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The Stakeholders of a User-Centred Design Process in Mobile Service Development

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ABSTRACT

The use of agile methods in mobile service development has gained much attention in software design research. In addition, involving the potential stakeholders of the mobile service in the design and development process has become vital in achieving the best service experience. Many application development methodologies, such as user-centred design (UCD), ensure that stakeholders have direct involvement in the design and development. This paper describes experiences of designing a mobile concept where various stakeholders, such as tourism companies, target application users, business experts and the application developers, were involved in the design and development process. The main focus of this paper is the roles and contributions of stakeholders in mobile services for outdoor activities such as kayaking, hiking and biking. These outdoor activities are associated with different functional and non-functional requirements that are essential considerations during the design and development process. Therefore, we utilized the UCD principle as an appropriate method of involving all stakeholders in the design process, and we show that hearing the stakeholders' voice is vital in the design of outdoor-based mobile service development.

KEYWORDS

Mobile Service, User-centred Design, Software Development, Mobile Tourism, Project Management

1 INTRODUCTION

This paper describes the design process of a mobile web service for outdoor tourism activities where users regularly need navigation, guidance and nature- and route-specific information. The outdoor tourists, such as hikers, bikers or kayakers, are often operating in an unfamiliar environment. Therefore, geo-location is the important feature in the development of useful mobile services.

The ultimate goal of the research project was to design a geo-location service to support and improve customer satisfaction with small tourism companies by offering new types of digital guidance and navigation services. In developing this type of application, where different stakeholders are involved, it is essential to grasp the stakeholders' needs and requirements. In addition, the user's direct involvement in the application design and development can help in anticipating possible errors and failures. Therefore, we selected the user-centred design (UCD) [1] as the development approach. The mobile service design and development was accomplished as university research and a development project where partner companies delivered their insights through a steering group and acted as pilot companies to test the application.

The advancement in web technologies, such as cloud computing [2-6], Software as a Service (SaaS) [7-8], Service-oriented Architecture (SOA) and Web Services [9-12], as well as software development frameworks such as Vaadin and PhoneGap [13-15], have provided a unique opportunity to develop faster prototypes and robust mobile applications for various business segments. Therefore, more research is required in how to manage design and development projects in which various user groups and design teams could co-create new mobile service concepts. The methods of value co-creation are emphasized nowadays in marketing, sales and design literature, as the end users and customers are taking a more active role in service design projects [16-17]. Hence, they are not only consumers of products but also active partners in designing new services.

This research project applies mobile web technologies to design and develop a customized mobile guide service for several small and medium (SME) tourism companies to use simultaneously. The product designed in this study is based on one mobile web service where the target service is deployed to the mobile device's browser. Therefore, the designed mobile guide is not a native mobile application but is delivered as a SaaS model to the tourism companies who then deliver the URL link to their own customers, i.e. the end users. This study applied the Vaadin 6.0 Java framework [13-14], Apache TomCat and LAMP stack (Linux, Apache, MySQL and PHP) on the virtual server. The research and development goal was to design iteratively with all stakeholders' mobile web services to meet the needs of outdoors tourism business services. To achieve the research goals in the UCD process we defined the following sub-tasks.

1) Elicitation phase: Conducting user studies and gathering requirements in order to design the potential mobile web service concept. This phase is realized by collecting requirements through iterative concept and prototype designing, and gathering stakeholders' feedback. The main focus of the concept design is the end users' experiences of the provided services.
2) Evaluation and assessment phase: Piloting and testing the mobile guide prototypes with several stakeholders in the real usage environment to gain instant feedback on the concept and the proposed services.

2 MOBILE SERVICES and TOURISM

The tourism business was among the first to build electronic commerce and internet-based shopping solutions. According to a TripAdvisor survey [18], 38% of travellers have used their mobile devices to plan a trip, and 60% of respondents indicated that they have downloaded travel apps on their mobile devices in advance. The survey shows that the use of tourism-based mobile applications focuses particularly on researching restaurants (62%), checking flight statuses (51%) and researching attractions (46%). Google's study [19] provides similar findings and emphasizes the importance of mobile services in the tourism business.

In outdoor activities, users often require navigation, guidance and other nature- and route-specific information. Tourists who are walking, hiking, biking or kayaking are frequently operating in an unfamiliar environment. Therefore, the aim is to design a tourism-based mobile system that supports most outdoor activities and is available from tourism companies [20, 21]. In addition to supporting the outdoor pursuits, the tourism companies could increase customer satisfaction by offering new types of digital guides and navigation aids as added-value services for their customers.

