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6 May, 2010

Technical Report
MSR-TR-2010

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ABSTRACT

In this paper we present a case study of longitudinal in-situ observation involving a social application for mobile communication. Explorations of new concepts generally suffer from the lack of users' familiarity, technical issues, and upfront infrastructure cost. This has particular significance for research that relies upon an adequate level of adoption within a community or a social group. Because of the complex interactions between technology, mobile infrastructure, individuals, and social dynamics we require methods that make provisions for uncertainty and ad-hoc inquiry. Our study demonstrates an adaptive approach to planning, design, and implementation that is responsive to social and infrastructure conditions. It represents a shift from traditional longitudinal studies that observe systems with fixed sets of affordances. It counteracts the dynamic social factors and investigations with evolving system features and research methodology. Consequently, it points to the plasticity required from the prototype service to ensure sustained use and adoption.

Categories and Subject Descriptors

H.5.m [Information Interfaces and Presentation]:

Miscellaneous; H.5.2 [User Interfaces]: Prototyping, User centered design.

General Terms

Design, Human Factors.

Keywords

Mobile communication, social software, case study, in-situ observations, living lab.

1. INTRODUCTION

Mobile applications and services present methodological difficulties for HCI due to the privacy considerations and lack of fixed locality to support observation, probing, and analysis in natural settings. The problem is partially alleviated in instances

when the user experience has been first shaped and understood within the desktop environment and then extended to mobile devices. However, the mobile born applications, which are also social in nature (e.g., Twitter), raise the complexity of HCI methods to another level. There, the technology is a medium for connecting individuals and shapes both the social and the individual experience. Thus, the standard HCI focus on an individual is not adequate and needs to be expanded to include characterizations of social groups that are relevant to understanding of HCI issues.

In this paper we present a case study that illustrates several distinctive issues related to in-situ observations of social applications for mobile communication. Through example of the weConnect prototype (<http://weconnect.co.uk>), we contrast the use of a short-term field study [20] for learning about the user's understanding, appeal, and potential usage of new concepts, with the need to assess the prototype readiness for a general deployment, emerging practices, and factors that influence sustained adoption and use. Since weConnect includes a strong social component its adoption depends on the community take up. However, it is difficult to anticipate the rate of users' engagement and our ability to collect user data. This immediately introduces the uncertainty involved from the study planning perspective and requires a staged approach. Furthermore, weConnect requires mobile infrastructure that is not yet main stream and natively supported by standard devices. Thus, we had to resort to the 'futuristic' but nevertheless natural setting of a 'living lab' which supports innovations that are ahead of the curve in technology and user practices.

We describe in detail a longitudinal study design that adapts to the changing dynamics between the infrastructure conditions, social behavior, and the research discovery process. It involves an evolving set of investigative methods and objectives. The study enables us to reflect upon the very nature of sustainable social applications in the mobile context. The complexity of the

ecosystem requires a level of *plasticity*¹ in the prototype preparation and deployment. This, in turn, requires repositioning of HCI objectives, from evaluating a predefined set of features to assessing creating a sustained interest and usage through adjustments and transformations. Such HCI approach becomes also reflective of the user centered design and development practices. They are equally fundamental and valuable for the realization and sustainability of the productized service.

In the following sections we provide the context of the study, reflect on the related work, and describe the study implementation in detail. We conclude with the discussion of the study implications and the summary of our observations.

2. BACKGROUND

2.1 Communication and Social Engagement

The notion of social services is commonly associated with social network sites such as Facebook, Del.ici.ous, LinkedIn, Yahoo! Answers and similar. With the popularity and large scale adoption of these services, research is typically focused on influence of design on the overall usage patterns [27]. However, personal communication is an essential aspect of the social engagement. This is particularly apparent in instances when communication applications are not designed to support social engagement but the users apply them in creative ways to achieve the sense of connection with a group or community. For example, parallel messaging via instant messenger is used to create an affective atmosphere that contributes to the feeling of social connection [21]. Conversely, the community engagement in Facebook, for example, is primarily used for personal communication, keeping in contact with high-school friends, shaping relationships that might otherwise remain ephemeral, and maintaining current relationships [7], similarly to the practices with instant messaging [12].

Social and communication come together most vividly in the social software for mobile devices, increasing the social connection and activity levels [4] [14]. There the boundary between on-line, mobile, and direct communication is blurred.

2.1.1 weConnect and Co-presence

weConnect is an exploratory research prototype, introducing a notion of the *personal media channel* that enables individuals to share content on a continuous basis with remote others—the weConnect service [20]. It aims to provide ways of communicating and sharing experiences beyond the common exchange of messages through SMS, MMS, and e-mail or fully synchronized communication via IM and phone calls. It supports *unicast* channels that one can create to transmit content to another person—somewhat similar to an RSS feed. These personal channels are one-way only and by default not visible to others who are not involved in communication. A person can have exclusive channels with as many people as they wish. Similarly, the recipients can reciprocate through a separate channel back to the person. weConnect can therefore be characterized as a ‘closed’



Figure 1: Mobile Application provides: user login, selection of options for viewing the channels or producing a mix or broadcast, and the channel viewer to see the content (top row). The user can switch between the users and view a different channel. If the user wishes to create a mix, it can use the images from the photo gallery or take a new photo, add animations and text, and then transmit (middle row). The photo can be enhanced with animated overlays and text (bottom row).

social application that enables individuals to attend to their individual relationships within their social environment.

weConnect design moves the mobile phones and Internet further to the social co-presence tool, enabling usage in a range of situations including social and functional use. Similar has been observed by [24]. The question arises what role weConnect channels might assume, what practices will evolve, and what types of relationships would benefit most from it. According to [23], one expects that emerging practices would be influenced by the social contexts in which the Internet and mobile phones are used. Furthermore, the work by [2] points out that individuals are likely to choose a technology for communication based on its affordances and its suitability with regards to the existing *ties* with individuals they are communicating with.

