User Studies on Mobile Ticketing

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Abstract. This paper presents the results of user studies on a public transportation mobile ticketing concept. The studies aimed at obtaining a thorough understanding of the diverse user needs in a travel ticket ecosystem, thereby providing relevant and valuable information to guide the development process of a new mobile ticketing system. The user studies were conducted in three phases, starting from analysis of the present ticketing system and ending with evaluation of the new concept generated. The studies were executed in close collaboration between academia and industry, and the results proved to have great impact, as they were used for making strategic choices between technological alternatives and in marketing the development of new mobile financial services to various potential business partners.

Keywords: User-centered design, User research, Scenarios, Mobile services, Public transportation ticketing.

1 Introduction

Designing a new ticketing system for public transportation is a notable challenge, as multiple user groups and their varying needs have to be addressed. Not only do the passengers use the system on a daily basis; rather the drivers and ticket inspectors do as well. Although all user groups share the same general demand for ease-of-use, each user group also has specific needs for the ticketing system. In addition to the needs related to the daily use of the system, the ecosystem also involves other needs related to the management, maintenance, and business aspects of the system. In current rapid product development cycles, it is very difficult to address and fulfill all the various needs and satisfy all the parties involved. Therefore, selecting effective methods and a well-balanced sample of representative users for the user studies is especially important. Effective communication between involved stakeholders throughout the development process is also essential to enable changes in the development early enough to save both money and time.

In recent years, there has been a noticeable trend to bring out more and more services for mobile use. One potential reason for this is the rapidly increasing number of mobile cellular subscriptions, which was globally expected to reach five billion in 2010 [1]. Public transportation ticketing is one application area that can surely benefit

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from the possibilities provided by mobile technologies. Besides, as public transportation concerns a mass of people, a successful introduction of mobile ticketing can further create opportunities for other mobile services.

This paper describes a case study where user studies were conducted to obtain a thorough understanding of the diverse user needs in a mobile travel ticket ecosystem. The objective of the study was to form a strong basis for the development of a Near Field Communication (NFC [2]) -based mobile ticketing concept. Before this case study, the development project had concentrated primarily on technological aspects, so the need for a user-centered approach was evident. Therefore, to broaden the scope beyond technological feasibility prototyping, user studies were conducted to get ideas concerning how to make the system easy and pleasant to use and even tempting for the passengers. Although the focus was on the passengers on public transportation, drivers and ticket inspectors were also included in the studies. Furthermore, the public transportation company and the developers of the planned system were involved in the studies through several workshop sessions.

In section 2 of this paper, we present the background information of the project and the technological framework, as well as the parties involved. The third section describes the process of the study; following this, section 4 gives an overview of the applied methods. Section 5 elaborates on the results of the study, whereas section 6 discusses the experiences we had in the case study and the role of our user studies in the continuum of system development. Finally, section seven presents our conclusions.

2 Background

The case study in this paper is a part of a Mobile Financial Services (MoFS) research program funded by TEKES (the Finnish Funding Agency for Technology and Innovation). The aim of the program is to promote the transition of financial services to the mobile environment, and to steer present use habits toward a “wallet in a mobile phone” mindset [3]. Both academia and industry are involved in the program. In this case study, Aalto University School of Science and the Tieto Corporation (a Finnish company offering IT, R&D, and consultancy services) were the most important parties.

At the moment, the public transportation of the Helsinki region is equipped with a system called Travel Card (see Fig. 1) that is based on radio-frequency identification (RFID) technology. The system consists of card readers and ISO 14443A–compliant DESFire smartcards [5]. Users can choose between two ticket alternatives: value and period. Value ticket users purchase single tickets by showing their card to the reader and pressing one of its numbered fare zone buttons, while period ticket users only show their card to the reader [6]. A Short Message System (SMS)-based scheme is also available, but with limited coverage of the transportation ecosystem.

The starting point for the development of the mobile ticketing system was to utilize NFC technology: Instead of a separate card, the tickets would be handled by an NFC microchip inside a mobile phone. Like RFID, NFC is a technology for short-range wireless connectivity that can also be used for peer-to-peer connections and reading passive RFID tags [2].

Fig. 1. Travel Card [4]

As we planned the user studies, we identified at least three challenges that would have to be addressed. First, we should be able to present feasible and inspiring ideas that would meet the requirements of both the development team and potential business partners, while maintaining a strong focus on the user perspective.

Secondly, the public transportation ticketing system has multiple user groups. In addition to passengers, bus drivers and ticket inspectors have their own perspectives and needs regarding the use of the system. These user groups are also known to be harder to contact than ordinary passengers are.

