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WAP Travel Planner
Final Report

This is a project for the course "INF[34]260 – Human Computer Interaction" at the University of Oslo – Department of Informatics, autumn 2007. Introductorily, the nature of problem space and the challenges to be met has been discussed. Secondarily, the general background of the report is introduced. Furthermore, the paper discusses the literature and concepts that the work is based on, followed by analysis using relevant methods. Finally, a conclusion and suggestions for improvements and to further work are made.

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2.1   Abstract

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2.2   Problem description

The main subject of this report is to, with regard to usability;

The group is interested in finding out:

- Analyzing the user:
    - Who are the users?
    - What are their needs?
    - What is their context of use?
    - Does the solution satisfy their needs?
- Evaluating the current solution using different evaluation techniques:
    - Usability testing
    - Heuristics evaluation
- Presenting proposals for improvements of the current solution (partly based on the evaluation).

2.3   Nature of problem description

Our research questions took starting point at a previous project on Trafikanten (Brovig, et al., 2005), which took place in spring 2007 as part of the INF5261 course- Development of mobile information systems. The students in this project conducted a survey amongst users of www.trafikanten.no , fellow students and relatives. One of the concepts they have looked into was "Real time mobile information", where they tried to see whether users are aware that such system are in place and if so, to what extent they use them. There results were based on 380 completed surveys.

What we found interesting to investigate further on was the result that 90% of the participating users were aware that Trafikanten offers real time information, but only few were using this WAP & SMS service. In their conclusion they suggest the following reasons for low usage:

- Awareness
- Complexity
- Cost

We choose to evaluate whether the low usage is due to complexity where we focused on the "user friendliness" of this service.

To elaborate on this, the subject to be addressed by this project is analyzing Trafikanten WAP "Travel planner" with regard to usability.

3   Background / Theory

In this section we will describe background information that will be relevant for the project and give a brief introduction to Usability, usability goals and theory of cognition. For more background and theory please see Appendix.

3.1   Usability

3.1.1   Definition of Usability

Usability is a quality attribute that assesses how easy user interfaces are to use (Nielsen, 2003)

 The word "usability" also refers to methods for improving ease-of-use during the design process.

3.1.2   Usability goals

Usability is defined by five quality components:

Learnability: How easy is it for users to accomplish basic tasks the first time they encounter the design?

Efficiency: Once users have learned the design, how quickly can they perform tasks?

Memorability: When users return to the design after a period of not using it, how easily can they reestablish proficiency?

Errors: How many errors do users make, how severe are these errors, and how easily can they recover from the errors?

Satisfaction: How pleasant is it to use the design?

4 Methodology

4.1 Techniques

In a usability analysis it is common to use different techniques in an iterative manner (Usa07):

- Understanding the user
- Develop personas
- Write scenarios
- Evaluation

4.1.1 Understanding the user

In order to learn about the users we had to meet them, observe them, and involve them in helping us to understand their:

- Needs for information
- Ways of thinking about information, and search for information
- Levels of knowledge about Travel Planner
- Levels of experience with the WAP Travel Planner and similar WAP services

By meeting the users, we could also find out about the technology they have available to them, what mobile phone they use, the physically environment in which they work, and so on. There are many useful techniques to get useful information from users and about users, just to mention some: interviews, focus groups and surveys. We chose to learn about our users through 3 techniques: Survey, Interviews and usability testing. This is often referred to as Triangulation. "Triangulation is a strategy that entails using more than one data gathering technique to tackle a goal, or using more than one data analysis approach on the same set of data" (Sharp, et al., 2007 p. 293). In our case we used results from previous survey (questionnaires) to reach a wider population, interviews to target Travel planner user group, and usability testing to measure how well users could use the WAP Travel planner for its intended purpose. We chose triangulation since it provides different perspectives and corroboration of findings across techniques, thus leading to more rigorous and defensible findings.

Before performing the usability test we asked the interview subject their gender, age and job in order to categorize them, in addition we asked the following questions to learn about their needs and context:

- How often do you use public transport?
- Which type of public transport do you use?
- For which purpose do you use public transport?
- Do you use internet or WAP to search for information?
- If you do, how frequent do you use this technology
- Are you aware of "Travel Planner" service?
- If you do, how do you access "Travel Planner information"? (WAP,

Website, SMS, at the station?)
- How often do you use this service? Are you satisfied with it?
- Do you use "WAP Planner" Service? If not why?
- Did you use other WAP services? If you did, which one?

Then lastly we wanted to know if the WAP system satisfied the users. To do that we made some scenarios they had to go through in the usability test.

The users then had to answer some questions after the session about the user experience. See section 5.4 for the complete usability test report.

4.1.1.1 Interviews

Conducting interviews is an appropriate technique in finding necessary information about the interaction design: It allows revealing the correct and current preferences and attitudes of users. Interviews are also effective by disclosing additional information which designers have not predicted and can lead to make proper adjustments on the interaction design.

Conducting interview aimed for data collection regarding interaction design has both certain advantages and disadvantages:

Advantages: Interview techniques have the benefits of being first-hand information and lead to identify possible details necessary for more deep analysis. Interviews are easy to conduct and direct. The data collected provides information about general rules and principles and is faster than observational techniques. Interview techniques are useful for investigating events which occur infrequently. The interviews can be recorded for a future analysis.

Disadvantages: Respondents are not committed to give correct answers and may often be influenced by what they believe the interviewer requires, or what they themselves wish to portray. The interviewer may need to acquire domain knowledge in order to know what questions to ask. There is a range of considerable bias due to the understanding by the users of the questions, and the subjective collected information might be misleading or inaccurate. The critical aspects are the choice of the place for the interview and how to conduct it.

There are three types of interviews:

1. Unstructured**:**
    An unstructured interview is when the interviewer does not impose any controls on the interview or the respondent. It is an intended to act as an exploratory conversation. Unstructured interviews are good for investigating potential emotional and/or sensitive personal issues.

2. Semi-structured:
    Semi-structured interviews should only be carried out in a situation where broad issues may be understood, but the range of respondents' reactions to these issues are not known or suspected to be incomplete. This type of interview is mostly applicable in situations where both qualitative and quantitative feedbacks are required.