Tourism companies nowadays offer their customers hard-copy maps that contain the route details. However, it is easy to transfer the existing route and guide information, as highlighted on the printed map, to mobile devices. In addition to the static paper-based information, mobile services offer dynamic information for end users, such as speed, location, distances and social information related to specific locations. The existing tourism applications mainly provide information and support for city or urban navigation services [22, 23], in which the use of the mobile device does not significantly differ from typical mobile device usage, e.g. from checking SMS or answering a call.

3 USER-CENTRED DESIGN

Several studies [24-28] emphasize the involvement of stakeholders in the software development process as early as the first phases of the innovation and design stages. Developing an innovative mobile application and service is not a straightforward process. It requires several iterative experiments involving end users before any successful commercialization of the product. Blank [24] states that going backwards is considered a failure in the traditional linear product development model, whereas in the iterative development model going backwards is a natural and valuable part of learning and discovery. Ries [25] has also emphasized a cyclical development process where going backwards is an important element in continuous learning and a natural part of software development. Additionally, Blank [24] emphasizes that, unlike in the linear model, finding the right

customers and markets is unpredictable, and developers make several mistakes before they get it right. Blank also emphasizes the importance of the initial phases in his customer development model, namely determining customers' real problems and needs. Similarly, Ries [25] highlights the involvement of end users in the software innovation and development process, and claims you can begin the fruitful learning and discovery process with them by testing and measuring iteratively your minimum viable products and prototypes.

The paying customers do not necessary explicitly know what they need or want, but they can offer valuable comments and suggestions for your visualized drafts and prototypes [26, 27]. Those comments and feedback work as guidelines in searching the possibilities for successful product and service innovations. Moreover, usability and user experience considerations are increasingly important in contemporary mobile application developments [28, 29, 30]. Mobile applications' usability often mandates multi-level usability assessments. This complex and yet important process is accomplished by applying appropriate software development methods such as UCD or lean product development. Both of these methods consider users as key stakeholders at the various design and development stages.

Gould [29, 30] states that in a usable system we need to involve users continuously in the development process and based on their feedback refine the design concept. The term UCD was first used by Dan Norman during the 1980s after the publication of *User-Centered System Design; New Perspectives on Human-Computer Interaction* [31]. User-centred design and the development of interactive systems and devices have since increased in importance in product development as UCD both cuts costs [32] and improves usability. Additionally, it should also place a special focus on the business benefits, which are easier to identify when using rapid innovation methods where end users are involved in the same process as business owners.

The UCD process is divided into different phases of creating a usable mobile application [26-28]: 1) Concept phase: The users' needs and the opportunities are explored by applying different user study methods, such as interviews and questionnaires; 2) Requirements phase: Prepare a list of the requirements revealed during the previous phase. Applying various data analysis methods, such as interview transcripts, or task and environment analysis and affinity diagrams, assists in preparing such a list; 3) Prototype phase: The list of requirements is converted to a low-fidelity prototype and shared with the users. Based on users' feedback, the design is retuned; 4) Usability assessments phase: Users then assess the high-fidelity prototype through a usability test.

Unlike UCD, in which users are consulted at various stages of the mobile application concept development, the lean development principle is based on the values that the product provides to consumers. Lean principles originated from the lean manufacturing developed by Toyota. However, lean software development originated from a book written by Tom and Mary Poppendieck [33]; essentially, it is a software development model inspired by lean manufacturing and agile development principles. The lean model focuses on customer feedback and the reduction of waste. Based on lean software development principles, waste is defined as any part of the development process that does not create value for consumers.

Therefore, the first step in following the lean principle is to understand and identify activities that create value in a product. In the digital service business, this practically means that users will not be motivated to use a new digital service if they do not see or recognize added value or personal interest in the new digital solution [34, 35]. The second step in the lean principle emphasizes that quality ought not to be a separate phase, and instead requires consideration at all phases of the software development. Creating knowledge is the third step in the lean principle, and stresses sharing information among project workers and customers. Deferring commitment to the lean principle promotes the need for decision making at the last minute. The lean principle moreover recommends delivering smaller increments of the software product over shorter time intervals and promotes project workers as independent decision makers in their designated tasks, allowing them to achieve their goals more efficiently. Finally, the lean principle recommends optimizing the product

based on consumers' requests and hopes, just as UCD does [36].

Hence, in creating innovative and new applications in the software business, we are actually solving problems based on unknown proposals, as users cannot describe exactly what they need or want. Therefore, this requires iterative, lean and user-centred methods.

4 RESEARCH METHODOLOGY

The research approach is case-study [37] that applies the action research strategy [38], as the design team members were also actors in both the research and design work phases. Data was collected through semi-structured interviews and structured questionnaires from stakeholders during the design and development iterations. Table 1 shows the targets and phases of design iterations in designing the outdoor mobile guide service, the role and number of stakeholders involved and details of where the user encounters took place.

Table 1. Design iterations, stakeholders and context.