2.1.2 weConnect Design and Implementation

weConnect comprises a Web server that manages user registration and media ‘mixes’ that are broadcasted through individual channels. The Web server is accessible to mobile devices, e.g., C500 Smartphone and PDAs, via GPRS connection, and to desktop computers or other devices enabled with Internet connectivity. The weConnect also includes two sets of client applications: (1) for creating media ‘mixes’ from images, text, and animation overlays and (2) for viewing the content of individual

¹ Plasticity, in contrast to ‘rigidity’ describes the ability to transform into a new form. In contrast to ‘elasticity’ which involves changes that are temporary and reversible, the plastic changes are permanent. In psychology, it refers to an intelligence factor that determines the ease of changing one’s perception of a situation for finding a new solution to a problem.



Figure 2. weConnect personal media gallery (top) contains images that are stored on the desktop or sent from the mobile weConnect interface. Thus it provides an easy access to media that has been used from the mobile phone. The user can easily resize and crop an image using the weConnect editing tool (bottom).



Figure 3. weConnect channel viewer on the desktop. The user logs in to access personal channels that others have created for him or her. From the drop-down list the user selects the particular channel to view (top row). The text is shown as animated banner, scrolling from right to left. The user can access and replay previous mixes (bottom) through the menu that appears on mouse hover.

channels. Both functions are available on the mobile devices such

as SmartPhones and PDAs and on the desktop.

A typical usage scenario involves a user taking a photo on the mobile device, adding text and animations to create weConnect mix, and then sharing the content with another person through a dedicated media channel. The recipient can use the weConnect channel viewers to view the content on a mobile device (Figure1)

or on the desktop (Figure 3). Similarly the user can create content on the desktop via weConnect web site and transmit to individual channels. The user logs into www.weconnect.co.uk and accesses personal image gallery that includes a simple tool for editing images. The user can select animation effects to be overlaid over the image (see Figure 2) and add text that would appear as an animated banner at the bottom of the image. Such created mix is pushed to the specific person's channel by selecting the person's name from the contact list.

The weConnect Web server stores the content and provides a gateway to the recipient. The recipient's device automatically 'pulls' the content from the server and displays it through the weConnect viewer on the mobile phone, the desktop, or any Web enabled device that runs the weConnect client. On the desktop, the content appears within a window of fixed dimensions (Figure 3) that can be placed anywhere on the desktop. The user can view multiple channels at the same time, in separate weConnect viewers.

2.1.3 Short-term Field Study

An earlier version of weConnect was subject to a two-week field study to assess the appeal, observe usage, and gain insights about usability aspects that are important for the personal experience [20]. For the study we selected individuals with strong personal ties and provided pairs of participants with SmartPhone devices with installed weConnect software. We provided training, covered the cost of the mobile services, and benefited from two types of incentives. First, some of the participants were recruited from the extended social network of the researchers conducting the study, which implied a degree of social pressure. Second, the participants were awarded their choice of hardware or software at the end of the study.

The study was conducted in a natural setting but for a relatively short period of time and with a limited number of individuals. Thus it left a number of questions open. Could weConnect provide a sustained value and motivate a continued use over time? Could we scale up its deployment to a wider population? Can we conduct successful investigation in spite of the fact that the application relies upon a non-standard client application and utilizes infrastructure is not yet main stream? These can be answered only through a longitudinal in-situ study.

Since the service adoption is essential for the study objectives, it seems most promising to focus on users with strong ties. People with strong ties influence each other to adapt and expand their use of media [15]. They typically use diverse media for different types of messages. The level of strength is determined by various characteristics: the amount of time people spend together, the frequency of contact, the emotional intensity, the intimacy, and reciprocal services ([10] [19] [15]). Granovetter [10] distinguishes between three specific ties in a community: social, community affairs, and business-professional. The social ties function as strong ties, business professional as weak ties, and community-ties are in between [11]. Introducing a new medium in

a community may be useful as an additional means of contact to support social ties [15] and conversely, strong social ties may facilitate the adoption of the new technology.

2.2 Longitudinal In-Situ Evaluation

Deployment of research prototypes is often more complex than beta releases of existing products that have an established user base, developed common practices, and a supportive ecosystem. In the case of weConnect, the prototype is based on Web technologies that facilitate Internet connectivity on mobile devices and personal computers (PCs). These are not commonly available to users. Furthermore, weConnect uses proprietary client applications for the PDA and desktops that users need to install and upgrade over time. Finally, we need access to communities for observation in their natural setting where people can develop genuine personal relationships. These requirements point to the Living Lab environment as the framework for longitudinal observations.