Thirdly, obtaining relevant user comments on concepts was not obvious, because of the unfamiliar NFC technology framework. This had to be taken into account when presenting ideas to the users.

3 Process

The user studies were conducted in three phases, namely:

1. Exploration of the current ticketing system and previous studies;
2. Idea generation to create scenarios of mobile ticketing use cases and value-adding services;
3. Evaluation of the scenarios with passengers.

The first phase of the user study aimed to construct a comprehensive understanding of the present ticketing system. The material from this phase served as a basis for a realistic context of use and the key requirements for the new system. The methods used in this phase included a survey, observations, and interviews with various user groups (passengers, drivers, and ticket inspectors). We also used previous studies (e.g., [7]) and student assignments as supporting material. A heuristic evaluation [8] was conducted at the end of this phase to support the classification and rating of the usability problems found.

Based on the results of the first phase, we started to generate ideas on the functionalities and value-adding services of the mobile ticketing system. Ideas were kept independent from the technological solutions, and the focus was on the passengers' interaction with the system. In the ideation sessions, brainstorming [9] and 6-3-5 brainwriting [10] were utilized. To illustrate some potential use cases of the mobile ticketing system, we drafted a few scenarios that were presented in a workshop session with representatives of both the potential customer (i.e., Helsinki Region Transport) and the developers of the system (i.e., Tieto).

Based on the workshop feedback, we formed one comprehensive scenario that covered the whole ticketing lifecycle from the passenger's point of view. The scenario started from making the user aware of the service and motivated to download the application to her mobile phone, and ended with the actual use of the application. In addition, some value-adding services were presented in the scenario to encourage the users to share their ideas about useful supplementary services. The finalized scenario was evaluated with 21 passengers of varying backgrounds. At this point, the drivers were not interviewed due to their tight schedules. Finally, the collected feedback was analyzed and presented to all the major public transportation organizations in Finland. It was also used as a basis for discussion in several workshop sessions, and as a marketing material in events promoting mobile financial services to other business partners such as telecom operators and banks.

4 Methods

In our user studies, we utilized various methods, namely surveys, observations, interviews, heuristic evaluation, and scenarios to collect both quantitative and qualitative data. Quantitative data was considered important in convincing the stakeholders of the severity of the usability problems in the current system and, thereby, of the need for a new system. Qualitative data, on the other hand, was considered essential for obtaining in-depth information on how passengers would like to use a mobile ticketing system, problems and threats they might attach to it, and supplementary services they would like to have available. In the next four subsections, we will elaborate on the methods that gave us the most valuable results.

4.1 Surveys

Surveys can be used to collect considerable amounts of user data quickly and with little effort. In this case study, we conducted a web survey, for which we gathered participants mainly via the Helsinki Region Transport website. In two weeks, we received 162 responses. The survey was conducted at the very beginning of the study to get a wide perspective on the passengers' opinions and needs as early as possible. In the survey, we concentrated on gathering data on user experiences of the present ticketing system and ideas on how a mobile phone could be used for public transportation ticketing.

4.2 Observations

In observations, the observer follows the actions of one or more people while they are carrying out their tasks. People can be observed from a distance without interaction, or by getting involved and interacting with them. The non-intrusive observation technique is especially suitable in cases where the involvement can cause unwanted changes in the dynamics of the situation, whereas involvement can sometimes reveal important subtleties.

We carried out observations in two stages. The aim of the first round of observation was to obtain qualitative data, while the second observation round concentrated on recording quantitative data. We collected qualitative data by observing the use of the current ticketing system from different perspectives, focusing on the factors that seemed to affect the use most significantly. The collected material was used as a basis for forming a comprehensive context definition covering differences in the means of transportation, the different user groups and their roles, and the effects of environmental factors. The context definition served as an important source of information for the requirements of a new mobile ticketing system.

In collecting quantitative observation data, the focus was on identifying usability problems and collecting data on their frequencies. During the second round of observation, we collected over 5 hours of observational data on 315 passengers entering busses, trams, local trains, and the subway. The quantitative observation data served as means to justify the need for a new system to the representatives of the public transportation companies. All of our observations were non-intrusive, since the aim was to get a realistic view on the problems that passengers face while entering the vehicles.

4.3 Interviews

Interviews can be used to obtain in-depth information about specific themes. Depending on the objective, the interview can be based on closed questions, wider themes, or a mixture of both. The interviews we conducted during the case study were semi-structured, avoiding closed questions and focusing on interviewees' comments and opinions on a few specified themes.