Design iterations of outdoor mobile guide service	**Stake-holder**	**N=**	**Where the interview, interaction or evaluation took place**
1. Business case and concept definition	Tourism company, ICT company and university-based tourism experts	6	Office
2. Validation of the technological solutions	Software developers	2	Street navigation, testing by kayaking on the Baltic Sea
3. Validation of the business viewpoint	Steering group members and two developers	6	Testing by kayaking on the Baltic Sea
4. Validation of the end users' viewpoint	Tourism university students	23	Testing by snowshoeing and hiking in the park
5. Validation of the expert users' viewpoint	Tourism experts	5	Testing by kayaking on the Baltic Sea
6. Validation of business scaling in the selected business segment	Customers and staff of tourism companies	50	Interaction at tourism centres and testing by kayaking on the sea and river

The study qualitatively analysed and applied the UCD principle to design a mobile web application for the outdoor tourism business. Outdoor tourism activities set special requirements for mobile application design processes. Therefore, in this paper we aim to reveal empirically the nature of the mobile application design process where several stakeholders are involved in the design and assessment actions throughout. The design process included tasks such as identifying requirements and creating mock-ups and prototypes with several iterative phases that utilize UCD principles.

5 DESIGNING and ASSESSING the MOBILE CONCEPT

5.1 Business Case and Concept Definition

The development team conducted a short study (n=6) to investigate the possibilities and the benefits of the mobile application for small tourism companies. The chief executive officer (CEO) of a tourism company, the CEO of a mobile software company, three tourism university lecturers and the director of a tourism education department participated in the survey and shared their insights on the possibilities for, and needs of an outdoor mobile guidance service. The university lecturers also work closely with several tourism companies, and therefore they have extensive knowledge of the possibilities and challenges for mobile services for tourism companies and their customers. The study mainly focused on revealing the possibilities for mobile services in this sector, and the tourism companies' expectations of, and business needs from, mobile-based services. By analysing the data the development team identified that location-based mobile services should include route information, a geo-location guide, maps suitable for outdoor

activities, points of interest, a link to the tourism company's e-commerce site, general and safety information and feedback functions. This was valuable information for our designers, and enabled them to propose an initial concept to the first partner companies. The designers themselves had prior experience of outdoor activities such as kayaking, camping and hiking, which helped greatly in coming up with additional features.

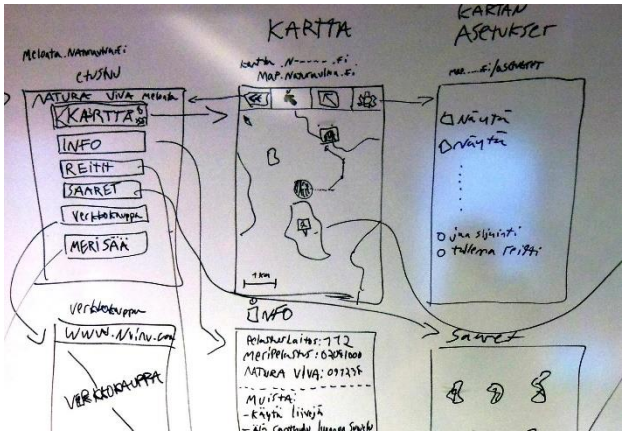

Figure 1. Example of the first conceptual plan and navigation structure.

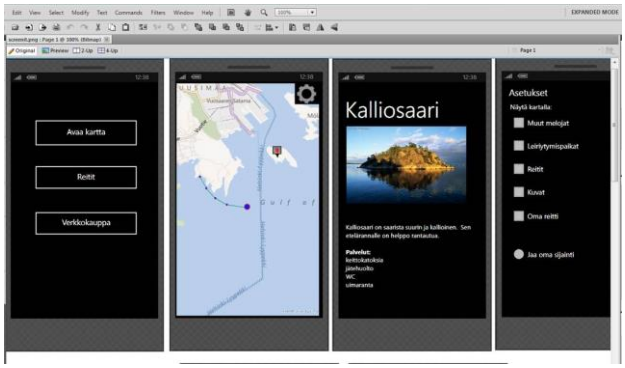

Figure 2. Example of drafts of the mobile guide's graphical user interface design.

The proposed features were shared with companies, and their feedback was collected and analysed. On receiving the companies' confirmations based on the proposed features, we investigated the technological feasibility with programmers and software developers. Thus, the initial concept for a mobile web application to guide and inform kayakers and other outdoors tourists was designed and drafted (Figures 1 and 2).

