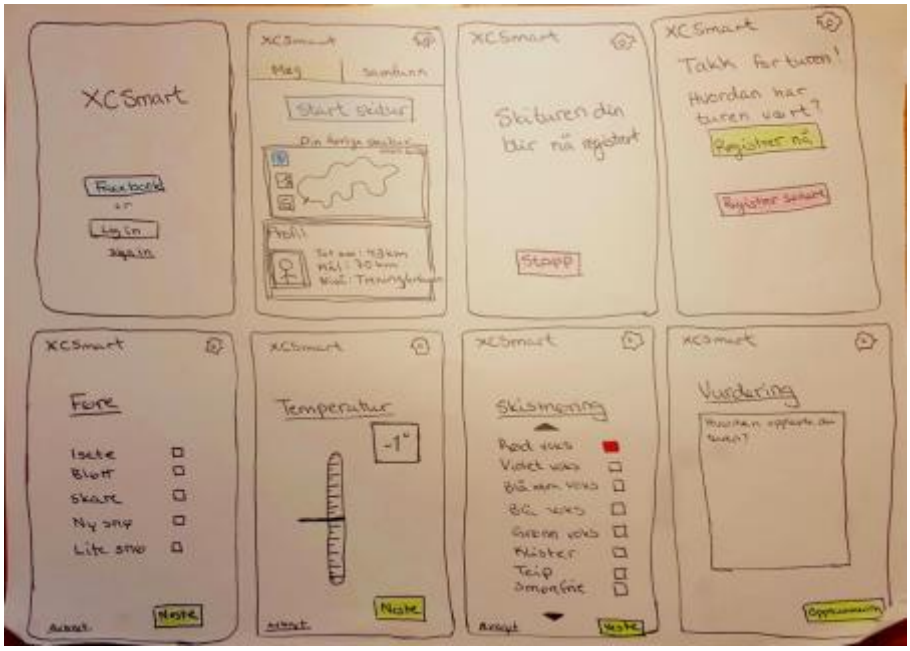


*Image 2: Paper sketches showing the task order of registering data from a skiing trip.*

Our low-fidelity prototype was developed with consideration to the data gathered from interviews and questionnaires, and also previous studies concerning collaborative user input and context aware technology as described in section 2.

## 4.2 User test

We had two participations to test our paper prototype. After the first test we did not get constructive feedback, it was more about how great and exciting this project was. One feature that was mentioned was the ability to move around in the map, to use checkboxes and to scroll up and down in the application. These are functions that cannot be tested on a paper prototype, but are functions that we would like to implement in a high-fidelity prototype.
First time you download the application you will have to sign up with Facebook or with your own customized login. The user also needs to make a profile where he or she enters name, age,

skill level and this season's distance goal. In our second test it was questions about anonymity, and the participant wanted to be able to make his own username, or at least have it as an option.

There can be times when you go out skiing for hours, and the conditions and temperature might change during the trip. It will then be useful to have different sections where you can choose conditions, temperature and wax for beginning, in the middle and end for your trip - timestamps could also be useful. If not having this option, it would be better to choose our condition categories more careful and only be able to choose one condition.

It was said that it could be some lack of motivation to actually register your skiing trip, and that could be solved by getting points every time you register. After getting a certain amount of points you could get some kind of reward, or you could be able to access more information.

## 4.3 Mid-fidelity prototype

In order to give the user a better impression of the user interface and the functions, we made a mid-fidelity prototype using another web service called *Proto.io*. This is a service which lets us make a high-fidelity user interface, as well as some direct interactions. From our low-fidelity prototype we were able to test the aspects of navigation within the application, in addition to the order of tasks to be carried out. With our mid-fidelity prototype, we were able to get feedback on the pure aesthetics of the application, and how the information was presented.


*Image 3: Screenshots of our mid-fidelity prototype*

With this prototype we wanted to test colors and placement of different objects. We wanted to make sense of the colors that we used and focused on *affordance.* For instance, we used a lot of blue and cold colors to replicate the feeling of snow and ice. We also used classic "traffic light colors" on our buttons to let the user know which buttons are used to proceed and which buttons are used to stop etc. Our intention was to make the coupling between expected effect and actual effect as clear as possible.

# 5. Future work

In this section we will present some possibilities for further development of our app, additional user groups which can be interesting to include in future studies and what functions might be interesting to develop.

## 5.1 User testing and development

If we would develop this concept further, we would continue with iterative user testing to make sure that we maintain the user's interests. We would test our mid-fidelity prototype and eventually make a high-fidelity prototype and test it in a natural environment. We would also do an in depth usability test. As mentioned in chapter 4.2, the focus will be on affordance and coupling, to make the user's expected result and the actual result as similar as possible. Based on the findings of these tests we can change and improve the design of the mobile application.

As it is not currently the season for cross-country skiing we would not be able to carry out a user test in the real use environment of the application. We could however try to simulate the activity to get some indicative results. For instance, we could use roller skiing as the most similar substitute. Although it will not be possible to test all the functions of the application properly, such as snow conditions, it would make it possible to test the GPS tracking and maps.

Our application is relying on GPS technology for tracking the user during the skiing trip, as well as finding tracks nearby. Because many people go skiing in the mountains, a problem that might occur is that the user loses their phone signal. This is an issue that we have not addressed in our design process, but it is most certainly something to think about for further development.