2.2.1 Living Lab Study Framework

A Living Lab typically involves a geographic locality that is equipped with a required infrastructure and involves a segment of population willing to experiment with new technologies and participate in user trials. For our study we sought a partnership with the i-City Living Lab² in Hasselt, Belgium and formalized our engagement as *the Living Lab Exploration of the Community Sharing* (LLECOS) study. The i-City provides facilities to support the design, development, deployment, and evaluation of communication technologies and services in different stages of maturity [25].

The Living Lab framework represents Test and Experimentation Platform (TEP) [1] that (i) involves real users in their natural context, (ii) observes their natural daily behavior, and (iii) considers the users as co-producers in the innovation process. It enables investigation of early technology developments based on ethnographic principles through four phases: contextualization, concretization, implementation, and feedback [25].

A choice of a specific Living Lab inevitably has implications on the design of the software and the deployment strategy. In this case, it meant integrating weConnect with the i-City wireless network infrastructure, the application management services, the user recruitment services, and specific PDA devices that were in use by 700 individuals within the i-City community. Most importantly, we had to assess the risk associated by the integration process and commitment to the Living Lab framework. For example, promoting weConnect on PDA devices instead of users' personal mobile devices benefits from the convenience of deployment and upgrades but may seriously undermine the adoption of weConnect, considering how important personal aspects of mobile phones are.

3. RELATED WORK

Application of traditional HCI methods for evaluating usability, user experience, or for probing more fundamental research questions are of limited use for mobile HCI. Mobility expands and complicates the research field site, necessitating the rethink of traditional observational methods. While lab based approaches

still tell us much, and have been expanded to more adequately represented mobile environments [13], they are removed from the intended contexts of use for mobile devices. Thus new approaches have emerged in response to the challenges of mobility. [13] provide a framework that groups mobile techniques into 'mediated data collection', 'simulations and enactments' and a hybrid approaches that combine the two types along with traditional techniques. The first group encompasses data collection mediated by participants and technology, e.g., through self reporting and diaries, data logs, video observation through wearable devices, etc. By making data collection automatic, or handing it over to the participants, such methods overcome a number of difficulties in the contextual evaluation of mobile devices and gather data without a presence of the researcher. Simulations and enactments, in contrast, are typically lab based methods although striving to free themselves from the constraints associated with such environment. They involve some degree of role playing, either through the enactment of scenarios or the use of lab based props to recreate contexts of use.

Kjeldskov and Graham's [18] review of mobile HCI methods reported on the range of methods and charted the research purposes to which they were applied. Considering the body of research dedicated to engineering, i.e., developing new systems or parts of systems, only 13 percent was accounted for by field and case studies. Evaluative research was strongly biased towards lab experimentation, accounting for 71 percent of the total efforts, while field studies represented only 19 percent and surveys only 10 percent. These figures illustrate the relative rarity of field studies and the fact that the majority of engineering has been undertaken without reference to real use contexts. [18] contend that this is detrimental and argue for a concerted effort to ground engineering and re-engineering within the field work and case studies, providing a richer and contextually relevant input to the process.

Hagen et al [13] argue that the most efficacious evaluation techniques for mobile devices employ a range of techniques. Each method elicits a particular type of data, and through the combination of methods one can draw the richest picture. However, while research questions and hypothesis can be constructed in advance, it is not always as easy to foresee the best method to answer them. Research, especially with mobile devices, is often contingent upon variables which are difficult to know in advance. In partial response to this [5] present a framework to enable designers and participants to perform low overhead, in situ modification of mobile prototypes and support iterative and participatory design in the field.

With the emergence of social software there is a need to develop methods that enable us to explain an individual's behavior in their social context. In addition to the interaction between the technology and an individual, we need to observe social interactions among individuals that are facilitated by the technology. Combining the mobile and social aspect we are faced with new challenges. The value added by a service like Twitter in the mobile context cannot be assessed without considering the social aspects.

Our task involves a long-term prototype deployment in a social and mobile context, where the control over the deployment and usage is low, introducing further uncertainty to the planning and execution of the study. Thus we need to devise an approach to

² i-City Living Lab has become a part of iLab.o in IBBT.

transition from a short-term, relatively controlled, in-situ observation [20][20] to a long-term deployment within a complex social environment, equipped only with an experimental infrastructure.

4. LLECOS CASE STUDY

We use the example of the Living Lab Exploration of Community Services (LLECOS) to illustrate an approach for conducting in-situ study of mobile services in the community context. We show how our research agenda evolved over the six month study. The study was conducted by an international team involving three organizations, including the administrative team from i-City Living Lab in Hasselt.

Because of the inherent uncertainty related to the deployment and usage, the study planning was done in an incremental fashion. In the remainder of the paper we present the resulting sequence of research stages with details of methods and findings. As we progressed with explorations of research issues, we investigated weConnect technology through (see Table 1):

Stage 1: Testing and usability feedback

Stage 2: Deployment and Log Analysis

Stage 3: Diary Study

Stage 4: E-mail Integration.