5.2 Validation of the Technological Solutions

The first paper mock-ups and the proposed concept plans were assessed by the partner tourism company, which represented the voice of the customer at the beginning of the development period. After the partner companies confirmed the concept, the development team began implementation of the application prototype. The application prototype development was based on Vaadin [16], which is an open source rich internet application framework that consists of a server-side programming model and client-side development tools based on the Google Web Toolkit and HTML5. Moreover, it includes a server-side solution where the majority of the logic runs. Additionally, Ajax technology is used on the browser side to ensure interactivity and a better user experience, whereas on the client side Vaadin mainly utilizes the Google Web Toolkit, which is also used for rendering the resulting web pages. The framework is based on event-based programming and provides widgets and add-ons for helping developers to design and build faster and richer web applications and solutions.

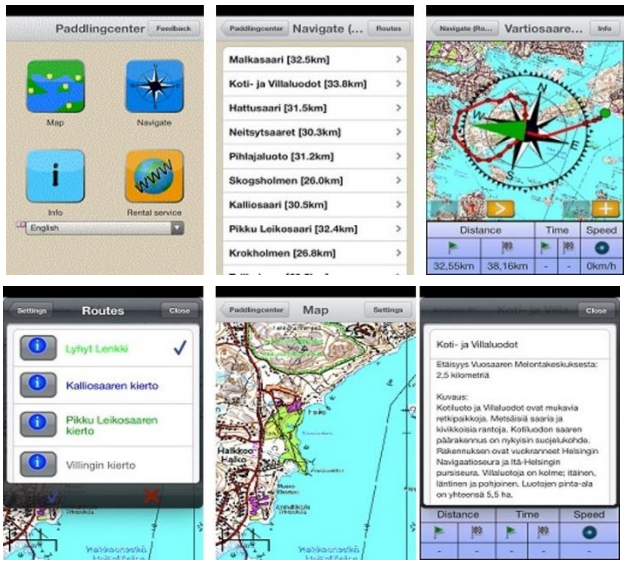

Figure 3. Screenshots of the mobile guide application built on the Vaadin Java framework.

The Vaadin framework provides ready-made user interface elements, and therefore the visual outlook of the user interface was based on the

Vaadin framework's visual themes. Figure 3 shows screen shots of the mobile guide application prototype. The mobile application is compatible with iOS and Android devices, and the content is created, updated and managed by the external content editor, which was also built for this research project.

The software developers (n=2) themselves first assessed the functions of the prototype at the street level, as geo-location features require outdoor testing. They focused on assessing the software code related to the digital maps, navigation, digital compass and global positioning system (GPS). After the functionality tests on the street, the first field testing involved the designers using the mobile guide prototype in a target environment while kayaking on the Baltic Sea. This field test threw up new issues, which caused the development team to reconsider the design. First, the mobile device had to be in a plastic waterproof bag while kayaking, and this caused significant challenges for the user interface designers. Although this was recognized beforehand to some extent, the bright sunshine and glinting water caused considerable visibility challenges in the real usage environment. Therefore, the user interface designers were required to redesign, especially the visibility and size of the buttons and other navigation graphical user interface elements. In addition, the strength of the users' internet connection varied while on the sea, and while it was strong enough in places, in others it weakened significantly. Furthermore, the kayakers were often sitting near the sea's surface, and the bobbing of the water and breaking of waves also disturbed the internet connection. However, the GPS signal was excellent on the sea as unlike in cities there are no physical obstacles. The unstable or variable internet connection on the sea and archipelago surprised the development team, and caused further changes to the initial development plan. For example, the development team re-prioritized the requirements and dropped the features that required continual online access and made changes to the logic for the navigation software component. Before making these changes, the application prototype crashed every time during testing.

In the first plan, the development team aimed to include online route tracking and automatic saving in the service, but this feature had to be removed from the first release, despite it being flagged as useful by the tourism companies. It would have enabled the companies to record the kayaking routes of their customers and later allowed them to identify the most popular routes. It was decided to keep this feature in the product roadmap, with a view to reconsideration in the future.

5.3 Validation of the Business Viewpoint

The development proceeded to the second prototype, the so-called Alfa version, which implemented roughly 70% of the requirements and was ready for testing by a small group of potential customer companies. The steering group members of this project represented the potential customer tourism companies. Two group members were company representatives, one member worked as the CEO of an outdoor tourism company and another member was marketing director of a company specializing in location intelligence and digital map services. Therefore, they each had valuable viewpoints on the business perspective of the application. Overall, the testing group consisted of four steering group members and two developers (n=6).

The steering group members conducted the field testing on the archipelago of East Helsinki in Finland. They each had their own smartphones in plastic bags and the mobile web application was running in the background of their phones. The test group kayaked the *Kalliosaaren kierto* route with the help of the application guide. The test trip took five hours, during which we conducted semi-structured group interview to collect feedback on the users' experience and the development needs.