3. Structured:
   Structured interviews are useful in situations where the respondent's range of replies may be estimated and there is a need to clarify details, opinions or ideas. Structured interviews work well when the assessment goals are clear.

We chose to conduct semi-structured interviews, since it was important to us to cover some issues we wanted to learn about and still leave room for the interviewer to ask more questions to make some answers more clear or to elaborate more about feelings and opinions.

4.1.2 Heuristic Evaluation

A heuristic evaluation is a usability evaluation method for computer software that helps to identify usability problems in the user interface (UI) design. Usability consultant Jakob Nielsen developed this method on the basis of several years of experience in teaching and consulting about usability engineering. It specifically involves evaluators examining the interface and judging its compliance with recognized usability principles (the "heuristics").

Heuristic evaluations are one of the most informal methods of usability inspection in the field of human-computer interaction. There are many sets of usability design heuristics; they are not mutually exclusive and cover many of the same aspects of interface design.

Quite often, usability problems that are discovered are categorized according to their estimated impact on user performance or acceptance. Often the heuristic evaluation is conducted in the context of use cases (typical user tasks), to provide feedback to the developers on the extent to which the interface is likely to be compatible with the intended users' needs and preferences.

Most heuristic evaluations can be accomplished in a matter of days. The time required varies with the size of the artifact, its complexity, the purpose of the review, the nature of the usability issues that arise in the review, and the competence of the reviewers. A criticism that is often leveled at heuristic methods of evaluation is that results are highly influenced by the knowledge of the expert reviewer(s).

Benefits:

- Can be used early in the design process (prototype)
- Can be used to evaluate the complete design
- Cost effective method

Limitations:

- Need to assume that you have good guidelines
- Representative problem

Also, heuristic evaluation should be used together with other techniques to get a complete evaluation.

(Sharp, et al., 2007)

4.1.3 Usability testing

Usability testing is for measuring how well people can use some human-made objects (such as a web page, a computer interface, a document, or a device) for its intended purpose, i.e. usability testing measures the usability of the object and focuses on a particular object or a small set of objects. Representative users try to do typical tasks with the product, while observers watch, listen and take notes. If usability testing uncovers difficulties, such as people having difficulty understanding instructions, manipulating parts, or interpreting feedback, then developers should improve the design and test it again. During usability testing, the aim is to observe people using the product in situations as realistic as possible, to discover errors and areas of improvement. What characterize usability testing is:

- Users usually come to you, it can be done remotely; tester and user need not be at the same location.
- You usually develop the scenarios.
- One or two users at a time. Total numbers: 5 to 12 users.
- You observe and listen to actual behaviors.
- May be formal or informal.
- Quantitative and/or qualitative results.

In each round of usability testing, you should first identify specific concerns and goals for that round of testing and develop the test to focus on those concerns and goals. For example, at this project's beginning we had set measurable goals, and tried to see how well the product was meeting these goals.

In our usability test, we wanted to:

- Identify any usability problems that the product has.
- Collect quantitative data on participants' performance.
- Determine participants' satisfaction with the product.

(Sharp, et al., 2007)

5   Data Collection

5.1   User analysis

5.1.1 Learn About the Users

To learn about users' reality, you need to get out and meet them, work with them, and involve them in helping you to understand their needs for information, expectations about the service, levels of knowledge about the subject matter and levels of experience (Usa07)

By working with users, you can also find out about the technology they have available to them. You can also gather many realistic scenarios and learn what makes a service work or not work for them.

Many useful techniques have been developed to get useful information from users and about users. Users research techniques including surveys, interviews, contextual interviews, card sorting and usability testing. We chose to combine quantitative methods with qualitative ones, where we used the empirical data from a survey done for Trafikanten spring 2007 and went into depth by using interviews and usability testing. In literature this is often being referred to as Triangulation[1] (Sharp, et al., 2007 p. 293). We will triangulate data from different sources to gain an overview of the system's usability.

We gathered information about our users mainly through 3 sources:

1. From an earlier research done in this area (380 filled questionnaires from Trafikanten project spring 2007)

2. Observation. Observing the users using this service during usability testing.

3. Interviews. Conducting in depth interviews with the users before and after usability testing.

5.2 From the report of the Trafikanten Project

As mentioned in section 2.3 our starting point was the survey done as a project in INF5261 – Development of mobile information systems. One of the concepts they had looked into was "Real time mobile information" which is one of the services available on WAP. They tried to see whether users are aware that such systems are in place and if so, to what extent they use them (Brovig, et al., 2005 p. 10). The results in the report were based on 380 completed surveys.

Of the total participants 49 % were younger than 30 years old and only 1.6 % were older than 60. 68.4 % lived inside Oslo and 71.6 % daily used some type of communication.

Almost 90 % said that they were aware of the real time information system. On the question of how do you access the real time information, the answer was:

At the stop: 75.5 %

Trafikanten website: 47.9 %

WAP: 14.7 %

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[1] Triangulation is a strategy that entails using more than one data gathering technique to tackle a goal, or using more than one data analysis approach on the same data. Triangulation provides different perspectives and corroboration of findings across techniques, thus leading to more rigorous and defensible findings.

SMS: 4.2 %

On the question what is your frequency of access to real time info on WAP, the answers was:

Never: 74.5 %

Several times a month: 11.05 %

Several times a week: 2.1 %

Daily: 2.1 %

The result of the survey shows that the main reason for this lack of use of SMS and WAP are a) a general scarcity of awareness of such services, b) the complexity of the technology, and c) its cost (Brovig, et al., 2005 p. 17). The respondents that were aware of the SMS and WAP service seemed quite clueless of how to use it. They associated a lot of ambiguity with the procedure. An important discovery they did in their research was that a user's first encounter with the service is often when the user is in a real-life situation, which perhaps is not the best time to learn how to use the service. (Brovig, et al., 2005 p. 18)

The conclusion of the report is that it seems as if the main issue is that the existing solutions are not user friendly enough and too time consuming for the travelers to bother using them. Some findings the group did that exemplify this are:

- Someone is missing the possibility to have bookmarks.
- If you want to update or do the same query twice you would have to fill out the forms all over again.
- How to use the SMS service is not very clear.

