Usability Guidelines for WAP-based Travel Planning Tools

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Abstract

Designing effective and efficient user interfaces for supporting complex tasks on mobile devices remains an intriguing problem. The rapidly evolving hardware and software mobile environments are complicating the design of elaborated applications like travel planning. Allowing mobile users to review their travel-plan information while travelling has been addressed by a recent R&D project. In order to improve usability and derive good design guidelines, two alternative WAP-based solutions were experimented: one based on providing explicit guidance and information, and another focussed on brevity and iconic metaphors. These two designs enabled to investigate mobile users' preferences and behaviour and the effects on usability and effectiveness. A user study was conducted and users' behaviour on both variants was logged. Using objective measures and users' subjective perceptions, the effects of design options, users' age and proficiency with WAP applications were tested. This study allowed deriving some guidelines by analysing which graphical components better support mobile usability, and which solutions should be avoided.

Keywords: Travel Planning; Usability; Mobile Internet; WAP, Web Portal.

1 Introduction

Nowadays cell phones are so popular and ubiquitous that most of us couldn't imagine living without them. More and more people use these communication and information access tools, and the functionalities and the challenges provided by these devices are growing (Turban et al., 2008) (Bertelè & Rangone, 2007) (Nielsen, 2009).

After the initial difficulties of the first WAP version in the late '90s, most people wouldn't have imagined that Mobile Internet would have ever gained a remarkable market share. But a recent survey in Germany (www.heise.de [May 08, 2009]) revealed that more than a third of Germans use their cell phones (at least sometimes) to navigate or read emails and another third intends to surf with their cellular phone (or at least to try it) within this year. According to GSM Association, more than 4 billion mobile connections were active already by year-end 2008, while the number of PC users is expected to hit 1 billion only in 2010. This growing availability and convenience of wireless communication technology as well as the wide diffusion of free Wi-Fi connectivity are the main drivers for the development of mobile services and mobile-friendly web pages.

Thus, information providers that want to address this challenging and emerging market have to go mobile, but the keyword is not to *miniaturise* existing Web-based services to run on mobile devices, but to *mobilise* them (www.littlespringdesign.com [June 04, 2009]). In fact, depending on the usage context, only some of the functionalities provided by an existing application or web page are of interest for the mobile user. For example, as in our case study, a traveller who used the PC to plan his holidays may not be anymore interested in flight suggestions while he is visiting the selected destination; or someone travelling in a northern Finnish province will not be likely to look for the weather conditions in southern Finland. Here the work of mobile designers begins: not by dropping some functionalities and by letting the rest to run on small screens with limited computational power, but by rethinking and redesigning a completely new mobile context-aware user friendly system (Jones & Marsden, 2005) (Cena et al., 2006).

The project "Country Portal for Finnish Tourism" was aimed at developing a newer advanced tourism portal for the Finnish country - VisitFinland.com. One of the main objectives of this project was to enable the user to obtain personalised travel recommendations and help while searching for accommodations or sightseeing. This recommendation service is supported by Trip@dvice, a recommendation technology already integrated successfully in various other country portals (Venturini & Ricci, 2006). Trip@dvice exploits case-based reasoning to support conversational interaction, intelligent ranking and data mediation. It helps the travellers to find the most appropriate travel destination, and recommends them which sightseeing attractions and events that would best fit their needs and expectations by looking at previous users' tastes and ratings.

Indeed, recommendation technologies have proved to effectively help users to face the problem of information and choice overload (Fesenmaier et al. 2006) (Adomavicius & Tuzhilin, 2005). However, when we consider the issue of accessing the same type of information, or to perform similar decision making tasks, through mobile devices, the information overload problem gets even harder, and the additional limitations of the mobile devices make it difficult to design an effective solution (Ricci & Nguyen, 2007). In fact, in principle, mobility makes it possible to deliver context-aware information services to mobile users wherever they are and whenever they need, but, system designers have to deal with the consequences of mobility and device limitations on human computer interaction. The approaches that were successful on PCs cannot be directly applied to mobile devices mainly due to their limitations in screen size and computational power, but also because of the impact of the external environment and the behavioural characteristics of mobile users.