Partially overlapping with the stages 3 and 4, we conducted a co-design workshop to explore the fundamental idea of weConnect through photo elicitation and participatory design. While this provided valuable input for future design of weConnect, it did not affect the technology development and research questions during the deployment of weConnect. Thus, we defer that discussion to future publications.

The initial research context was set with the high level research questions: *What is the impact of rich, multi-layered, and continuous personal media on close relationships within social groups? How would close relationships change with the use of such technology?* Our initial hypotheses were:

- H1. The predominant use of WeConnect will be as the means for creating a virtual co-presence.
- H2. Perceptions of the weConnect application will be formed by the characteristics of the social groups.
- H3. The nature of the relationship among individuals will affect the content and purpose of the created weConnect mixes.
- H4. weConnect will add to the group dynamics within existing communities.

In the following sections we describe individual stages, reflecting on the reasons they occur and the outcomes they lead to.

4.1 Testing and Usability Feedback—Stage 1

The first step in the study implementation involved integration of the weConnect service with the Living Lab environment. That called for usability testing and was conducted by involving members of the i-City staff and extended research team. The objective was to identify and possibly rectify obvious technical and usability issues. The participants were encouraged to try the service for several days and provide feedback. As a result, the development team was directed to address the identified issues. Extra attention was given to the PDA version of the software

Table 1. Study Timeline

Stage 1. Testing and Usability weConnect v.1		
Sept'07	Usability Testi-City LLab	i-City Eng. Staff
Stage 2. Deployment and Log Analysis, weConnect v.2		
26 Oct'07 - 12 Nov'07	Online survey	Couples, Friends, Colleagues
6 Nov'07 - 19 Nov'07	Introductory Interviews	Couples, Friends, Colleagues
1 Dec'07 - 19 Dec'07	Online survey	Community members
18 Dec'07 - 18 Dec'07	Introductory Interviews	Community members (9 p.)
Stage 3. Diary Study, weConnect v.3		
12 Dec'07 - 20 Dec'07	Re-introduction and distribution of diaries	Couples, Friends, Colleagues
28 Dec'07	Re-introduction and distribution of diaries	Community members (4 p.)
23 Dec'07 - 18 Jan'08	Completing diary	Couples, Friends, Colleagues
16 Jan'08 - 23 Jan'08	Completing diary	Community members
20 Feb'08	Telephone feedback (diary + application)	Community members
Stage 4. E-mail Integration (in parallel with co-design workshop , weConnect v.4		
2 Apr'08 - 15 Apr'08	In-depth interview (diary + e-mail service)	Couples (4 p.) Friends, colleagues
10 Apr'08 - 14 Apr'08	In-depth interview (diary + e-mail service)	Community members (5 p.)
25 Apr'08	Telephone feedback (e-mail service)	Community members

since a significant effort was required to synchronize the i-City platform on the PDA and the weConnect client applications.

4.1.1 Software Modification – weConnect V.2

The software testing pointed out the issue with

Interoperability. The weConnect Web service (www.weconnect.co.uk) that includes editing tools and management of media content worked only with the Internet Explorer browser.

Usability. Functions of different action buttons on the website and the PDA were unclear. Furthermore, it was suggested to include notification when users receives a new mix.

Features. There were too few overlays with emotional connotation. There was no helpdesk and contact information on the Web site.

Perception. There was a general perception of the 'lack of added value' compared to other familiar media, e.g., MMS.

As a result, the development team made a number of changes and released weConnect v.2. The website was given a new look, with added overlays for emotional expressions (hearts and kisses). It was expanded with legal documents comprising a disclaimer to clarify privacy issues, personal and non-commercial use of the service. It included online help and contact e-mails. Most

importantly, the version v.2 provided an automatic connection to the service once the user logged onto the PDA. This reduced the need for double logging. The analysis infrastructure was expanded to include a comprehensive support for analysis of the service

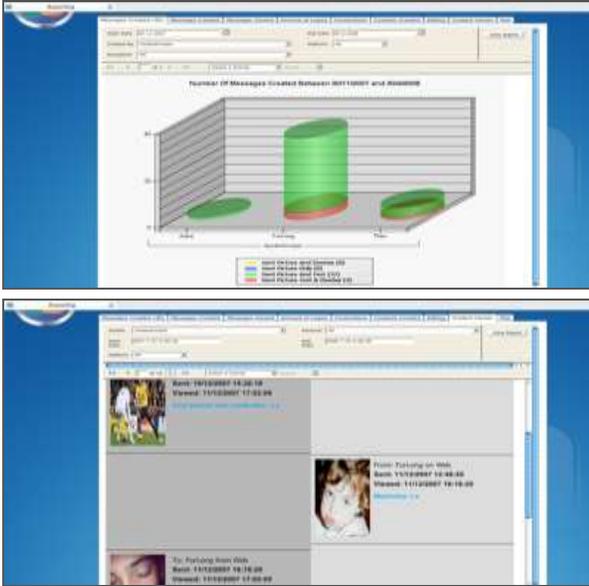


Figure 4: Automatic logging and reporting of weConnect activities across users (top), including details of shared content through personal channels between two individuals (bottom).

logs, with pre-defined reports for easy monitoring of the usage (see Figure 4).