(Brovig, et al., 2005 p. 22)

5.3 Heuristic Evaluation

For our heuristic evaluation we used four evaluators. All of the evaluators had different mobile phones and tested the same scenarios. First we had a session with individually evaluating, and thereafter discussing the different results together. The usability results we found were rated from one to four, dependent on how seriously the problem was (in our opinion). The rating system are explained more in details in section 5.3.3.

5.3.1 Mobile phones used for evaluation

Phone1 – HTC Windows mobile version 5

Phone2 – Nokia 5500 sport

Phone3 – Nokia 6230

Phone4 – HP iPAQ 514 Windows mobile version 6

5.3.2 Scenarios

Go into WAP address: wap.trafikanten.no

1. Search for all departures from the station "Holtet"
2. Search for travel route between station "Holtet" and station "Jernbanetorget"
3. Search for real time information in Oslo from station "Holtet" line nr. 19

When completing the first 3 scenarios, continue with different set of data input.

1. Search for all departures from the station "Ullevål stadion"
2. Search for travel route between station "Ullevål stadion" and station "Stortinget"
3. Search for real time information in Oslo from station "Ullevål stadion" line nr. 4

5.3.3 Severity Ratings for Usability Problems

The severity of a usability problem is a combination of three factors:

*   The **frequency** with which the problem occurs: Is it common or rare?
*   The **impact** of the problem if it occurs: Will it be easy or difficult for the users to overcome?
*   The **persistence** of the problem: Is it a one-time problem that users can overcome once they know about it or will users repeatedly be bothered by the problem?

The following 0 to 4 rating scale can be used to rate the severity of usability problems:

0 = I don't agree that this is a usability problem at all
1 = Cosmetic problem only: need not to be fixed unless extra time is available on the project
2 = Minor usability problem: fixing this should be given low priority
3 = Major usability problem: important to fix, so should be given high priority
4 = Usability catastrophe: imperative to fix this before product can be released

5.3.4 Heuristics

1. Visibility of System Status

2. Match between System and the Real World

3. User Control and Freedom

4. Consistency and Standards

5. Help Users Recognize, Diagnose, and Recover From Errors

6. Error Prevention

7. Recognition Rather Than Recall

8. Flexibility and efficiency of use

9. Aesthetic and Minimalist Design

10. Help and Documentation

(Nielsen, 2005)

5.3.5 Results

1. Visibility of System Status

The system should always keep user informed about what is going on, through appropriate feedback within reasonable time.

Description	Rating
In multi page data entry screens, each page was not labeled to show its relation to others	2
In real time information text box, it was hard to see if you are in input mode or not	2

2. Match between System and the Real World

The system should speak the user's language, with words, phrases and concepts familiar to the user, rather than system-oriented terms. Follow real-world conventions, making information appear in a natural and logical order.

Description	Rating
It is not intuitive to know that the sigh # refers to "all stations", instead it should be replaced with the informative text like "all stations"	3
Using the word Trafikanten is not intuitive enough, should be changed to "main menu", as often used in other services	2
Use of "new search" is inconsistent. In some situation new search will take you to main menu, while other time it takes you to the start of the search process	3
It is not intuitive to know that the sign * refers to "no real time available" instead it should be replaced with the informative text like "no real time available"	2

3. User Control and Freedom

Users should be free to select and sequence tasks (when appropriate), rather than having the system doing this for them. Users often choose system functions by mistake and will need a

clearly marked "emergency exit" to leave the unwanted state without having to go through an extended dialogue. Users should make their own decisions (with clear information) regarding the costs of exiting current work. The system should support undo and redo.

Description	Rating
A "home" menu should be present through all screens at the top of the window. Otherwise it is too time consuming to browse back to the main menu	3

4. Consistency and Standards

Users should not have to wonder whether different words, situations, or actions mean the same thing. Follow platform conventions.

Description	Rating
The button "New search" is inconsistent. On some service as "between stations" it takes you back to the main menu, while on "real time" it takes you back to a new real time search.	3
The placement of the search buttons is inconsistent. It appears in different places on the screen. Sometimes it's next to the text and other times below.	1
Use of abbreviation is not following a simple primary rule for abbreviation, E.g. : .a =Asker, .ab = Asker Buss, .ak= Aker Brygge båt, .as Akershus sykehus, .aks= Akershus sykehus	2

5. Help Users Recognize, Diagnose, and Recover From Errors

Error messages should be expressed in plain language (NO CODES).

Description	Rating
No possibility of having a detailed view in error messages. (for experts)	2

6. Error Prevention

Even better than good error messages is a careful design which prevents a problem from occurring in the first place.

Description	Rating

In general, we didn't experience many error messages, but those we did were not informative enough. E.g. " The service was terminated" could be changed to " the search was terminated"	2
You have to fulfill the whole search before you get to know that there is no route between those two stations. This information could appear as soon as you type in the second station., so you avoid spending time on punching in date, time and type of transport	2

7. Recognition Rather Than Recall

Make objects, actions, and options visible. The user should not have to remember information from one part of the dialogue to another. Instructions for use of the system should be visible or easily retrievable whenever appropriate.

Description	Rating
There is no help menu or tips to help you search in a right way. Especially important for novice user	3

8. Flexibility and Minimalist Design

Accelerators-unseen by the novice user-may often speed up the interaction for the expert user such that the system can cater to both inexperienced and experienced users. Allow users to tailor frequent actions. Provide alternative means of access and operation for users who differ from the "average" user (e.g., physical or cognitive ability, culture, language, etc.)