The practical motivation that initiated our study was the design and development of a mobile service (a mobile travel-planning agent) for VisitFinland.com, so that the largest number of cellular phones users, irrespectively of the phone characteristics, but just supporting WAP 2.0 access (Shiller, 2003) could be effectively assisted in reviewing travel plans created on the PC-based web interface. Mobile-friendliness is the core aspect that we concentrated on. The mobile travel planner is not providing the same functionalities as the online PC-based system, but only a customised subset of them, realised in a different way, due to the mentioned limitations of wireless communication technologies and mobile devices interfaces.

Moreover, to assure the best usability, and to identify design guidelines of general applicability, we built two alternative WAP-based systems, both offering the same logical functionalities, but with some notable differences in the user interface. In this way, alternative approaches to common design problems were compared. For instance, the usage of radio buttons in comparison to links for option selection, or the provisioning of extensive information and instructions vs. a faster navigation, or a different usage of colours and icons.

These two running versions were compared, with respect to effectiveness, efficiency and usability, in a user study described later in this paper. That study enabled us to test a number of research hypotheses. The practical outcome of this research work is the improved usability of the VisitFinland.com WAP-system. In addition, we believe that the emerged results have a more general applicability and the derived guidelines can be taken, together with the results of other similar and complementary projects (Buhalis & Pistidda, 2009) (Haid et al., 2008) (Kramer et al., 2007) (Lee et al., 2007), as a basis for improving the user acceptance of WAP-based mobile designs.

Section 2 provides some general information about the functions of the mobile travel planner and the user interface, while in Section 3 the research hypotheses are explained, by showing the differences between the original and the modified design and their expected effects on usability and effectiveness. Section 4 describes the usability analysis procedure, and in Section 5 the obtained results are explored and the findings are discussed. Section 6 contains a short summary of the study and its conclusions.

2 Travel Planning Functions and GUI

As we mentioned in the Introduction, one of the main use case was to provide ubiquitous access to the travel plans built previously by the users (using the PC-based version of the portal). In addition, we were required to make available this functionality to the largest number of mobile devices (users). For this reason we opted for WAP 2.0 xhtml, as the vast majority of current mobile phones support WAP browsing and we discarded other appealing options, such as J2ME or Android. It is worth noting that nowadays, as an effect of the newly introduced, more effective, mobile Web browsers, as that included in the iPhone, Web browsing (WAP xhtml) is becoming more and more popular.

In addition, specific design guidelines for the whole portal were defined during the GUI analysis phase. In particular, the guidelines stated that the usage of mobile services should be as simple as possible on every kind of device, even in presence of a very limited screen size. For this reason, most graphical elements were oriented in a list-based fashion, such that with minimal scrolling users could find the information they need, and tables should be avoided if possible.

The required travel planning system functionality is summarised in Fig.1. The user enters the mobile application through a main menu of the mobile portal. On this main (or home) page there are links to all the major functions, such as the mobile travel plan inspection system, but also other features like map browsing, or the function allowing the user to write and share notes, and many others. Here we focus on travel plan browsing since the other functions are not relevant to the research hypotheses discussed in this paper.