At the beginning of the study, we conducted four individual interviews and one group interview. Two bus drivers, one tram driver, and one ticket inspector participated in the individual interviews, and five passengers participated in the group interview. We interviewed the drivers and the ticket inspector in their real work environment. The real context, with all the tools and systems at hand, was considered to give valuable results, since it would remind the drivers and the inspector of situations that were relevant and descriptive for the Travel Card system. The aim of the passenger group interview was to expand on some of the findings from the survey responses, such as flexibility in time and place in loading the money or period onto the card.

In the evaluation phase, we interviewed 21 users individually about our finalized mobile ticketing scenario. Our aim was to gather information about motivational factors, perceived threats, and potential usability problems. The interviewees included 12 women and 9 men whose ages varied from 15 to over 50 years; most of them had a travel card loaded with either a period or value.

4.4 Scenarios

Using scenarios in the design and evaluation of new systems is an effective way to convey concept ideas in a format that is evenly accessible for all of the stakeholders, regardless of their background [11]. We used scenarios to illustrate our ideas for various stakeholders involved in the project. Our first scenarios of how passengers would use the system were narrative descriptions supplemented with sketched comic strips. The finalized scenario was constructed around a series of computer-edited photos from different phases of the imagined use of the concept system (see Fig. 2). Familiar devices such as a regular mobile phones and the current card reader placed in a realistic environment were considered to reduce confusion caused by unknown technology and encourage users to express their ideas and opinions.

Fig. 2. Examples of scenario visualizations

5 Results

As we used various methods in our studies, we managed to cover a wide variety of situations and different factors. In this section, we present the most important results of the case study. The results have been sorted in terms of the data-gathering method.

5.1 Exploration of the Current Ticketing System

Based on the survey results and the group interview session, it was evident that possibilities for checking the travel card value and validity were currently too limited. Checking the information is possible only with a card reader device and in some of the ticket vending machines. The passengers wanted to check their card value and validity more flexibly, irrespective of place and time. They also wanted a more flexible alternative for loading value and period onto the card, since this is currently possible only in kiosks and in some of the ticket vending machines, which might not be at

hand when needed. During our user studies, we also discovered that the passengers thought the card reader did not provide enough feedback on the actions, showed the feedback inconveniently, and did not allow for correcting false button presses that the passengers occasionally made while trying to ensure that they had purchased the ticket successfully.

The recorded observation data gave good insight into the problems people face while using the system. We discovered that every other user had some difficulties in purchasing a value ticket with their Travel Card. It was also noticed that people mostly used both hands to select the fare zone on the card reader, so they had to lay down their bags, thus slowing down the boarding of the bus. In problem situations, the bus drivers were not always willing or able to help the passengers. The observations gave valuable information on the requirements of a mobile system for reducing problem situations. For instance, the mobile ticketing system should be easy to use with one hand, as well as if the user is on the phone while entering the vehicle. The quantitative results of the observations gave credibility to the requirements that we presented in our workshop sessions.

In the individual interviews with the drivers and the ticket inspector, the need for fluent and reliable use of the ticket system was emphasized. For example, the bus drivers mentioned that they often needed to help people to select the right fare zone, which slows down boarding. The drivers also pointed out that the cold winter climate causes problem situations in reading the smartcard. The interviews also revealed that the drivers and the ticket inspectors did not like the current SMS system at all, since it was difficult to validate the tickets from a tiny phone screen, especially in poor lighting conditions. The interviewees emphasized the need for a system that enables easy validation of tickets and, therefore, thought that NFC-based mobile ticketing could suit their needs well, since it resembled the current travel card system in terms of the ticket validation procedure.

5.2 Evaluation of the Scenarios with Passengers

As we evaluated the mobile ticketing concept with passengers, we received very positive feedback about the fluency and flexibility provided by the mobile system. Flexibility was considered the most important motivational factor for adopting the mobile ticketing by almost half of the interviewees. Another significant benefit of mobile ticketing, highlighted by approximately a fourth of the users, was the fact that their mobile phone was something they almost always had with them, whereas a separate card was forgotten at home more often as a consequence of using different jackets or handbags. Users also noted other positive aspects of the mobile system, such as the possibility of useful supplementary services. However, value-adding services were not by themselves considered reasons for switching to mobile ticketing. Our interviews also revealed that while receiving monetary benefits was generally a tempting idea for most people, it was not considered a major motivational factor for a change of service; rather, it was more something that would increase satisfaction.