Description	Rating
It is very time consuming when you always need to type in the whole text, and that there is no possibility to choose from a list , once you type the first letter	3
It is only possible to bookmark "real time" searches, but not the other two searches	3
It could have been useful to have a "history" function, where one can go in and see the last 5 searched, for example, and use them again.	2
It could be useful to have the possibility of saving the results of a search, so one can use it later, without accessing WAP	1

9. Aesthetic and Minimalist Design

Dialogues should not contain information which is irrelevant or rarely needed. Every extra unit of information in a dialogue competes with the relevant units of information and diminishes their relative visibility

Description	Rating
Nothing found	

10. Help and Documentation

Even though it is better if the system can be used without documentation, it may be necessary to provide help and documentation. Any such information should be easy to search, focused on the user's task, list concrete steps to be carried out, and not be too large

Description	Rating
No help menu in this service. Could be useful to a novice user. Especially explaining sign like # and *	3
Should provide shortcut to help menu, once they implement help menu to this service	1

5.3.6 Comments
A general comment is that tasks will take longer time to execute on a mobile phone than on a computer. This is because of navigation problems. We have also experienced that different mobile phones behave differently, for example some phones used hour glasses to indicate the time to complete tasks while others didn't. The screen resolution and the size of the phone also contributed to the general impression of the service. I.e. high screen resolution gave the impression that the information presented on the screen gave better overview. Some phones used less time to access and present the information as well as changing between pages, while others used much longer time.

5.4 Interviews and usability testing

5.4.1 How the testing was carried out
In our usability test, we wanted answers to these questions:

- Are the test participants able to complete the task scenarios successfully?
- Considering successfully completed tasks, how fast do participants do each task?

- Considering successfully completed tasks, how many pages (clicks) does it take to complete each task?
- Do participants perform well enough to meet the usability objectives?
- How satisfied are participants with the product/service?
- What changes are needed to make sure that the service will enable more users to perform more successfully?

We wrote a couple of scenarios which helped us to understand the context of use of 'WAP Travel Planner'. We conducted one-on-one usability testing where we tested 6 users. According to Jakob Nielsen to identify a design's most important usability problems, testing 5 users is typically enough (Nielsen, 2000) the questions mentioned above were used as measurable usability goals, i.e., they included:

- Time
- Accuracy
- Overall success
- Satisfaction

We asked the user to follow these scenarios while we observed (what the users did, where they succeeded, and where they had difficulties with the user interface), listen, and took notes. We asked the users to accomplish three simple tasks with their WAP phones:

Go into WAP address: wap.trafikanten.no

1. Search for all departures from the station "Holtet"
2. Search for travel route between station "Holtet" and station "Jernbanetorget"
3. Search for real time information in Oslo from station "Holtet" line nr. 19

When completing the first 3 scenarios, continue with different set of data input.

4. Search for all departures from the station "Ullevål stadion"
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6. Search for real time information in Oslo from station "Ullevål stadion" line nr. 4

Before and after the usability testing we interviewed them to learn about their previous knowledge of "Trafikanten travel planer" and their knowledge to WAP and other interactive medias overall. After the testing we wanted to know what they thought about the service and if it's likely that they will use the service in the future.

5.4.2 Result
We interviewed 6 persons before and after they completed the task for usability testing.

5.4.3 Before the session:
Five of the interviewed were male and one was female. Their age was between 23 and 39 years old. Some of them used public transport on a daily basis while some only once or twice a week.

Everyone mostly used buss or subway. All of the interviewed answered "yes, every day" on the question "Do you use Internet or WAP to search for information?", but two commented that they only use internet.

All of the interviewed were aware of the "Travel planner service" and they all accessed it by website if they wanted to use the service. In general they used the service a couple of times per month; no one used it much more frequent.

No one used the WAP-service, although one person sometimes used SMS. Two wasn't aware of the WAP-service, two said they always had access to internet and checked the departures before going to the stop. Only two of the interviewed used WAP at all, for other services.

5.4.4 Time for the Usability testing
(Minutes and seconds)

First attempt	Person 1	Person 2	Person 3	Person 4	Person 5	Person 6
Scenario 1	1.50	2.20	3.00	3.00	2.20	2.50
Scenario 2	3.0	2.30	1.50	4.00	1.35	1.40
Scenario 3	1.39	0.35	1.10	1.00	1.00	1.45

Second attempt	Person 1	Person 2	Person 3	Person 4	Person 5	Person 6
Scenario 4	1.02	1.40	1.10	0.40	1.45	2.00
Scenario 5	1.50	1.05	0.35	1.00	0.55	1.25
Scenario 6	1.30	0.35	0.55	1.00	0.40	1.00

5.4.5 After the session:
The overall impressions of the service ranged from great and very god, to not very impressed and bothersome. Two comment that the pages loads fairly quick.

When asked, "What did you like least about the service?" answers were:

- That you need to punch all the text. A cumbersome thing to do on a mobile phone.
- Also, it should be a more visible button to go back to the main menu.
- It also takes too much time to load the pages.

- New search (Nytt søk) was not easy to find. Need to scroll all the way down to find it.
- Lack of "tickers" known to me, very hard to find back to the start page.
- The "2 minutter gange" choice didn't make much sense to him
- Too much scrolling. On the page where you choose type of transport, walking distance and so on you have to scroll too far down to get to "neste". Should be on top.
- The not so modern WAP design/interface
- If you are new in Oslo and do not know how many "Ullevål Stadion" there are in Oslo, so you can't find which "Ullevål Stadion" you want to go to.

Two wanted to improve the search for the station, one were interested in making a list of suggestions for the station's name come up after you have punched the first letters. So you then could choose from the list.

When asked, "Could you think to use this service? If you do, how often and under which circumstances?" the answers were:

- No. Only if I am at a place where I don't have access to Internet. I also don't think it is so important with information about traffic schedule. Bus, Tram and subway go so often so I don't mind waiting some minutes.
- Yes, this would be great when I am out socializing late at night with limited transport services, but not during a normal day because of a more frequent transport schedule.
- Maybe next time when I have no access to a computer with internet. I think the web solution is easier though
- Not really, not like it is today. But that is mainly because of the phone itself.
- If I don't have other options, but the real time service I might use in delays etc.
- Right now I don't use it.

On the question, "What can possibly stop you from using such service? the answers were:

- It take too much time to use and also bothersome to punch all text.
- Problems with the net, or the time it takes to gather information.
- Don't know.
- Cumbersome to use WAP on the phone. Mainly because of too much clicking of buttons and takes too long.
- Bad network coverage, money and other factors such as unavailable service.
- Expense and difficult to follow it

Are you happy with the way "WAP Travel Planner" information is currently displayed?

- Yes, but still I prefer to use desktop which have bigger screen. There is not much place to display information on the mobile screen and it's not so fun to scroll up and down.
- Yes, but it will take some time for me to get used to WAP as a medium per se.
- Missing more design and maybe buttons instead of just text.
- Yes, but not happy with how the phone works.

