Designing for the Mobile Device:

Experiences, Challenges, and Methods

New computing and communication platforms create the possibility for new business models and new applications to support and enhance our lives. But new platforms also challenge us to reinvent design methods and principles. As new technology becomes mainstream, designs and business models that work for the target user population and business are a critical success factor. Mobile devices are opening up new business opportunities, new conveniences for users, and new design challenges.

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Illustration by Lisa Haney

Designing for limited mobile platforms such as cell phones presents unique demands over designing for larger devices. Sophisticated applications on such devices are quite new; users do not have a history of experience with similar applications to draw on in learning a new one. These applications are often downloaded over the air: no manual, no "getting started" card, not even much room for help functions. The physical capabilities of the different devices are varied: screens of different sizes and aspect ratios; one, two, or three soft buttons; four-way directional buttons, or two-way, or none; a menu button or none; several font sizes or one; and so on. But the greatest challenge is the absolute lack of screen space—whatever is displayed had better matter to the user.

Designing for the mobile platform is not just a challenge of application design. Mobile applications come along with a complicated business model still being worked out in the marketplace. The carrier owns the connection and relationship to the customer, thereby providing access to a potentially effective distribution model. The carriers provide a one-stop billing model for downloaded applications and subscription services. Content applications must consider the design of the application itself, the source of the desired content, the cost of the content, and branding partners that serve to drive customers to the application. All the players in the market put constraints on what can be built and designed. And the revenue model—still being explored—is challenged to produce business success for all the various players.

Several years ago, my group at InContext Enterprises identified the mobile platform as the most likely area to inspire innovative design and influence business growth. This emerging business—and significant revenue potential—represents tremendous opportunity for application and device developers. Beyond obsessively checking email and answering the phone, we are seeing consumers and enterprise users taking advantage of devices and applications that provide desired information, services, and communication function wherever they are. Delivering quality, usability, and business viability are essential hallmarks of success in the current connectivity landscape.

Many questions arose during our design efforts for mSports[1] applications: What methods will work to collect data from fans at home and moving around? How can we prototype something that is very small? What interaction design will work and easily transfer from one phone to the other? How close does our design have to be to the interaction paradigm of the other applications on the phone? Being a content application, delivered on a carrier, with a branding partner—what do we do about the need for multiple brands? And how do you create revenue when so many participants wanted a cut? Finally, the carriers, hardware vendors, and software platforms were not the most stable environments for development. Anyone desiring to enter this market will be faced with resolving these questions and addressing new challenges in this rapidly evolving realm.

The articles in this section present experiences with real-world aspects of mobile application design from the perspective of key participants in this growth area. The authors address essential questions and also seek to raise more questions as part of the dialogue on design for the mobile platform. This section addresses three fundamental areas anyone designing for the mobile platform must consider: method, business, and brand.

Field Data

In my experience, using field data to drive design is an essential element for success. In the first two articles, authors from Nokia and Microsoft share their experiences and lessons learned from methods of field data gathering that have proven successful and that did not work as anticipated.

[1] See www.msports.us for information about mSports Baseball delivered under the SportsIllustrated.com ScoreCast brand.

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The User Experience Group at the Nokia Research Center is tasked with looking ahead three to eight years, providing qualitative data to influence and motivate future product development. They have used many techniques in locations all over the world and in situational contexts that make data gathering challenging at best. Here, Nokia researchers Jan Blom, Jan Chipchase, and Jaakko Lehikoinen share their very practical lessons learned that designers can benefit from immediately.

Colleen Page, from Microsoft's Customer Design Center, shares the evolution of qualitative research techniques for mobile platforms from 1997 to 2003. She discusses what worked and didn't work and also describes key learnings about mobile users' lives and needs. Her article shows how qualitative data derived from from her team's exploration of different cultures and the impact of social networks yielded insights that affected product direction.

Business Reality

Before going into the business of application design it is best to develop a comprehensive understanding of what you are getting into. Authors from Sprint and Digia share their experience and the unique demands of being both the carrier and a small third-party development company.

Members of the User Experience Group from Sprint describe a day in the life of Sprint PCS Vision Multimedia Services, which was launched in August 2004, from the perspective of the design team within the carrier. The business and design constraints, use of volumes of quantitative user data and past experience to drive design decisions and accommodate all players in the business are eye-opening.

Digia, on the other hand, was a small third-party mobile application development firm before the acquisition forming SysOpen Digia. When their User Experience team decided to develop their own two applications, Genimap Navigator and ImagePlus, they were faced with resource and time constraints typical of a small company. But their user experience team still managed to infuse user data into the process. Digia's Eeva Kangas and Timo Kinnuen share the evolution of their processes and reveal the challenges of prototyping for the small form factor.

Branding

The issues involved in designing for small form-factor devices were the topic of a workshop I conducted at last year's ACM Computer-Human Interaction conference.[2] The subject of branding was raised as an issue for discussion, but the participants had few ideas regarding how to frame or address the question. David Rondeau frames the issues and widens the discussion by drawing on literature about branding and his experiences with InContext Enterprises' development of mSports. He provides a framework for considering the issues faced in designing applications for use on small mobile platforms. He also raises the issues and generates the questions that any application developer, carrier, content provider, or device developer must address.

The goal of this section is to provide samples of the reality of designing for small mobile devices. As the industry realizes the value of this platform for providing needed functions and capabilities to users we will all be pushed toward generating new business models, new methods, and new products that will enliven and enhance people's lives. C

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[2] *Designing Mobile Applications with Customer Data: Techniques that Work for Mobile Platforms.* See www.incent.com/community/design_corner/04_0526.html for notes on this workshop.