The overall analysis of the user feedback revealed that company representatives, i.e. business experts, were satisfied with the application. They expressed positive attitudes towards the concept and their experience of it as it helped them to navigate the archipelago and displayed the selected route information. The field test revealed that the application displayed the current kayaking speed and accurately calculated the distance to the next turning point and the final destination. If a kayaker turned away from the route, the navigation arrow turned red; when the direction was corrected, the

arrow returned to green, digitally guiding the kayaker back to the correct route.

The users also emphasized that they felt secure and safe by having the application at hand. Moreover, the field test demonstrated the potential business benefits for tourism companies. They stated that the mobile guide *"would work as a digital tourism guide that helps companies to scale business"*, which also indicates that better services could result in increased customer satisfaction. In general, the application received positive feedback, especially the user interface design that it was said supported use in challenging environments without any major technical or usability problems. The testers naturally suggested some new features, such as a warning mechanism, or at least better information about ferry routes, and a "home button" that would guide the kayaker directly back to the home harbour.

This testing round also raised some additional development requirements. For example, each route included several turning points, which can be defined on the editor site while creating a new route on the system. If a kayaker went 50 metres past a turning point the navigation compass began to point backwards, towards the turning point, unless the kayaker clicked the next-point button. Instructive information was required to do this, but smartphones' small screens do not allow the space to accommodate this extra information, and we found that only pop-up windows would be user friendly. The development team had already recognized this challenge, but no simple solutions were forthcoming; the software cannot know if you are lost and going in the wrong direction or whether you have passed the turning point but actually headed in the right direction. The solution requires more intelligence, and this need was added to the further development roadmap.

5.4 Validation of the End Users' Viewpoint

The tourism company Natura Viva arranged the field tests several months later, where (n= 17) tourism university students used the application while snowshoeing different routes on sea ice. The testers represented authentic end users as the tourism students were active in outdoor activities and many had specific experiences in the activities for which the application was designed. Feedback was collected after testing using a structured questionnaire that included closed and open-ended questions. Thirteen of the seventeen testers returned the feedback forms; seven used an iPhone and six an Android device. Eleven of the thirteen used mobile applications daily or at least a few times a week. Similar tests were carried out two months later with a group of tourism students (n=6) that used the mobile guide application in navigating a route on the paths of a city park. Figure 4 presents a picture of the users' field test.

Figure 4. Tourism university students preparing to test the concept by snowshoeing a route guided by the prototype application.

The overall feedback we received was positive and optimistic. For example, typical replies to the question "Good things in this navigation application?" included: *"very clear with coloured arrows pointing to the right direction"; "it's simple and easy to follow"; "easy to see where you are, the direction and generally easy to use once it's started";* and *"it's really fun and easy and doesn't require any special skills to use it"*. The testers, however, raised development issues, such as: *"could add some sounds/feedback, and block the screensaver"; "the arrow was kind of restless at times, it was difficult to follow…"; "the current location should be in the centre…";* and *"sometimes the arrow was slow and showed green for every direction".* These comments indicated that navigation was the key feature on which users focused, meaning it ought to work perfectly. The testers requested additional features, such as: *"a person telling you where to go, so you don't have to look at your phone constantly"; "voice feedback";*

"amount of steps taken and a voice telling you where to go"; and *"info about the things to see around you".* Some testers thought the application already had everything they would need, stating: *"Nothing. If I need a navigation app, navigation features are all I need";* and *"I can't think of any. Everything I needed was there".* The testers did not raise the requirement for radical changes or any compulsory need for new features. As the previous examples demonstrate, the users believed that the basic features would work well, and that any new features would improve and simplify the user experience, but only when the basic functions worked properly. The basic features are the foundation for the use of more advanced features, i.e. secondary features, for use only if the basic features of the application bring value. The basic features are essentially a doorway to the use of mobile applications.

5.5 Validation of the Expert Users' Viewpoint

The design team arranged a two-day testing trip where tourism experts (n=5) used the mobile application while kayaking three routes on the Helsinki archipelago of the Baltic Sea (Figure 5). The experts were a German navigation consultant and trainer with vast experience of outdoor tourism, wellness activities and associated navigation devices; two tourism experts (a lecturer and a project manager) from the tourism education department of a university; the CEO of an outdoor tourism company that offers services, e.g. kayaking, for tourists in the Helsinki area; and the project manager of this research and development project. Three of them had prior experiences about the application from the previous testing iterations. All participants used the mobile guide application while kayaking pre-defined routes during the trip.

Data related to the usage experiences and development proposals was collected from the semi-structured group interview conducted during the test trip while participants were using the mobile guide. The framework of interview themes concerned the benefits for users, development needs, technical problems and the business potential in European markets. Overall, the user experience was positive, although a bug in the iOS 6.0 operating system blocked the automatic geo-location feature in the Safari browser. The automatic location information worked for a spell and then stopped, and the application had to be restarted.

Figure 5. A tourism expert testing the mobile guide while kayaking.