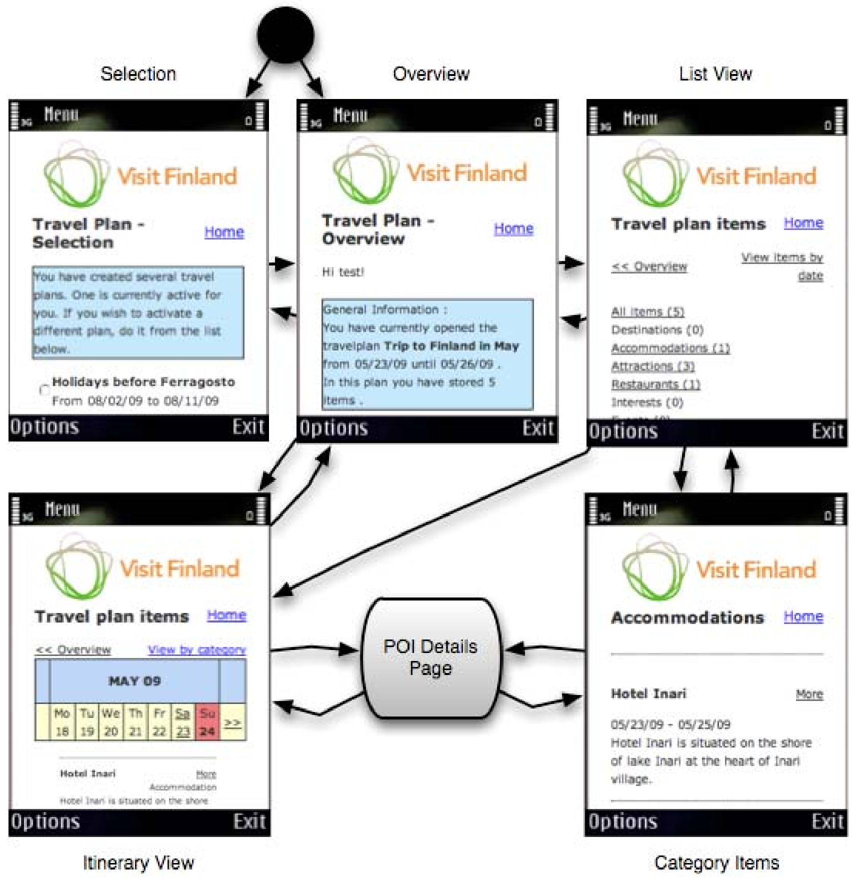

Fig. 1. First version of the user interface and system page-flow (V1)

From this main menu, the user can access the mobile travel planner, and inspect the travel plans that he created with the PC-interface of the web portal. After having selected one of these plans, the system shows an overview page, containing some general information regarding the selected travel, i.e. the time duration of the travel plan and the number items (points of interest) that the user booked or planned to visit (included in the plan). From this page, the user can also go back and select another travel plan (if available), or proceed and browse the single items – either in a list ordered by category, or grouped by day, i.e. in a calendar.

In the list view all the available product categories (e.g. accommodations, events, attractions, restaurants,..), are listed, and for each category the number of items present in the selected travel plan is displayed. By clicking on one of these category links, the user is forwarded to a corresponding page listing the planned items belonging to the selected category. Each of these items has a "details page", which is accessible by clicking on a link, and a short description shown below the item title.

If the user chooses to activate the itinerary view, he is presented with a small horizontal calendar, containing the days of the 'active' week. The current date is preselected if it belongs to the planned travel. Otherwise, when the planned holiday is in the past or in the future, the nearest day to the current date is preselected. The user is able to browse the items planned for another day by clicking on its date, and can switch week or month, by clicking on the provided side arrows. The items planned for the selected day are always shown below the calendar in a list containing the item titles, some short descriptions and a link to a details page.

4 Research Hypothesis

In addition to the system version illustrated in the previous section (V1), we designed a variant system (V2), providing the same required functions, but with some differences in the graphical user interface and in the logical system interaction. The page-flow of the second version is depicted in Fig.2.

These changes are motivated by some recent studies on WAP usability (Buchanan et al., 2001) (Jones and Marsden, 2005) (Forum Nokia, 2008) (Nielsen, 2009) (http://patterns.littlespringsdesign.com/ [October 29, 2009]). We will now motivate individually the changes made in the second version with corresponding hypotheses linking these differences in mobile web design to an expected effect on the user. These hypotheses should be interpreted as conjectures that V2 improves V1 because of the mentioned difference.