## 5.2 Additional target groups

If the mobile application would be released, and reached a rather big user pool, we would try to widen our target group. By analyzing the actual user group, we would gain information about users that are not currently in our actual target group. Beyond that we would carry out a survey to find out which people beside our target group would be interested in this application and what requirements they would have in contrast or addition to our actual target group.

We also thought about expanding our target group to beginners and have the application serve as an aid or a tool to teach them about cross-country skiing. For this possible user group, we would definitely have to gather more data to investigate their needs. We expect that those users' requirements would be vastly different from what the application is offering due to that they have no experience with cross-country skiing.

## 5.3 Ideas for future functions

During the brainstorming we had a few ideas that could be implemented, but we chose not due to the time limit and scope of this project. We discussed the possibility of using some kind of sensor under the skis to give real time information about the snow temperature and density to make sure that other users always get correct real time information. We also discussed the possibility of a discussion board or chat function. The idea would be that users can contact other users regarding their reviews, to ask for additional information. This idea is similar to the concept described in chapter 2.3.

We also talked about applying some kind of gamification aspect in an attempt to encourage users to go skiing more often. For instance, we could implement the possibility of competing over distance coverage with your friends, and create teams etc. This could also increase the participation culture what would increase the motivation of giving recommendation as described in chapter 2.6.

Further, we also wanted to implement a search function which lets the user search for different variables, such as temperature or type of wax in order to find tracks nearby with some preferred conditions. Another feature we discussed was the possibility of adding markers on the map for cabins where skiers can take a break and buy a cup of coffee etc. Then it would also be possible to make a search based on whether there is a cabin somewhere along the track.

# 6. Conclusion

As mentioned in our introduction, we wanted to focus on the aspect of social collaboration through mobile technology, to increase users' knowledge about more technical aspects of skiing.

One of our key findings is that it can be hard to achieve the required user base to actually make an app that is so dependent on user contribution to work. Our studies show that most people are quite reluctant to share information, especially if they do not achieve some feeling of recognition or accomplishment, which corresponds to the study described in chapter 2.1. Therefore, we find it important to address issues related to trust and reputation when designing technology for social collaboration.

## 6.1 Answering the research question

For our conclusion, we want to return to our initial research question;
*How can social collaboration through mobile technology increase users' knowledge about the technical aspects and conditions of cross-country skiing?*
We see now that we were too ambitious at our starting point, seeing as we only had four weeks to draw a conclusion. Within the timeframe of this project, we have not been able to answer the research question the way we anticipated. This is mainly due to the fact that we have not had the time to develop and test our solution thoroughly. However, we can by looking at our data collection and user testing imply that the intended use of this app could have increased the users' knowledge about the technical aspects of cross-country skiing. We definitely found a need for this kind of information, but are not able to conclude whether our solution would be sufficient to address this need.

## 6.2 Limitations

We faced problems that we have been aware of at the beginning of the project as well as those we have not thought about. We were aware of the fact that it is not the time for cross-country skiing in Norway at the moment but as the course takes place in the autumn semester we had no influence on when the project starts. Furthermore, we know that there can be a problem regarding getting a phone signal in the mountains. The biggest challenge for us was the lack of time. We had to reduce the amount of functions we wanted to implement after the brainstorming because we knew that we would not have time to focus on all of them properly. But this was not the only problem that occurred because of the short time frame. This fact lead to a series of successive delays: Conducting a data collection that gives us a good amount of information about the user needs as well as our target group took a lot of time compared to the fact that we only had four weeks at all for this project. To start deciding which functions we wanted to implement and start designing a low-fidelity prototype we needed this information. Furthermore, the testing of this prototype took a few days and we also were not able to do that many tests as we wanted. After analyzing the tests, we started immediately to develop the mid-fidelity prototype based on the findings but due to the fact that we just finished it we had no time to test it.
In summary we faced a few problems with different difficulty. The most difficult problem was definitely the lack of time and therefore the fact that we could not answer our research question until now as said in chapter 6.1.

# References


Bernd Karstens, M. K. (2003, June 15). Visualization of Complex Structures on Mobile Handhelds. *Proc. International Workshop on Mobile Computing*, s. 8.

Harald Holone, G. M. (2008, October 10). Aspects of Personal Navigation with Collaborative User Feedback. *NordiCHI 2008*, s. 10.

Harald Holone, J. H. (2010, October 20). Negotiating Privacy Boundaries in Social Applications for Accessibility Mapping. *Proceedings of the 6th Nordic Conference on Human-Computer Interaction: Extending Boundaries*, s. 9.

Juno Hamari, J. K. (2013, January 7). Social Motivations To Use Gamification: An Empirical Study Of Gamifying Exercise. *ECIS 2013 Completed Research*, s. 12.

Mark Bilandzic, M. F. (2008, February 22). CityFlocks: Designing Social Navigation for Urban Mobile Information Systems. *DIS '08 Proceedings of the 7th ACM conference on Designing interactive systems*, s. 10.

Sakari Tamminen, A. O. (2004, April 24). Understanding Mobile Contexts. *Personal and Ubiquitous Computing*, s. 9.

Steve Harrison, P. D. (1996, November 16). Re-Place-ing Space: The Roles of Place and Space in Collaborative Systems. *CSCW '96 Proceedings of the 1996 ACM conference on Computer supported cooperative work*, s. 10.

Trenton Schulz, F. G. (2015). *Best Practices for Creating Accessible Mobile Applications.* Norwegian Computing Center. 0314: Norwegian Computing Center.