The test users raised significant benefits related to safety and entertainment aspects. The mobile guide provided users with the feeling of safety as it displayed their current location, speed and distance information related to the route. There was no similar application known to exist in European markets that allowed tourism companies to edit and manage content and with a user interface designed for use during outdoor activities, particularly kayaking and hiking.

5.6 Validation of Business Scaling in the Selected Business Segment

The design team arranged (n=4) company pilots after the application concept and functional prototype were readied for performance and usability assessments. Three company pilots were arranged with tourism companies that largely offer their customers kayaking, canoeing and hiking services on the sea or in river areas. The fourth pilot involved a hotel in Lapland, Finland, that targeted hikers.

All of the companies received their own application's internet address or uniform resource locator (URL) with their own content including points of interest, route content and instructions. The development team also printed a poster that invited customers to test the mobile guide application. The end users were personally met at the tourism premises, except the hotel guests were

planned to leave their written feedback in the hotel reception; due to its distance from Helsinki as face-to-face meetings were not feasible.

The design team conducted end user interactions with approximately 50 customers and staff members (n=50) in three different kayaking or paddling centres. Most end user interactions took place on land while users were preparing for their kayaking trip. In the first phase of end user interaction, the interview mainly focused on the interest of the new proposed mobile guide service, and on the second phase, if the potential end users interested to review or test the application, the user experience and technical functionalities.

In addition to the feedback documenting, data was also collected from the unstructured feedback function of the application. The users had possibility to give written feedback to the designers through the feedback functions of the application. Examples of the user experience and technical feedback received were: *"Does not work in HTC Sensation Z710e phone, application does not recognize the phone, e.g. Google Map works fine in the same phone and it has been tested over one day and the application started several times";* and *"The application basically works, but minor failures disturb usage".* The users also gave practical ideas for how to improve the application, such as: *"The navigation arrow could be larger…"; "...you could add a new feature that helps users: A touch and a user indicator (blue point) on the screen would change visible point instead of target point… …the blue point would appear "wave" element…";* and *"The approaching colours (green/red triangle) would change in the app. based on a 90-degree sector. Could you also do this for 45-degree sectors?"*

In this testing iteration, the design team also shared the mobile guide prototype with the staff of tourism companies and discussed with them their expectations and requirements. The staff of tourism companies were eager to know how their customers accepted the mobile guide application, and what kinds of benefits it could offer their business. All of them believed that mobile services would form an essential part of the tourism business in the future, with the "automated guide" and "digital tourism guide" seen as the mobile applications with most potential in outdoor activities, given that their customers expect guide and route information. Investing in this would probably increase customer satisfaction and encourage fearful kayakers or hikers to purchase an outdoor trip or rent a kayak. However, the managers' open question remains: How will they earn a return on their investment if the mobile service is offered free of charge?

5.7 Limitations of the Pilot Testing

On starting prototype testing at the tourism company premises in the sixth iteration, we expected to encounter eager users because almost all of them were interested in the mobile guide application at the previous phases. However, the results of assessing the prototype indicated that only a few of the end users pro-actively downloaded or scanned the quick response (QR) code while participating in activities such as kayaking or hiking. Most of the end users who tested the application and provided feedback were asked to use the application, but few downloaded it voluntarily. The steps involved in testing consisted of loading or scanning the application to the browser, learning the key features, using it during the trip and reporting their experiences.

Kayaking is an activity that requires you to concentrate to maintain balance, which means if you are not careful there is a risk of damaging or wetting your own mobile phone while getting familiar with the functions of the mobile application. That is reasonable justification for why many kayakers did not try to use the new application while focusing on their kayaking. As a result, several users liked to hear and speak about the application, but were hesitant to try it in practice. The most active and enthusiastic users were those with some experience of mobile navigation devices; therefore, we call this group of users the early adapters and expert users. Often, the early adapters are interested in new technologies in their field of interest.

Despite the problems discussed above, during the prototype tests in the field environment the design team did collect enough feedback from the active potential users who voluntarily tested the application. In addition, conducting interviews with potential users provided us with substantial relevant feedback and increased our understanding of users'

expectations and priorities. However, it is important to mention that the hotel prototype testing was not as successful as the other company pilot tests because the design team failed to conduct face-to-face interviews with the target users. As a result, we gathered little relevant feedback from the hotel-based end users. It is difficult to estimate how many of them actually tested the application, but few returned the feedback form. Nevertheless, the post-interview with the hotel manager was beneficial and provided new insights regarding the application. The timing of the prototype testing was not optimal as most users hike in the autumn. In addition, most customer at the hotel were retirees and thus not the most eager testers of new mobile applications. Furthermore, the design team could not remotely support and motive potential end users in testing the mobile service in practice. The design team learned that visitors to hotels are not spontaneous or proactive testers, and instead need to be tempted or convinced to test through motivating or helping them in some way. Similar findings emerged from other piloting premises; the users needed to be motived to provide formal feedback.