- Not really, as I explained above about the design, the interface could be fancier.
- I am not sure. I don't use it

5.4.6 Analyze

With the questions mentioned earlier in this chapter as a starting point we are here going to present our analysis of this testing and interviews.

- Were the test participants able to complete the task scenarios successfully?

  Yes they were. But some of them had problems with accessing the WAP-service on the mobile phone. This was different from phone to phone, and some of the participants weren't using their own phone during the test. On this point we helped them so that they could move on to the Trafikanten pages.

- Considering successfully completed tasks, how fast did participants do each task?

  The time it took to complete the tasks varied a lot from person to person but the first and second scenario took much longer time then the third (the real time information) for all of the participants. They all completed the scenarios during the second attempt faster compared to their first attempt. Notable is that the persons who used longest time on the first attempt were fastest on the second (person 3 and 4).

- Considering successfully completed tasks, how many pages (clicks) did it take to complete each task?

  Our intensions were to observe the path and notice the numbers of "clicks" that the participants used to fulfill the scenarios. But we soon realized that considering the small size of the screen on a mobile phone, this was not easily done and could affect the participants work. So instead we relayed on that if the number of pages needed to fulfill the tasks were so many that it was considered to be a problem, we would get to know about it through the interviews. No one commented on this specifically but several of the participants thought it was too much punching, but that seemed to be in relation to punching in text.

- Did participants perform well enough to meet the usability objectives?

  Yes. As mentioned in the user analyzes the Trafikanten travel service is meant for everyone traveling with public transport in Oslo. So the service should not require any specific knowledge or competence on how to use this kind of services. We think that our participants performance are what you could expect from Trafikanten travel services potential users.

- How satisfied were participants with the product/service?

  As mentioned above the overall impressions were split from great and very good, to not very impressed and bothersome. Two commented that the pages loads fairly quick. No one was extremely negative.

Our findings from the heuristics evaluation and usability test can be supported by earlier research already done in the year 1999-2000 (Nielsen, 1999) (Nielsen, 2000). The usability issues mentioned in this report were just as relevant back then. It is amazing to see that seven

years later not much has changed regarding to WAP usability (E.g. the phone keypad as an input device, screen size and not optimizing the user interface for each handset)

In his paper from 1999 (Nielsen, 1999) Nielsen wrote his impressions after touring Europe where he found great interest for WAP in Scandinavia and much skepticism in other countries. In his opinion, since WAP is a way to access the Internet through a mobile telephone, using its square-inch-sized window, will lead to impoverished user interfaces for two reasons:

1. a **tiny screen cannot show any context**, nor can it show menus or visualizations of alternatives
2. telephone **push-buttons are poor controls** for advanced functionality

To support his opinion he mentioned that experience from many other user interface platforms indicates that a bigger screen leads to better usability than a small screen and that a graphical user interface adds even more usability. Obviously, in order to be mobile, the device must have a smaller screen than a desktop computer. A compromise somewhat along the lines of the Palm Pilot can combine mobility with a decent-sized screen. A palm-sized form factor can double as a telephone through the use of a small headset; possibly connected wirelessly through Bluetooth. Cell phones as currently known must die.

In 2000, Nielsen wrote in his paper (Nielsen, 2000) how British and continental newspapers were full of stories about WAP phones that don't work and services that were difficult to use. While at first media were positive to WAP , in May-June 2000 The picture started changing and the first negative reviews were published in European newspapers that had tried WAP services and pronounced them useless. In July 2000 a new consensus had been reached: nobody predicted great things for WAP any more. The excitement had shifted to future mobile services with bigger screens and faster, always-on connections.

Speakers from various Web design shops in London said that they had started to prefer the term "mobile Internet" in their pitches. Reading between the lines, this was a way to disassociate themselves from the coming WAP failures and retain credibility as providers for the next generation of solutions.

In 2000 Nielsen and his group conducted user research with WAP phones and got even more dismal results (Nielsen Norman Group Report WAP Usability Report, December 2000[2]).His key sentence regarding developing for WAP was end of "Design once, display Anywhere". Based on his research he claimed that WAP almost always has miserable usability for many reasons: ridiculously small screens, slow bandwidth, and the need to place a new call every time the

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[2] Nielsen Norman Group conducted a field study of WAP users in London. Users were given a WAP telephone that provided mobile access to the Internet. They were given tasks to perform in laboratory usability studies before and after being allowed to use the phones on their own. They were also interviewed about their experience using WAP in the field. 70% of users decided not to continue using WAP

device needs to connect. The digits-only keypad is a laughable input device. Also, the actual telephones vary in their design and sometimes have poor human factors that don't deliver as good a user experience as would be possible under the given constraints.

Because of these many weaknesses, designers of WAP services have concluded that they need to **optimize each service for each of the different telephones** and its specific restrictions and interaction techniques. Designing a separate service for each handset model is necessary: the weaker the platform, the more it becomes necessary to squeeze every last bit of usability out of it by having a tightly targeted and optimized design.

The sad conclusion was: it will be much more **expensive to develop services for WAP** than for conventional browsers. Much of the early success of the Web was due to the simplicity of development where you could design a single website and have it work across platforms. The browser wars taught us that websites don't want the expense of having to maintain multiple versions.

His advice was to **Skip the current generation of WAP**, meaning that developing services for it will divert the attention and resources from the more promising next-generation services and companies will be wasting a lot of money on services that will only be used for a year.

 If companies do launch WAP services, heed the advice to optimize the user interface for each handset. Doing so is more expensive, but if they don't do it, their service will be so miserable that it is guaranteed to fail.

Discussing our findings, supported by previous research, gave us an idea on what to concentrate on next in a future research. This will be explained in details in section 7.

6   Conclusion and suggestions for improvements

As previously mentioned we selected a user group of age within 15-45. We sat a criterion that the users must have a mobile phone and use the public transport to some degree.

What we found out about the users' needs through the interviews after the testing was in general a need of a fast service to gather real time public transport information. The context of use was in general in situations outside the normal day travel times since most of the users we tested have these times memorized. Also the users we tested claimed they would find the service more useful in situations where they don't have a PC with internet available, since the Trafikanten webpage is their primary choice of service to find this kind of information.