H1: Radio-button list (V1) vs. list with links (V2): Radio-button lists are often used to present to the user alternative options to choose: the user can choose an item, read the others, and - if necessary - choose another item. Then, the user is forwarded to the next page by clicking on a button below the list. On the other hand, by using a list of links, the user selects one and the page opens immediately after clicking. We conjectured that links (V2) are more usable than radio-buttons (V1) when choosing among a set of similar products to inspect (as in the case of alternative travel plans to inspect, see Fig.1 and Fig. 2, "Selection" screen), i.e., there is an impact on the time, the perceived effort, and on the number of clicks, for solving the planning task.

H2: Detailed instructions (V1) vs. faster navigation (V2): Generally, very detailed information and instructions lead to slower navigation on a mobile device because of the small screen size. In V1, to improve information provision, there are very detailed instructions for the user (see for example Fig. 1, "Overview" screen). In V2 some of this information is missing, leaving some more space for other information to be displayed earlier on in the navigation process, e.g. combining the overview page with the list of categories (see Fig. 2, "Overview" screen). We conjectured that mobile users will not read many instructions (V1), and thus will prefer a more compact but faster navigation (V2), in order to get the information needed as soon as possible.

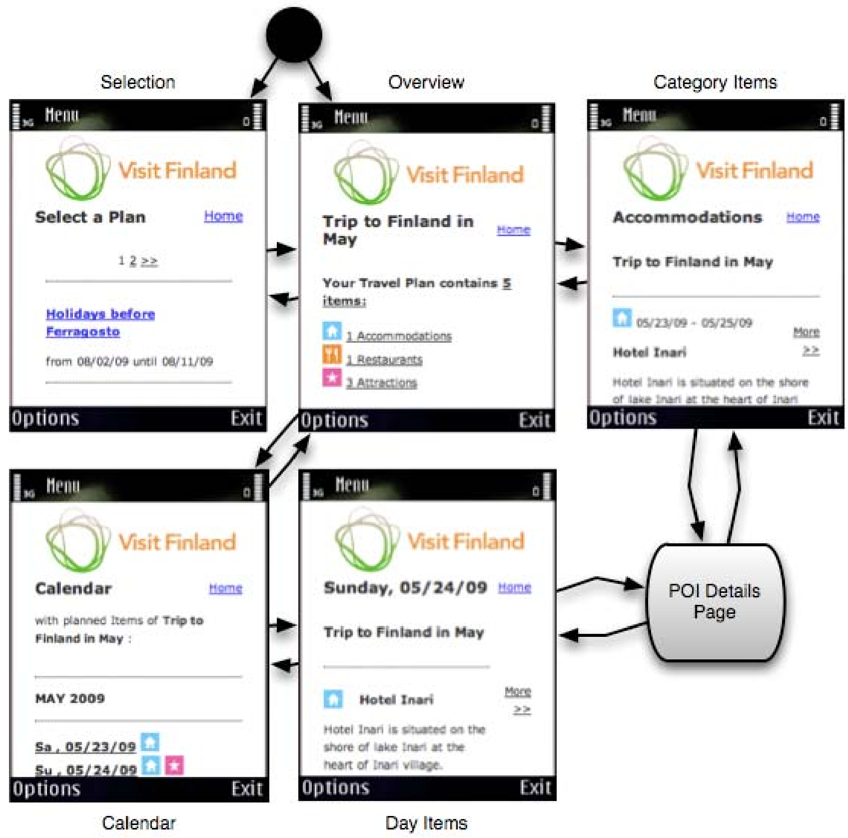

Fig. 2. Modified work-flow and interface to (possibly) improve usability (V2)

H3: More extensive information (V1) vs. short descriptions with icons (V2): In many cases the system designer can decide whether to show some information using textual descriptions, which require less system memory (faster download), or icons, which need less space, but are slower to download. In V1 the information is very detailed, whereas in V2 small icons replace some of these descriptions (e.g. names of the categories). We conjectured that icons are easier to see and to interpret; thus they will positively influence perceptions of ease, efficiency and effectiveness.