Although the users considered the idea of mobile ticketing to be mostly beneficial for many reasons, they also expressed some concerns. Many of the users were worried about the security of the system, as well as the potential problems in downloading and setting up the service application. In the scenario interviews, we provided the users

with two alternatives for accessing the service, and asked which one they preferred. The alternatives were 1) downloading the mobile ticketing application by placing the mobile phone near a passive NFC tag in a bus stop advertisement, or 2) sending an SMS to a provided number and receiving a hyperlink to download the application. Many of the interviewees perceived the first alternative as a relatively unsecure way to download the application because of the potential risk for viruses and malware. However, it was generally considered a convenient way to start using the service. The latter alternative, utilizing SMSs, turned out to be more widely accepted, as users thought they would have more control over the process, thus reducing the security risks. Regarding both of the alternatives, the users were concerned with data transfer costs, as the majority of the users did not have a broadband Internet connection with fixed pricing. Many of the users also pointed out the problems that they had experienced when trying to install applications to their mobile phones.

In addition to the previous concerns, users also expressed their suspicion related to some other mobile-specific matters. Lack of technical reliability was seen as one threat, since new advanced smart phones were considered relatively unreliable. Furthermore, some of the users mentioned running out of battery as a possible problem. The current smart card solution was considered more reliable in these terms.

In addition to the weaknesses of the existing ticketing system that were uncovered, the results of our study highlighted important facts about users' attitudes toward and expectations of the mobile ticketing system. One remarkable finding from the user interviews was that a significant proportion of users expressed their unwillingness to buy a new NFC-enabled mobile phone just to be able to use a mobile ticketing system. Some stated that they might consider NFC compatibility when purchasing a new phone, but it was not seen as the determining factor in the purchase decision.

6 Discussion

In our user studies, we noticed that the results from different methods clearly highlighted different aspects that effectively complemented each other. For example, the interviews with the drivers and the ticket inspector revealed weather-related problems that were not noticed during our observations in the summertime. In addition, involving multiple user groups brought out varying needs. While the drivers were interested in the efficiency and fluency of boarding the vehicle, the ticket inspector focused on ergonomic aspects and simplicity in relation to checking the validity of tickets.

The quantitative results proved to be valuable in convincing the representatives of Helsinki Region Transport of the severity and frequency of usability problems with the current ticketing system. Although the problems with the system were known, the representatives were stunned by their frequency.

Scenarios turned out to be a natural way for all the stakeholders to understand and comment on the context and usage of the projected system. Using real photos enabled us to build a comprehensive and yet credible and realistic scenario quickly and without the need for good drawing skills. As the use context and technological devices, such as the mobile phone and card reader, were familiar to the users, they could easily concentrate on the new service, and assess its utility and usability.

The whole process of user studies lasted less than two months. Nevertheless, we were able to gather diverse material, helping us to form a holistic view on the various issues involved in the ticketing ecosystem. We were also able to address the major requirements of the various stakeholders, and came up with solutions and ideas that were well accepted by both the users and the company representatives.

The studies revealed that the users had interesting prejudices, as well as attitudes and habits that were, to some extent, in conflict with the developers' assumptions. For example, the average phone renewal cycle turned out to be considerably longer than assumed. Due to the lack of NFC-capable devices on the market and the users' unwillingness to buy them, strategic decisions were made in the development process, and new solutions had to be considered. From this perspective, it was determined that the shift to an entirely mobile-based ticketing solution would be more successful if handled through smaller steps.

From our user studies, flexibility turned out to be the most important factor in user expectations of the mobile ticketing system, as the current system was considered too rigid. Our studies also revealed that a majority of the users were unwilling to enter extensive amount of information with a mobile device due to a limited display area and a small keyboard. Two-thirds of users wanted to limit the use of mobile phones to setting up the service and daily use, and preferred to give most of the registration information with a desktop computer. Based on these findings, a decision was made to provide a partially mobile ticketing solution as the first step toward a completely mobile system. In this first step, some features such as loading period and value would become available through mobile phones and desktops, but the daily use in the vehicles would still be handled in the current way. This approach would bring flexibility to the system and familiarize the users with mobile services in the public transportation context while preserving the familiar everyday use logic.

7 Conclusions

Although interest in mobile services has increased substantially, and users in our studies saw the advantages of the mobile system over the current system, there are still issues that have to be considered. Based on our findings, security concerns and other attitudinal matters seem to be significant factors affecting the user acceptance of mobile services in the context of public transportation. Additionally, the users seemed unwilling to put much effort into the adoption of a new ticketing system.

The results presented in this paper have given an overview of the problems with the current ticketing system in the Helsinki region, as well as users' attitudes and opinions concerning a mobile ticketing solution. It may be that not all of our results are directly applicable to other public transportation ticketing ecosystems, but the results give insight into the attitudes various user groups have related to this kind of service. Most importantly, we believe that the results presented highlight the different contributions of the methods utilized, thus giving ideas for methodological choices in similar cases. Our case study also serves as an encouraging example of how versatile and elaborate user studies, combined with effective communication throughout the process between the stakeholders involved, can support decision-making in the development of a new system.

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