In general this report shows that the Trafikanten WAP page is useful, but not satisfying in all ways. There are clearly some improvements to the user interface that could have been done to make the service a lot better.

One important thing we noticed is that it's a big difference on how you experience the service from phone to phone depending on for example screens size and resolution. This affected the impression of the service and lead to quite different opinions on what is really a usability

problem, during the heuristic evaluation. But the most important usability problems that we found and that the participants in the usability testing commented on are:

- Lack of a help menu
- Too time consuming to type the whole stations name
- Not possible to bookmark search except for on the "real time" service
- The use of # and *signs which was not explained clearly enough.
- Inconsistency of how the pages are built up, lack of "home" button.

With all the things that could have been done better, we conclude that less complexity of the system and better usability, most likely will draw more users.

But as said in 2.3 the low usage can also depend on low awareness of the service and/or that people think it is expensive. We don't believe that the second reason, cost, is the most important one regarding how much people in general use their mobile phones. If you needed the WAP-service and were aware of it and it would make daily life easier for you, we think people would spend the few "kroner" it costs. We think that the low usage has to be seen in relations to how much people use WAP in general. As we could see in the usability testing only two used WAP at all, and in our project group no one use WAP very often if at all. Maybe even the "perfect" Trafikanten WAP-service would have a limited number of users.

From these conclusions we have made some suggestions of what we think would increase the user friendliness of the service and maybe make more people use the WAP-service.

6.1 Suggestions for improvements

6.1.1 List
It would be very helpful if the user could choose a station from a list. It is very time consuming when the user always needs to type the whole station name, especially on an inconvenient key board on a mobile phone. An example could be that the name of the station pops up once you type the first letter.

6.1.2 Bookmarks
It should be possible to bookmark a search in all three services. So far it is only possible to bookmark a search in "real time" service.

6.1.3 Help menu
It would be helpful to include a help menu in this service. Could be useful to a novice user, especially explaining signs like # and *

6.1.4 Map

It could be helpful to include a map showing the location of the nearest station. Users are likely to use this service for travel routes they are not familiar with, and possibility not familiar where the station is located either. A map could solve this problem in such situations.

6.1.5 Language

It is not intuitive to know that the sigh # refers to "all stations", and * refers to "no real time available". Instead it should be replaced with informative text like "all stations" and "No real time available".

6.1.6 Consistency

Use of "new search" should be consistent. The way it is today, in some situation new search will take you to the main menu, while other times it takes you to the start of the search process

6.1.7 Home menu

A "home menu" option should be present through all screens at the top of the window. Otherwise it is too time consuming to browse back to the main menu.

6.1.8 Error Message

Error messages should be more informative so the user can understand the cause for it. Is it due to problems in network coverage or other reason for example?

6.1.9 History

It could have been useful to have a "history" function, where one can go in and see the last 5 searches, for example, and use them again.

7   Further work

As mentioned in section 5, the results of the heuristic analysis (5.3.5) and the results from the usability testing (5.4.2) points to several usability issues that needs to be improved in order to create a better user experience. In section *6.1 Suggestions for improvements* we bring up features that we believe will improve the usability of the "WAP Travel Planner". Just to mention some: including a list of stations to choose from, including help menu, possibility to bookmark in all 3 services, including a map, home menu and more.

Since we only did a first round of a usability testing and analysis of it, it could be interesting in a future project to conduct a second round of usability testing with an improved interface.

This means that we should build a new prototype of the "WAP Travel Planner", based on the suggestions we made in section 6.1 (Which are based on the results from our heuristic analysis, usability testing and interviews with the users). After building a new prototype, we should go back to our users and conduct a second usability test where we use the same scenarios as we did in the first round, measure the same usability goals we used in the first round and conduct an in-

depth interview with the users after the test in, order to get an impression of how they perceive the new interface. At the final stage we should analyze the results and see if the new prototype is perceived as more users friendly than the currently one.

Another idea for future work could be conducting an evaluation of "Travel Planner" on a **"mobile Internet"**, where we will use heuristic evaluation and usability testing as evaluation methods.

In chapter 5.3.6, we comment that we experienced that different mobile phones behaved differently and that the screen resolution and the size of the phone also contributed to the general impression of the service. In addition, we experienced that some phones used less time to access the WAP service than others.

These things takes us back to the point in 5.4.6 where also previous research on WAP usability mentioned the same drawback of WAP and advocated for "mobile Internet".

Opera Software has today a widget called Trafikanten, which gives "real time" information on a mobile pone, which is perceived by users to be very practical and useful. During a lecture held in INF4260 with a developer from Opera Software we got to know that Opera is going to launch Travel Planner on Opera mini in the near future. This could be an interesting project to evaluate whether the usability of this service is better when using a web browser on a mobile. Experience already shows that many users prefer Opera Mini over other web browser on their mobile phone. The reason for it is that it is much faster to load a web page with opera mini due to the fact that opera compress the information on their server before sending it over to a mobile phone, thus creating a better user experience.

(Ommundsen, 2006)

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9 Appendix

9.1 Use case

**Using WAP
Travel Planner**
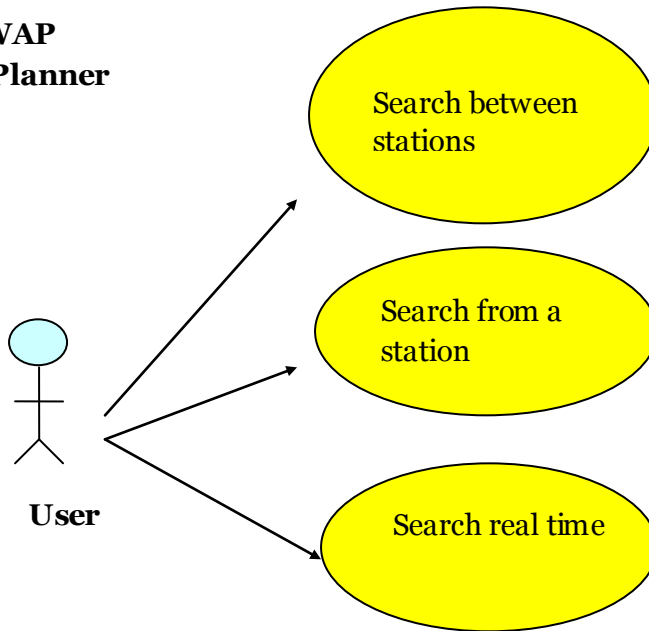
9.2 Work and Communication

9.2.1 Milestones

At the start up of our project we developed a milestone plan for ourselves. A milestone plan is very useful in a way that you have to relate to deadlines, and you can work with smaller pieces of the project.