H4: Horizontally oriented calendar (V1) vs. list of days (V2), and forward-/backward- links (V1) vs. scrolling (V2): There are very different approaches to visualise calendars. In general it is possible to show a calendar in a horizontally oriented table, representing weeks or even months in a very evocative way. In this case, to change the current selected week (or month) the user clicks on a link. Or it is possible to represent a calendar in a vertical list of days where the user can navigate by scrolling up and down. In V1 the calendar is represented with a horizontal table, showing one week of the travel in each screen. In V2 instead a list of days, linking to the details of each specific day, is used. We conjectured that the list of days is easier to use (as scrolling is very simple), and gives a better overview of the travel; thus the second will be preferred by the majority.

Some other general hypotheses regarding the system evaluation were defined:

H5: Age influences time: Younger participants will be faster in completing the tasks.

H6: Habit influences time: Participants who have been using internet on a mobile device (a cellular phone or a PDA) will be faster in completing the scenario than people who have never tried this technology before.

H7: Habit influences clicking: Testers that already used Mobile Internet before will also use the system in a more efficient way, i.e. with fewer clicks.

H8: Neither age nor habit influence the participant preference for one version: There might be some differences in the personal preferences of the participants; but neither their age, nor their knowledge or use of mobile internet will influence these preferences.

5 Evaluation Strategy

For mobile systems evaluation it is important to use a concrete mobile device when performing a usability analysis, as emulators on a PC might impact on the perceptions about ease of navigation (Jones & Marsden, 2005). For these reasons we initially tested the two mentioned versions on a range of devices with different characteristics to assure portability and robustness of the system, as well as a smooth rendering of the graphical interface. Then we finally performed a focussed user test where one single device was adopted since we could not control the variability of the devices in a rather small group of testers (25).

We adopted a within-group model, where four user tasks were created: two tasks to be completed with one system variant, and two slightly different tasks with the other version. The first set of tasks included: a) "In which hotels have you slept during 'Carnival 2008'?", and a) "What have you planned for the 10th August 2009 in the 'holidays before Ferragosto' plan?". The second set of tasks included: a') "Which attractions will you see in your 'early summer holidays' plan?", and b') "Where have you been on 31st December 2008 in the 'Christmas holidays'? plan". Hence, in each task the participants were asked to find some information (specific to the given task) and to use the different views as well as the menu. The two sets of tasks were randomly swapped, such that their (possibly different) easiness would not influence the results, i.e. half of the testers performed tasks a) and b) on the first system version and tasks a') and b') on the second one, and the other half vice-versa.

During the task completion the beginning (login) and the end (logout) were logged (timestamp), such that the time a participant took for the completion could be computed afterwards. Also the numbers of clicks were logged, in order to obtain some information about the (objective) effort a user took to complete the scenario.

A questionnaire was developed to measure the (subjective) usability reusing the NASA task load index (humansystems.arc.nasa.gov/groups/TLX/ [May 06, 2009]) and IBM's Computer System Usability Questionnaire (Lewis, 1995). It was slightly adapted to the special needs of the study. It asks for some general/personal information (required for the statistical analysis), and contains twelve statements to evaluate the user interface, the information provided, the usage learning, some overall perceptions, the perceived performance. The statements were evaluated on a scale ranging from -2 (strongly disagree) to +2 (strongly agree): after having tested each system variant the users where asked to evaluate the statements Q1-Q12 (Table 1). In the end, after testing the second version (either V1 or V2 according to the randomly selected order), the user was asked to provide some free comments about the two system versions and to explicitly compare the two systems, namely to mention the preferred one along different aspects: overall impression, interface, information presentation and the main functionalities (Q13-Q19 in Table 1).

Table 1: Usability Questionnaire

User Interface	Q1	It was simple to use this system
	Q2	I can effectively complete my task using this system
	Q3	The interface of this system is pleasant
Information	Q4	The organization of the information provided by the system is clear
	Q5	It was easy to find the information I needed
	Q6	The information is effective in helping me complete the scenario
Learning	Q7	It was easy to learn to use this system
Overall	Q8	Overall, I am satisfied with this system
	Q9	I like using this system
Work Load	Q10	The task was not mentally demanding
	Q11	I didn't have to work hard to accomplish my level of performance
	Q12	I was not insecure, discouraged, irritaded, stressed and annoyed
Comments	Q13	Most positive aspects (if any)...
	Q14	Most negative aspects (if any)...
Conclusions	Q15	Which system do you prefer?
	Q16	Which system has the better interface?
	Q17	Which system is more useful and informative?
	Q18	Which category view do you prefer?
	Q19	Which calendar do you prefer?