At that point we also made a conscious decision not to make design changes in response to two suggestions:

Notifications. Our intention is to explore the nature of the ‘always on’ live channel and observe the reaction of the users and the impact that such a design decision has on adoption.

Differentiation. We opted for the use of images, text and overlay since these content types are readily available and would not require significant departure from the current practices. weConnect can support editing and streaming of video and audio content but we decided for a more conservative feature choice, assuming that the familiarity and reduced technical complexity would create lower barrier for adoption.

4.2 Deployment and Observations—Stage 2

Recruitment of the study participants was the most essential aspect of this stage of the LLECOS study. These users were to assume a dual role: as subjects of the study and as ‘seeds’ for spreading the service throughout the community. We aimed at a diverse sample of participants along several dimensions: age, gender, profession, belonging to a social network, and communication habits.

The objective was to recruit couples, smaller groups of friends and colleagues, and one larger group of individuals who belong to a community and have an established social network. We opted for strong ties between the couples, friends, colleagues, and members of the community. We were interested in people aged between 16 and 40, anticipating that they are more familiar with new applications such as mobile phones and PDAs with camera.

That age group is known to make use of technology for various reasons, personal, functional, emotional, and practical [22]. Particularly intricate was a selection of the community based on assessment of ties between community members and characteristics of their personal networks within the community. We were looking for communities with active members who see each other face-to-face on a regular basis. This would provide an opportunity to observe interplay between on-line and off-line communication, and rich shared experiences.

4.2.1 Participants

Throughout the project we used 33 participants in different phases. Among them, 23 males and 10 females shared their feedback with the researchers. The average age of participants was 24. Most (24) were still studying, mainly at the university of Leuven or Hasselt, while nine participants were employed in different companies. Seventeen participants worked, studied or lived in the province of Limburg, near the city of Hasselt. Others (12) worked, studied or lived in the province of Brabant (Flemish part), near the city of Leuven. Some (4) were domiciled in the province of Antwerp but were studying and living in dorms in Limburg during the week. This had immediate implications for the logistics around the study implementation, in particular, the face-to-face meetings and interviews, and the potential use of weConnect application.

Table 3. Couples, friends and colleagues participating in the study

Name	Sex	Age	Profession	Relationship	
Lien	F	21	Student	Couple - not officially* living together	
Kris	M	34	Employee		
Sarah	F	41	Employee	Couple – two children	
Frans	M	37	Employee		
Filip	M	22	Student	Couple - not living together	Friends
Florence	F	21	Student		
Julie	F	20	Student	Couple - not living together	
Joost	M	21	Student		
An	F	32	Employee	Colleagues - Friends	
Pauline	F	37	Employee		
Nathalie	F	31	Employee		

*By ‘officially not living together’ we refer to couples that spent most of the time together, during the week and weekends, but resided at different addresses.

Couples, Friends, and Colleagues. We recruited five social groups based on their relationships (Table 3). All participating groups comprised subscribers of the i-City Living Lab. That was the only common background they shared. They never met members of other groups and during the study they were interviewed only within their group’s context. Some of these participants live and work in the province of Limburg, others in the province of Brabant (the Flemish part of Belgium).

Community. We opted for the student organization Filii Lamberti, related to the faculty of informatics, mathematics and natural

science, University of Hasselt, and recruited 14 members to participate in the study. Filii Lamberti has about one hundred members. All the recruited members live in dorms during the week and with their parents during weekends, except Wouter, an employee who lives together with his fiancée. Six members who were involved in our study were in a romantic relationship at the time of the research.

The organization does not have an explicit code of conduct but some unwritten rules are followed such as keeping the community room clean. The community room is open to all the members but primarily occupied by *presidium members*, the core group that is responsible for different aspects of the organizations. Six study participants were members of the presidium. They frequented the community room before and after the lessons and during lunchtime.

4.2.2 *Introductory Interviews*

During the study we conducted three in-depth interviews with each participant in total. This first set of interviews was video recorded. The objective was to receive more detailed information about the participants, introduce them to the weConnect application, and observe their first reaction to the prototype. Interviews with the individuals, couples, and friends were held between November 6 and November 19, 2007. The interviews with the community members took place on December 18 and December 28, 2007..

In order to make them engaging and informative we applied two projective techniques. The first technique used a concept map, helpful for aggregating shared understanding among the participants about a common concept [8]. The second projective technique involved word associations with four communication tools: landline, cell phone, text message and e-mail. The participants could add other communication tools that they use on a regular basis. During this first meetings, the participants were shown a demonstration of the software and given a list of instructions how to download the software to their mobile devices and the desktop.

4.2.2.1 *First Impressions*

The introductory interviews provided good insights into the users' perception of the prototype prior to having a chance to try it for personal use. The application was introduced as a broadcast medium, with creative and personal input from the users. However, the participants perceived it as a *personal communication tool* that could be used in a private context. The concept of a channel for broadcasting multi-layered content did not resonate with them since the implementation resembled other mobile communication technology such as MMS. They anticipated that weConnect would be taken up mostly by female teenagers. They themselves did not feel a need to add it to their current choice of communication technologies.