Name	Date	Description
M1	24.09.2007	When wonder document is written down
M2	13.10.2007	When user analysis is done
M3	22.10.2007	When heuristic evaluation is done
M4	22.10.2007	When usability testing is done
M5	05.11.2007	When midterm report is written down
M6	19.11.2007	When proposals for improvement of current solution is done
M7	03.12.2007	When final report is written down

9.2.2 Group meetings

We decided to have a two hours group meeting every week. The day before the meeting, we sent an email with an agenda of what we were going through. In the meeting we distributed work, planned next milestone, evaluated last milestone, and generally discussed important issues related to the project. We also had occasionally meetings just before some of the milestone deadlines.

9.2.3 Communication

In addition to group meetings our main communication channel was email and Vortex. We created a directory in Vortex under our project where only group members had access to. There we uploaded updated versions of our documents. We also used e-mail to send documents, but

mostly we used it for planning and as a communication tool. We also communicated through SMS and phone when necessary

9.3 Wireless Application Protocol (WAP)

WAP was initially developed in 1997 by Motorola, Nokia, Ericsson and Phone.com and were meant to make content on Internet available for mobile terminals.

The Wireless Application Protocol is envisaged as a comprehensive and scaleable protocol designed for use with:

- *any mobile phone from those with a one line display to a smart phone,*
- *any existing or planned wireless service such as the Short Message Service, Circuit Switched Data, Unstructured Supplementary Services Data (USSD) and General Packet Radio Service (GPRS).*
- *Indeed, the importance of WAP can be found in the fact that it provides an evolutionary path for application developers and network operators to offer their services on different network types, bearers and terminal capabilities. The design of the WAP standard separates the application elements from the bearer being used. This helps in the migration of some applications from SMS or Circuit Switched Data to GPRS for example.*
- *any mobile network standard such as Code Division Multiple Access (CDMA), Global System for Mobiles (GSM), or Universal Mobile Telephone System (UMTS). WAP has been designed to work with all cellular standards and is supported by major worldwide wireless leaders such as AT&T Wireless and NTT DoCoMo,*
- *multiple input terminals such as keypads, keyboards, touch-screens and styluses.*

(Bollen, 2000)

With WAP, communication between Internet and the handheld device will go through a WAP gateway. Which will either send the requested page directly to the device if the page is written in WML (Wireless Markup Language), which is the language used by WAP, or it will try to convert the page from for example HTML to WML.

WAP has since it's emergent usually gone hand in hand with GPRS which for years has been the standard for a mobile to connect to Internet. In recent years more and more devices have been implementing new and faster communication technologies like 3G and HSDPA. However, since WAP was a buzzword in GPRS' heydays, many people , mistakenly, regards WAP and GPRS as the same service and therefore think of WAP as a rather slow service, when in fact it's the GPRS service that sets the benchmark for transfer speeds. But it is no problem with connecting to for example wap.trafikanten.no with a 3G phone equipped with a browser, and get a much faster user experience.

Another problem with WAP, or actually GPRS, is that it's also regarded by many as quite costly to use. This prejudice was also uncovered in our user-study interviews. In order to try to confirm

or bust this "myth", we have collected some prices from some of the biggest phone operators in Norway which are presented in Table 1.

Operator	Price per Megabyte	Price for doing a search on Trafikanten*
Telenor	12.50 kr	0.24 kr
Netcom	20.00 kr	0.39 kr
Chess	14.00 kr	0.27 kr
Talkmore	7.50 kr	0.15 kr
Tele2	14.50 kr	0.28 kr

Table 1 *The prices was calculated by taking the sizes of all the pages you have to go through when performing a station-to-station search on wap.trafikanten.no, which amounts to about 20 KB

As we can see in Table 1, the prices for performing a station-to-station search are not that steep but rather quite affordable. To compare it with some services heavily used today we can say that doing a search is about the same price as for sending a SMS, which most of use seems to have no problem paying for.

9.4 Mobile Interfaces and cognition

It is no surprise that representing information to a user on a fairly large PC monitor is quite different than representing information to a user through a mobile device. Although their small sizes make them ideal for carrying with you when you are on the go, it's also their greatest weakness when coming to displaying information. With its limited screen real estate it's important to not flood the user with a lot of text and graphic. Especially limiting the use of graphic is not only important in regards to screen size, but also in regard of bandwidth. The bandwidth of mobile phones' WAP/GPRS service is very limited so making the user wait for loads of data to download will most likely make for an unpleasant and frustrating user experience. However, in recent years, faster services like 3G, HSPA, Wi-Fi has increased the bandwidth significantly. So with these types of services the bandwidth is not really a barrier anymore, but the potential user base is probably far from that of WAP/GPRS since all these services requires compatible hardware and here GPRS surely has the lead. But more and more phone models include these new, faster technologies.

9.4.1 Designing for the mobile interface

So how do you design for a mobile interface? The book (Sharp, et al., 2007 pp. 265-269) discusses this from different angles, but mostly with regards to how the user controls the device and attempts to improve it. We however, since we're evaluating a service that has to base itself on how the controls works on devices used today, won't go into too much of details in this area. But of course, we will have to consider how the service works with these already existing controls and if there's any room for improving them. But mainly we will concentrate on how to utilize the screen to its' fullest and making a service that is both easy and effective to use.