The analysis was performed by 25 participants, aged from 12 to 60; 12 test participants were experts in computer science (students or professors). The remaining 13 testers were some of our acquaintances; they have a medium/low computer usage experience: 7 were using the computer at home or in the office, and 6 of them were barely capable to use the computer. The different ages and background knowledge were distributed equally between the two test-groups. Moreover, no one was told which one was the original or the "improved" version. All the tests were performed in a similar context, i.e. a silent room with not much people in it; the same cell phone; everyone got the experiment explained before, and got questions answered during the test.

6 Results

6.1 Usability Evaluation

Looking at the differences in the evaluation according to the 12 statements in Table 2, it is clear that for all the statements the evaluation of V1 is lower then V2. Especially with respect to the simplicity (Q1) the users evaluated better V2. The lowest results (for both versions) are for statement Q9 ("I like using this system"). Hence suggesting that both GUIs could be further improved.

It is possible to conjecture that links were easier to use, looking at the answers to statements Q1 ("It was simple to use the system"), Q2, ("I can effectively complete my task using this system"), and Q3, ("The interface of this system is pleasant"). This conclusion is further supported by looking at the users' comments, stating that links are preferred. Thus the first hypothesis H1, that links are preferred over radio buttons, is supported in the analysis.

In general, V1 is based on the idea of providing to the user extensive information, while V2 tries to keep the instructions and information short, and to replace some information with icons. Since V2 was rated higher than V1 – on average for each single statement – one could derive that users prefer short information and small icons when using a mobile device. We found also many positive comments for the usage of icons. Thus, hypothesis H3 is supported by the results obtained from the usability test.

Table 2: Average answer to usability statements for the two system versions

	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	Average
V1	0,88	0,92	0,76	0,80	0,64	0,96	1,16	0,84	0,52	1,04	1,04	1,04	0,88
V2	1,60	1,44	1,28	1,44	1,44	1,24	1,52	1,40	0,80	1,28	1,32	1,52	1,36
p	0,00	0,02	0,02	0,00	0,00	0,07	0,01	0,00	0,05	0,06	0,09	0,03	0,00

Calculating the t test (two-tailed, paired) for the 12 statements, we found that in 9 cases there is more than 95% confidence that these differences are significant. Only on three statements (Q6, Q10 and Q9), regarding perceived performance and information presentation, the two systems are not *significantly* different, but for all the other statements they are.

6.2 Performance of the users in the different systems

By comparing the average task execution time and the number of clicks, it results that the users needed about *42% more time* to complete the scenario with V1, and on average they needed *7 clicks more* to complete the tasks on V1 (on V2 the average number of clicks was 10.8). Both differences are significant and therefore V2 can be confidently considered as simpler to use.

6.3 Final comparison between the two versions

The users' overall preferences were even clearer than the answers to the statements: 23 out of 25 participants preferred V2, one did not express any preference and another one preferred V1.

The different implementations of the overview and the categories list provide good examples supporting hypothesis H2: detailed navigation in the overview page on one side, and faster navigation in the second version on the other side. The fact that 17 testers voted for the category page of V2, while only four preferred V1 (and – again – the additional comments expressed by the participants further support this) leads us to conclude that hypothesis H2 is supported, namely that users prefer faster navigation to more detailed information.

Hypothesis H4 compares the two versions of the calendars: V1 implements a horizontal calendar, which is recognised as a traditional calendar by most of the people and therefore the users should be familiar with it. V2 contains a completely different calendar, presented as a list of days, that was (possibly) easier to use, but perhaps less common. The resulting data shows that 17 test participants preferred the V2 calendar, while only five preferred the horizontal one. Thus, hypothesis H4 is supported.