6 DISCUSSION

6.1 The Key Roles of Stakeholders in Mobile Service Design

The UCD process should adopt a broad perspective and not focus only on the end users if a successful new service is to be produced. Instead, software and ICT services must satisfy other stakeholders, such as business managers, the software team, project management and, in many cases, the project financiers and providers [39, 40, 41]. It is essential to begin the iterative development process by identifying the most significant stakeholders and their impact on the overall application in UCD. This novel application design and development is a result of merging tourism business offerings with existing technological possibilities. Co-operation and interaction between software developers, project management, tourism experts, tourism companies and their potential customers provided useful resources for defining specification requirements and realizing the expected user interface design. Conducting various prototyping phases, continuous testing events with target users of the application and several interview sessions with tourism companies' management have provided us with a great deal of valuable data. The analysis of the gathered data in this case has helped significantly in defining and prioritizing features and identifying the potential stakeholders' demands. Figure 6 demonstrates the three key stakeholders groups involved in the application concept design process.

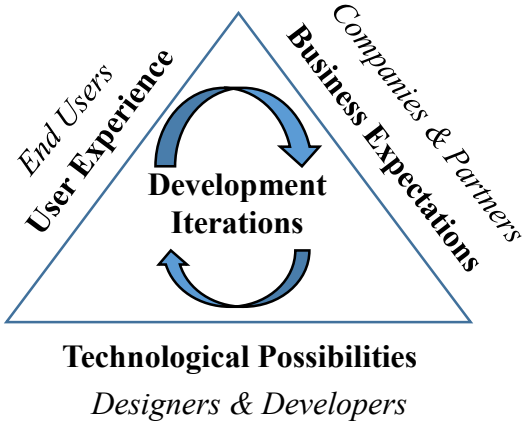

Figure 6. The key stakeholders and their contributions to the mobile service design process.

This paper emphasizes the importance of involving the most significant stakeholders in the design process, not only at the beginning of the project but throughout every phase of the design and development work. The diversified interaction and collaboration with end users and potential customer companies helped us to focus on the most important and requested features and to continually prioritize the product backlog, the development plan and the product roadmap.

6.2 The Main Contributions of Each Stakeholder

This paper emphasizes that working in a cross-disciplinary team ensures a broader viewpoint during the design process. The users' involvement may affect the specification requirements from the elicitation phase onwards, right up to the prototype evaluation phase. Therefore, as Figure 7 shows, using the mobile guide application can be categorized into three main phases: the end users

use it before their trip mainly for route planning; during their trip it is mainly for navigation and information about the route and points of interest; and after their trip they can share their experiences. The system administrator takes care of the configuration and the tourism companies' personnel manage the route and information about points of interest.

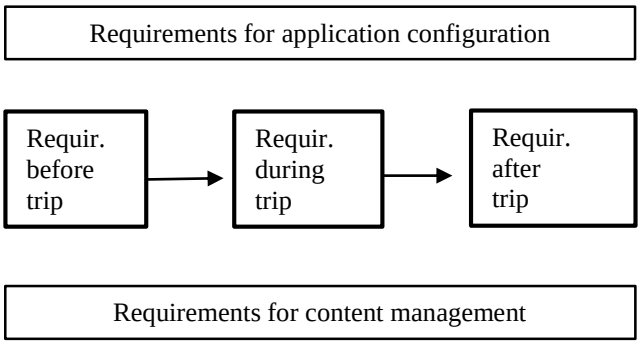

Figure 7. Requirement categories in designing a mobile guide concept for tourism businesses from the viewpoint of the end-user journey.

This design experiment showed how differently business managers and end users might focus on features that software developers view as self-evident. As an example, users were given the option to enable or disable the objects in the application's user interface, which meant they had the freedom to customize the application content. However, the end users did not speak about such possibilities, and it is probable that few took advantage of them. Customization features are usually advanced features, and most end users probably focused on the basic features while initially testing the application. This finding emphasizes the importance of road mapping in the research and development processes, especially from the viewpoint of how the users will prioritize features. By testing a set of features, we have been able to prioritize them and determine the key features, the so-called critical success factors, for new mobile services in the tourism market. It is also important to note that often there are conflicts in interest between the stakeholders involved in application development. As an example, the main concern of the tourism companies' management is the business benefits, such as more revenue, increased customer satisfaction and differentiation from competitors, whereas their customers or end users are expecting direct benefits for their outdoor activities, such as automatic route guides and more relevant information.