One important aspect for creating "user friendly" services is of course understanding the user. If we don't know at all how a user thinks, what they expect, what they want or what they need, it will be hard to develop something they will enjoy. Here, the HCI field of *cognition* comes in to

play. Cognition is described in the dictionary (Ans07) as "*The mental process of knowing...*" Further, the book (Sharp, et al., 2007) has separated cognition into specific processes which is:

- Attention
- Perception and recognition
- Memory
- Learning
- Reading, speaking, and listening
- Problem-solving, planning, reasoning, decision-making

Although all of these processes are important in order to understand the users, some of them are not as relevant to our project since they are already solved or handled by under laying levels. For example is a GUI already in place in the phone, letting us rely on recalling rather than remembering, which is easier for most humans.

In regard to *attention* it is important to keep in mind where the user is likely to use a WAP travel planner. Being made for mobile devices we would expect the user to also be in a mobile situation, be that on the bus heading for work, walking down to the local grocery store and so on. It is obvious here that the fight for the user's attention is most likely different than of that where the user is sitting in front of their computer. A person's attention on the bus might be more focused on things like "What is the next stop?", "When should I get off?", "Should I give up my seat to someone else?" While a person in front of a computer can often, if they choose, only pay attention to the task at hand. Say, checking their e-mail. Of course, on most people's desktop today there is a lot that screams for attention. For example right now there's an application on the task-bar on my screen blinking in different colors asking for me to change my attention from writing this paper and chat with a friend of mine. But a key different here is that I can "easily" decide not to. But a pedestrian however, can't simply decide to ignore all traffic around him/her when handling their mobile phones. A decision like that might be a fatal one. Therefore it's important to be to the point and precise when making a service or application for the mobile phone since the user probably don't wish, or have the time, to scan through a lot of information.

With *perception* it is often important that your icons or graphics are easily understood by the user. In WAP services however, it's probably better to avoid graphics at all, for reasons described earlier. What is important though is that you have a logical grouping of information and components and those are in a sensible order. An example here would be to have the "To" and "From" field in our travel planner grouped together, preferably with a search button. It might also be more correct to have "To" before "From" or vice versa depending on cultural and social norms. As described in the book:

"*In practice, which interface is most appropriate, most useful, most efficient, most engaging, most supportive, etc.., will depend on the interplay of a number of factors, including reliability, social acceptability, privacy, ethical and location concerns*" (Sharp, et al., 2007 p. 286)

When it comes to learning it is important to remember that most users prefer to "learn through doing" (Carroll, 1990). So all menus should therefore be self-explanatory and require no reading

of a manual or similar, especially since the user is most likely in a mobile situation and won't have time for it, as described earlier when discussing *attention*. It's also possibly best to keep the number of options and settings somewhat limited to not confuse the user.

Further when making a mobile application or service you have to decide, as for all applications and services, in what way the user should interact with the application or service. Should input be done by keys/keyboard or by speech? Should information be given to the user by text or by sound? Many of these aspects are really up to the phone manufactures. They will have implement voice recognition in their phones before we can utilize it for example. Then other factors come into play, will a mobile user in a vibrant city landscape be able to hear a woman telling here when his/her train leaves? Or is it much easier for the user to simply read it? But then again, won't his/her attention from a possible dangerous traffic situation be diverted to the screen of his/her phone? There is a lot of for and against to consider here, but for our purpose the technology and use puts up a few natural guidelines. On a phone with a slow GPRS connection for example, making the user download sound files with train departure times would take time and be inefficient.

One important thing to keep in mind when designing for mobile devices is:
"*While many general principles for human-computer interaction also apply to small terminals, they can not always be taken for granted, and to simply transfer interaction components from desktop computers will often lead to unexpected problems*"
(Holmquist, 2000)

9.5 The World Wide Web in the palm of your hand

There exist numerous methods for taking a fully grown website interface normally displayed on a large PC screen and shrink it down to size to fit a smaller screen like the mobile screen. One popular method used by among others Opera Mini sets up a proxy between the user and the web which shrinks the page down to a size that fits the mobile screen, making it unnecessary to scroll horizontally. You also often have the option to turn off image loading, making it useful for those with the slower GPRS devices. In **Error! Reference source not found.**, the Trafikanten webpage is displayed in Opera Mini. As we can see, the travel planner search engine is displayed on

top, if this is by design we don't know, but it makes it easy for the user to make a search without having to scroll down much at all. But, if you're only interested in the planner, you still have to download the rest of the Trafikanten page which contains a lot of news as well. So is this the only way to access the travel planner when you are away from your computer and have to rely on your

Figure 1 www.trafikanten.no displayed on Opera Mini emulator

phone? The answer is no. Trafikanten, like many others, have made a WAP page offering the same service. A WAP page, unlike a normal web page that has been shrunk down in size to fit a mobile phone, is often tailored specifically for devices with a limited screen area and limited bandwidth. The design is mostly minimalistic and often only made out of text and hyperlinks. Graphics are either non-existent or kept to a minimum. In services, like the travel planner, forms

and input boxes are also utilized for obvious reasons. If you look at **Error! Reference source not found.** you can see the design of the WAP service. It's clearly more compact and lighter than the original Trafikanten page. The start page consists only of text and hyperlinks, minimizing download times. Most unnecessary information has been scrapped in favor of useful menu options. The only text that could be debated if is necessary or not is "Velkommen til Trafikanten!" But also this has been moved down to the last line so it won't interfere with the more important options if you have a really small screen. This goes against what most of us are used to in everyday life where the norm is to first welcome the user. This is not limited to only computers, but goes for all aspects of life. When entering a store for example, it's not unusual for a sign to welcome the customer to make them feel more at ease. When you travel by plane, it's normal for the cabin crew to welcome you as you enter the plane, also here to make you feel welcomed and at ease. So why this disregard for basic courtesy in the travel planner then? Well, having to scroll through a welcome message before getting to the actual and useful content would probably be more of a nuisance for most users rather than a sign of good faith. This approach is more to the point and direct, which would be preferred as explained in "Designing for the mobile interface".
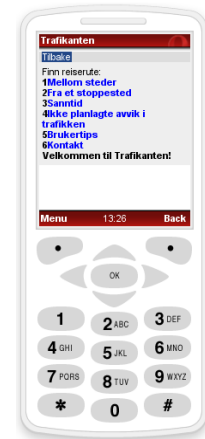

Figure 2 wap.trafikanten .no displayed on Opera Mini emulator