Some participants perceived the one-to-one aspect of weConnect as a positive element while others saw it as restrictive. While weConnect enables special connection between two individuals, some users anticipated a need to share the same mix with others at the same time. This was pointed out several times by community members who liked sharing things that bond them, like parties:

'It could be more community based. That you could create one folder with all the pictures you've taken at a party last night. The

people, who joined your contact list, could view the pictures you've uploaded.' (Karl, male, 23)

Context. We discussed a hypothetical scenario of an 'on the spot action': being at an event, experiencing and wanting to share a moment, creating a mix, and pushing it through the channel. The participants did not expect that to be put into practice, not with the complexity of the current application design. They expected weConnect to be used when people have time, mostly over weekends, during leisure time, or situations when there is nothing important or interesting to do (e.g., waiting for a train).

The internet connection was another factor expected to influence the use rate. Internet, fixed or mobile, is needed before they can create a mix or tune into a channel.

'You'll have to search for a reliable wireless internet connection. The amount of such connections is sometimes too limited.' (Florence, female, 21)

Motivations. The participants expected that the potential recipients of weConnect content would be among their personal network, i.e., friends, family, and partner. Some expected to use it for sharing contextual information, i.e., about the situations they experience, while continue to use other technologies for practical information. Furthermore, they expected to send wishes and greetings that they normally send via text message, post, or e-cards.

'I would use the application on birthdays, Christmas, New year. Or if I've taken a very good and funny picture' (Florence, female, 21)

Others expected to share pleasant experiences with those who are not around at the time (i.e., virtual co-presence). Party images, pictures of the children to the husband who is away, etc., are examples of these. The participants did raise the issue of the risk of missing a mix due to lack of notification and pointed out that this will prevent usage for time critical media exchanges.

4.2.3 *Log Analysis and Second Interviews*

Analysis of logs during November and December showed very little user activity. We revisited our introduction routine and decided to attempt a more hands-on and structured training during the introduction to the technology. Thus we scheduled another face-to-face meeting with the participants for an interview, on December 19 and 20, i.e., within the five weeks of the initial introduction of the service. From the user feedback we identified critical issues: (1) too few wireless access points to the Internet, (2) problems downloading the desktop player, in some instances due to the high security settings on the PC, (3) complex UI on the mobile and desktop, (4) no status indicators when sending and receiving the content, and (5) most students used Firefox while weConnect was implemented for Internet Explorer only.

The problem of the desktop viewer was particularly acute due to the fact that the client application used the latest .NET framework which has not been pre-installed on the users' computers. Thus, the users had to take an extra initiative, find on-line the right version of the .NET framework and install before they could use the desktop client.

4.2.4 *Service Modifications – weConnect V.3*

In response to the findings, we released version V.3 of the software that included the link for downloading the supporting software (.NET framework), the progress bar to inform the users

about the status of the activities they are performing, and introduced the notification when a mix was sent. In addition to the hands-on introduction of features, we also provided online manual both in Dutch and English.

4.2.5 Research Questions

We realized that the adoption of the software is heavily undermined by the combination of technical and usability issues. This usability was not limited to the applications alone, as we perceived it from the start, but to the usability of the service as a whole, including adequate support for application download and installations.

We were at the second decision point on whether and how to proceed with the study. We needed to generate a rate of adoption and usage in order to obtain feedback and respond. We decided to focus on obtaining details of the precise context in which the application would be used and thus opted for a diary study to complement the interviews and logging. In retrospect, that decision was very beneficial to kick-start of the application use through focusing user's attention and encouraged engagement.

4.3 Diary Study—Stage 3

A repeat of the service introduction with the participants started at the end of December for couples and friends groups and on February 20, 2008 for the community participants. This was done during the second interview, focused on learning more about the users' perceptions and usage.

We provided the participants with a paper and pencil diary in an A5 booklet format. This diary design was event based, asking the participants to note important events related to the weConnect use, i.e., the 'triggered events' [3]. Each diary contained 28 event pages. Using a combination of closed and open answers we tried to limit the effort of filling out the diary.

The diary study is a method amenable to mobile HCI research but carries the risk of errors due to users' retrospections and possible attempts to recapture the events they missed to record. In our case, we can counter out this inaccuracy by cross referencing user's notes with the data from the log files. With the diary, we also included a brief manual of the weConnect application, to give participants an opportunity to look things back in case they had forgotten some details. Furthermore, we supplied a stamped envelope that the participant could use to send the diaries back to the researchers. By the end of the diary study we received 14 out of 25 diaries.

4.3.1 Context and Content

From the diaries, it was apparent that weConnect is seen as a personal tool, used in private setting such as one's living room or bedroom. Most participants did not have a company when they were using the application, except those few who used it in a public space (e.g., community room or at work). weConnect was primarily used in the afternoon or in the evening. The diary showed users intentions to reciprocate and the logs analysis confirmed that most of the users successfully created media mixes in that vein. However, reciprocation was not the primary driver for the weConnect media sharing.

Participants created varied types of content, similar to the content identified in the short-term study [20]. Predictably, they used weConnect around Christmas time for greetings. This is significant for the fact that media mixes were sent not only to the

participants of the study but others who were not engaging in the project.

We did not see the signs of significant 'spreading' of the applications. Besides the flurry of Christmas greetings, the only instance in which a participant invited an 'external' person to join the study is by Julie: *"I invited my sister. She uses it because it's fun and can tease me and Joost."* (Julie, female, 21). Others noted that there already exist sufficient media channels to exchange information with friends and family members; thus there is no urge to try something new.