6.3 User Involvement in Application Design

The management of pilot companies naturally considered the mobile services in a broader context than that considered by the end users. Therefore, there were several "layers" of interest within the development of the mobile service. The UCD principle ensures that all stakeholders' interests are taken into account, and several users have various roles in the digitalized service process. The prototype testing results indicated that the mobile service precipitated unanticipated and new added value for small tourism firms and their customers.

This project found that end users place significant value on the core features that offer them most benefits and satisfaction. However, these features have to be implemented in a proper way, one that results in an excellent user experience. The lack of proper functionalities or a poor design process results in a service failure from a usability point of view. Hence, the developers should recognize those features and their nuances as quickly as possible and prioritize their development effort by focusing on them. This can be achieved using rapid development methods and a mobile web development framework, and its add-ons, to shorten the lead-time of software product development cycles.

Mobile applications need to attract and attach themselves to the users emotionally to achieve sustainable usage [42, 43]. This is even more important in outdoor navigation applications, where the user not only has to emotionally attach to the application, they must also trust and feel secure with the application, a point raised during the field testing phase of this application. This is particularly important because the target users of the applications are often kayakers, joggers, cyclists or hikers who are alone or in a small group in rugged or rural areas. Moreover, the mobile service usage and functionalities should be easy to load and fast to navigate, and the functioning logics should

follow the user's mental models, i.e. their prior assumptions.

The field tests revealed that the end users and companies' staff members were satisfied with the overall concept and the application, and viewed it as a useful service that would provide added value for outdoor activities. Interestingly, many active kayakers used waterproof mobile devices and had downloaded some form of tracking application to their devices. The end users liked the information offered by the application, such as points of interest, guided route information, speeds and the distance to the destination. For instance, some users liked to see how fast they were able to kayak on a particular route or how far away the destination was, or to be able to locate the nearest point of interest.

6.4 Managing the User-centred Design Process

The involvement of several stakeholders in the design process requires careful project planning and management, as each stakeholder reviews the concept, requirements and user experience from a different perspective. As Ries [25] states, it is easier to build known software products for established markets than to innovate unknown product concepts for emerging early markets. Therefore, to optimize the use of resources and shorten the time-to-market, it is recommended to plan carefully which features could be tested using scenarios, screenshots, sketches and other mock-ups without the need for coding the application itself.

Table 2 shows six design iterations that involve different stakeholders and validation targets and content. The testing of usability and the researching of business benefits involve different development goals, although they can be tested using the same prototypes. This study shows that all six of these iterations bring value to the mobile service design process and have a unique role in the process. It is also recommended to involve all stakeholders in the design process as early as possible, as they will affect its success on launching the mobile service in any case.

Table 2. Design iterations, stakeholders and the targets of each design iteration.

Design iterations	Stakeholders and target of design iteration
1. Business case and concept definition	Business owners: Produce initial concept plan and visual drafts to create a common understanding of the goals
2. Validation of the technological solutions	Software developers: Validate technological solutions by testing functional prototypes in the real usage context
3. Validation of the business viewpoint	Company representatives: Validate the business viewpoint by assessing the concept using prototypes
4. Validation of the end users' viewpoint	Potential end users: Validate the end users' viewpoint by assessing the concept using prototypes
5. Validation of the expert users' viewpoint	Domain experts: Validate the marketing, sales and service viewpoints by assessing the concept using prototypes
6. Validation of the business scaling, delivery and service needs	Company pilots: Validate the scalability, delivery and service needs by piloting mobile services with real potential customer companies

This study points out that usability issues are only part of successful product design. For example, the managers of tourism companies were most appreciative of business benefits, while the end users focused on the guidance and navigation benefits of the application. To obtain relevant feedback in field testing situations, interviews and performance assessments in real usage environments should focus on emotion- and motivation-related issues, as they have a direct impact on the financial success and scaling of a new mobile service.

7 CONCLUSIONS and FUTURE WORKS

This case study, accomplished using an action research strategy, contributes to software development methods by describing an experiment in which users were involved in the mobile service design through six different design and assessment iterations. Each of the iterations had its own role and specific stakeholder group, and each helped the design team to gain rich and versatile user experience data. As a UCD method it worked

logically, and each phase synchronized with the others.

The study revealed that iterative UCD increases significantly the number of stakeholder touch points, and therefore helps to integrate business and user needs with new technological possibilities. We have also shown that the involvement of various stakeholders in new mobile service development ensures better integration of business expectations, mobile web technologies and user experiences. Hence, the UCD approach should adopt a broad perspective, not only the viewpoint of end users, as the successful new mobile service must satisfy business managers, end users, software developers, project management and, in many cases, the project financers.

The latest cloud computing, mobile technology advancements and UCD methods have created a unique opportunity to boost digital services, especially in the small business market segment. Hence, this requires fresh research on how such new digital services can be designed and developed more quickly by involving various stakeholder groups in an iterative design process.

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