Using a χ^2 test on the questions about the users' final preferences we could derive that these answers are significantly different (at least for 98.05%) from those that would be obtained by an equal probability for the replies (i.e. which system is preferred). Therefore the results are relevant for the study and the hypotheses are validated.

6.4 Influences and correlations within the results

Calculating correlation we discovered that the frequency of Internet usage does not have any significant influence, neither on the participants' preferences, nor on the required time or numbers of clicks. Similarly for the past usage of WAP: it does not have any influence on the testers' preferences, neither on the time needed for task completion. The only correlation that is significant enough to be mentioned is the positive correlation between WAP knowledge and the number of clicks employed in the first version.

Therefore, hypothesis H6 (that habit influences time employed) is not confirmed, as well as hypothesis H7 (that habit influences the number of clicks). Even more: H7 is partially rejected as the correlation is positive and not – as assumed before – negative. The second part of hypothesis H8 is supported: knowledge of Internet or WAP is not significantly correlated with the users' preferences.

Hypothesis H5 – age is correlated with the time required to complete the task – is supported: As the (positive) correlation is not caused by chance – with a certainty of 98% (V1) or even by nearly 100% (V2). This means, on average, that younger people took less time to complete the scenario. Thus, H5 is supported. We finally observe that regarding the impact of age on system preference (H8), the results did not show any significant difference.

7 Conclusions

Mobile usage is still a major challenge for many websites. In a recent mobile study performed by J. Nielsen (http://www.useit.com/alertbox/mobile-usability.html [July 20, 2009]) the average success rate (in performing typical tasks) was only 59%. That is substantially lower than the 80% success rate that they obtained when testing websites on a regular PC.

In order to detect usability problems of a mobile travel planning web site (version 1) we designed and developed a second version that we thought would be more specifically suited for mobile devices (version 2). 25 people tested both versions using just one type of smartphone (Nokia N95) with a mid-sized screen and with a standard phone keypad. The success rate of our mobile travel planning web site was very high; all but one tester completed their assigned tasks. On a 1-5 scale the first version got a 3.88 average rate and the second 4.36. So we can conclude that in our travel planning mobile web sites we did not find major usability issues when the application was running on a phone of that class. Moreover, the second version was considered as better than the first one for some reasons that we collected and we propose here as useful design guidelines for future WAP applications:

G1: Lists with links are preferred over radio buttons.

G2: Faster navigation is preferred over detailed descriptions.

G3: Short descriptions with icons are preferred over extensive information.

G4: Scrolling is preferred over forward/backward links.

G5: Age positively influences time, younger people need lees time.

G6: Habit does not influence time, i.e., more experienced people may not use less time or clicks.

Beside this useful outcome, it's important to note that some users stated that the design could be improved (for both V1 and V2), so some further efforts should be made to enhance the GUI experience. Hence some future work could be focussed to either improving the usability of the current functions or to mobilise additional features, such as the mobile recommendation service for alternative contextual conditions (e.g. in case of rain or for a change in the itinerary). Another option would be to design still another version for touch-screen phones (such as the iPhone or the new Google Android devices). The Web experience on these phones is so superior that even applications that appear poor on standard feature phones or smartphones looks much better on these devices. All these aspects could further attract more users to use the system.

In conclusion, we believe that the outcome of this study shows that mobilized Web sites, when browsed on reasonable featured phones as those we used in our test, can be as effective as Web sites on regular PC. Moreover, the guidelines that we derived can be used as an additional set of recommendations that, together with the still growing outcome of similar studies (http://www.forum.nokia.com/ [September 28, 2009]), can help to incrementally improve the future mobile web/WAP applications in tourism. We know that the underestimation of the importance of the user interface design factors can jeopardise the acceptance of a mobile service and can lead to the failure of the service, even though the functionalities are interesting for the user. Hence, the outcome of this work should be considered as a small but concrete contribution to the knowledge on WAP usability and the diffusion of mobile services for tourists.

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