4.3.2 Software Implications – weConnect V.4

In the attempt to remedy the issue of unreliable wireless infrastructure, the i-City Lab provided users with GPRS cards with unlimited usage. However, that attempt was not effective since the users could not use both voice and GPRS for weConnect on the same SIM card – they had to switch the SIM cards whenever they wanted to use weConnect.

We realized that mobile connectivity was an insurmountable issue and thus decided to refocus investigation of weConnect concepts through desktop sharing instead. Have we gained enough momentum and common knowledge in the community to increase the usage of weConnect? What barriers remain after we remove the mobile infrastructure issues?

To this effect we introduced two new features: (1) sending media mixes via e-mail and (2) using the Internet browser as the client for viewing the content, thus eliminating the need for downloading the weConnect proprietary client. The recipients of an e-mail with imbedded weConnect mix would be automatically assigned a 'studio' space with all the channels that were created for them by other individuals. Thus, individuals did not need to register in order to view mixes. Furthermore, they could unlock the channels from the studio and place it on the desktop. They could view any number of channels at one time.

4.4 E-mail Integration—Stage 4

4.4.1 Final Interviews

The e-mail service was rather transparent and most participants knew immediately how to use it. The studio, with its ability to drag different channels onto the desktop, gave the participants the feeling that they can connect to different persons at once. Most participants tuned in occasionally to the different channels. Many pointed a need for notification of content arrival. The lack of notification obliged them to tune into the application even when they have not received a new mix. This asynchronous aspect was an important cause of low activity. Many sent mixes were shared face-to-face, i.e., the people viewed the content when they encountered the sender: *'There was a good chance that we saw each other face-to-face before we looked at the new mix'* (Kris, male, 34).

The participants made suggestions to expand the application with personal overlays, adding voice messages, and integrating with existing communication channels (e.g., Windows Live Messenger). Many intended to share media amongst people outside the study. However, it turned out that some e-mail accounts had high security levels. Thus, recipients received only a part of the mix or the mix would disappear into the spam folder. Participants who experienced these problems stopped using the service.

Community Observations. We held separate interviews with smaller subgroups within the community group. They were selected on the basis of the friendship ties between members and

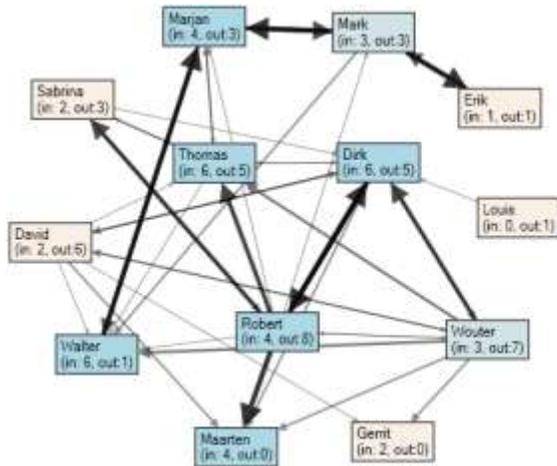


Figure 5. Social network of the Filiti Lamberti social group indicating number of mixes exchanging among themselves.

the number of messages they have sent to each other. The strength of the friendship tie was measured through the online questionnaire at the beginning of the study ('who do you like most within the community?') and their input during interaction with other members. Each smaller group included at least one person who engages in an active way and closely related individuals were affected by the high activity rate (Figure 5). At the same time, the application does not strengthen the weaker ties. Community members who are not so popular and attempted to create a channel with more prominent individuals were not reciprocated. The communication between two such members stayed restricted to face-to-face contact.

Finally, the effect of the community as a source of knowledge and support has begun to form. For non-technical individuals the application seemed too complicated. They depended on the technical knowledge of the surrounding network. *'It was really frustrating because it couldn't sort it out. Anne explained it to me again. They sent me different mixes and I never received them. Very frustrating'* (Pauline, female, 37).

4.5 Summary

Reflecting on the research questions and hypothesis in Section 4, the study has shown that:

- We connect was used as a tool for establishing virtual co-presence. The mixes that were sent during the living lab research were heavily embedded with personal and contextual information.
- The hypothesis of different perception across social groups was not confirmed. The participants had a uniformed view: they perceived weConnect and an individual communication tool that does not added value compared to other applications. They asked for expansion to the community channels, and did not want to be connected continuously; thus requested notifications of received content.
- The characteristics of participants' relationships did affect the content and the purpose of the mixes. Particularly

interesting were observations of community members that exchanged mixes ranging from personal content to community events that were of broader interests.

- weConnect does not seem to further the group dynamics within the larger community group: it seems to strengthen the strong ties but does not improve the weak ties.

Despite technical, infrastructure, and design issues, the adaptive approach that we applied provided a dual benefit. First, we collected the usage data and arrived at better understanding of design issue. During that processed, we gained insights into the deployment and adoption issues that are essential should weConnect be productized and deployed for wide user consumption.

5. DISCUSSION

The LLECOS study shows that setting up a longitudinal in-situ study of a mobile application in a social context may not be a simple extension of a standard field study. We single out several important differences:

- (1) The heightened degree of interaction between the prototype and the extended infrastructure that supports the study.
- (2) The influence of the social aspects on the natural and unprompted spread of the application. This includes the expectations of the prototype to add value, replace, or fit alongside the established practices with products already available in the market place.
- (3) The lack of mechanisms for sustaining users' attention to the prototype service, as normally achieved through marketing campaigns and incentives associated with product and beta releases.
- (4) Uncertainty and unpredictability of the exploratory work over a prolonged exposure to a complex environment. Global planning is impractical and that shapes the management of the study and the decisions for interventions, e.g., through new research methods or deployments of new prototype versions.

The study illustrates the required level of technical maturity and organizational readiness that need to be fulfilled before a prototype can be successfully deployed in a natural Living Lab setting. In our case, the technical readiness applied beyond the boundaries of the Living Labs infrastructure. The i-City environment is equipped with infrastructure for deploying mobile applications but it does not extend to the personal desktop environments that was part of the weConnect service. For example, the need for .Net framework to run the weConnect desktop viewer was the issue of general market readiness to absorb a new application in the early stages of the .Net platform.

It is safest to introduce a prototype gradually, allowing for assessment of requirements and the adjustment of the study management. The technical team needs to reach a required level of agility to react to the user feedback on short notice and communicate the action plans and results back to the study participants. This may range from infrastructure issues, to the technology enhancements, and new research methods and procedures.

From the prototype design point of view this means a high level of plasticity that allows for transformation of the prototype into a

form that allows for the next level of investigations. In the case of weConnect that first meant morphing of the original weConnect applications with the PDA platforms of the i-City Living Lab and then expansion with the e-mail integration and studio feature. Both were in response to the infrastructure conditions and the research objectives to investigate the basic concept of a live always-on channel for personal use within social context. Thus, in our case the plasticity preserved the essential parameters but in other contexts it may lead to a complete transformation to a new product, as often happens with start-ups that are responsive to the market demands.

The study also shows that the longitudinal qualitative research is shaped by strong interaction between the user sampling, data collection and analysis, and evolving discovery process. For example, the initial analysis of the i-City community guided purposeful sampling. The analysis of logs in the deployment phase informed the adjustment of methodologies for data collection, i.e., by complementing interviews with the diary study. Further insights and the flexibility of the platform enabled us to take a leap and open up the service outside the original weConnect framework, extending it to e-mail. This required a tight feedback loop and engagement of the technical development and design of the prototype, the infrastructure management, management of the research plan, agenda, and communication with the participants.

What would we have done differently? In retrospect, we realized that understanding the value of a new concept through longitudinal deployment comes close to the productization. Research questions and prototypes that explore new concepts need to withstand the challenges of adoption, investment and sustainability of longitudinal use. This, in turn, requires consideration of the added user value. In the case of weConnect we made the decision to restrict the service to easily accessible content in order to facilitate the adoption. However, the lack of the perceived novelty that could have been brought through streaming of personal videos and audio mixes, has affected the perception relative to the existing applications. Thus, making the trade-off between the prototype design and general market readiness requires careful considerations.

Besides reshaping the prototype itself, we could consider modification of the process and put further emphasis on

- Expanding the technical requirement tests for participants, including the home environment and desktop readiness.
- Tighter integration with the user environment and practices, e.g., by deploying the prototype on personal devices rather than PDAs.
- Evolving the user sample more readily, to avoid the 'tiredness' and give expanded applications a fresh start.

However, the fundamental question remains: Can we formulate an investigative research agenda when the service adoption is an essential pre-requisite and need to be achieved during the course of the longitudinal study? Research requires the community adoption and the adoption of the prototype determines the community; thus, the social experiment and the community become equivalent and inseparable.

We observe that successful online community services lean towards the open platform, enabling ingest of new applications that bring novelty and freshness to the evolving community

(mySpace, Facebook). The adaptive research approach and the plasticity requirement on the research prototype resemble this process. The essential difference is in the level of productization driven by the market awareness and competitive positioning, the promotional effort, and the commitment to sustainability that drives the emphasis on the customer value. In all other senses the experimental setting for longitudinal field work resemble the naissance of a product.

6. CONCLUSIONS

The study illustrates the approach to the longitudinal in-situ observations of new concepts within the social and mobile context. Faced with the lack of main-stream infrastructure the concept investigation was situated within a Living Lab environment. The experience shows that the interconnection of the controlled environment and the broader computing infrastructure may pose challenges for study deployment. This is particularly delicate in the case of mobile applications that require community adoption. When prototype adoption is the essential prerequisite for the study, one has to make choices and trade-offs between the novelty and technical complexity on one side and the perceived added value that drives the adoption. In our case, constraining the functionality to the familiar media deterred from the desirability and possible long term adoption.

During the study, the effort for driving the adoption and investigation of the user behavior evolved in parallel. That was achieved through iterative technology refinement and adaptation of data collection techniques. While the case study remains within the technology adoption stage, the process is extendible to the observations of established user practices. The emphasis on the adaptive research approach and plasticity of the service design and implementation are likely to provide adequate response to the evolving user community and application and infrastructure requirements.

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