Contextual and Cultural Challenges for User Mobility Research

Considering the lessons learned while studying the worldwide variety of mobile device users and situations.

Personal, mobile synchronous and asynchronous communication has proven to be very desirable for all types of users, with estimates of more than a half-billion mobile phones sold each year [2]. Nokia Research Center's User Experience Group, working with other user practitioners in Nokia, seeks to understand why people do the things they do with their mobile communication devices and proposes solutions that best address their wants and needs. In accordance with the principles of user-centric product concept design [4], the solutions are designed to inform and inspire the product creation process within Nokia. Given that the group works three to eight years ahead of what appears on the market,

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Illustration by Lisa Haney

confidentiality concerns restrict disclosure of many of these concepts and the findings on which these concepts are based. Instead, in this article we share some of the essential lessons learned from our projects centering on the early stages of product concept development. Two areas have proved to be particularly challenging in this respect: coping with multiple contexts and multiple cultures in the study of mobility.

Mobility Across Contexts and Cultures

The purpose of discovery research is to explore, document, and understand the scope of a particular theme and to use the findings of this research to guide and support the development of new products, applications, and services in the mobile realm. A product that benefited from applying such an approach is presence-enhanced contacts, a service incorporated in a number of popular Nokia models, including the 6170 handset sold in the U.S. Our recent discovery research themes include what people carry and why, time and contact management issues, communication needs of mature users, device competence of non-literate users, device sharing, and personal identity concerns. The topics we research are often quite broad, leading to a number of challenges in the methodologies we use. Here, we highlight these issues and how we have addressed them.

Contextual approach to mobility research. Mobile phones are carried and used in a wide range of environments, including at home, at work, on the street, while driving a car or using public transportation, and in restaurants or other public settings; literally from the moment people wake up to the moment they go to sleep. Tamminen et al. [8] state that mobile urban environments differ from indoor contexts, such as offices or lecture rooms in many important ways. Internal factors, such as tasks and goals are different due to external factors such as social resources that are dynamic and unpredictable. We fully agree with the authors and believe that studying the user in an everyday, mobile environment is a challenge.

Moving between environments, especially the transition from public to private spaces and vice versa, involves significant changes in context. The mobile phone is often used during these changes in environment and this too needs to be studied. For example, a phone call can be initiated on public transportation but completed after arriving home. To understand the user's context we need to gather data wherever the users are, and adapt to their changes in context. The methods we commonly use to this end include Contextual Inquiry, shadowing (essentially following people with their permission), short photo diaries, and observations. Changes in environment present a number of practical hurdles.

At night a shadowed participant can move from a well-lit home to a dark street to a nightclub. Flash photography draws unwanted attention that affects behavior and disturbs others in proximity, which is why it is banned from our research. Fortunately, night-vision-equipped cameras largely solve this problem. In close proximity public environments, such as a subway or bus, obvious use of the recording equipment again draws attention to the participant so the researcher is required to be adept at nonchalantly recording data of the user. The equipment can facilitate this—either by being hidden, disguised, or more often—by appearing not to be in use. Recording sufficient photo and video data in very tight environments requires the attachment of a wide-angle lens and is still impractical at short notice or for short periods of time. The length of time spent in proximity of our participants makes shooting video the whole time impractical: we work to the rule of thumb that an hour of video will take at least three hours to analyze. In many discovery projects capturing high-quality stills supported by short clips of video has proved sufficient. Research covering keypress input with the mobile phone definitely requires video and our colleagues have developed a video-camera kit that can be mounted on most mobile phones and accurately records both screen and input data [6, 7]. Lastly, there is no substitute for the effectiveness of a notepad and pencil.

Being prepared. Exploratory fieldwork requires researchers to plan for a range of outcomes. Unpredictable weather can make operating equipment difficult and create discomfort for the researchers. A rained-on participant can change into fresh clothes at home but the researchers are largely limited to what they are able to carry. Some items of note in the researchers' carried "emergency kits" include: coins and notes in the local currency; energy bars and drinks; pens; power plug adapter; spare batteries (for phone, laptop, camera); extra memory cards; DV cassettes; mini-tripod; clean clothing; rainproof outer shell; credit card (accepted in that culture), pre-paid travel card(s), and a printed copy of pertinent contact information.

Length of the session. The mobile phone allows participants to make ad-hoc changes to their plans. Given this variability, we reserve at least one full day to study any given individual. During screening we aim to understand the kinds of things the participant typically does during the week, to prepare for the shadowing session. Since interesting behavior can occur during movement between environments, participants are asked in advance about their travel plans, and the research team ascertains whether it is feasible to travel with the participant.

Gathering data on participants' communication

activities during the shadowing session is challenging. The participant often receives phone calls or is intensively involved in text messaging dialogue. Such situations enable observation of the behavior at the one end of the conversation only. In order to get more fully into the communication activity, the researcher needs information regarding the context of the party not present in the situation: where is this person located and in what type of a situation? How are the two persons linked to each other? What motivates the communication?

The least intrusive way to elaborate on the communication activity is to retrospectively ask the participants to describe it in their own words. They do not necessarily have information about the context of the other party, but will be able to expand on the content and intertextuality of the communication incident. In the case of text-based communication, such as text messaging or mobile instant messaging, participants may be willing to show the dialogue to the researchers in addition to verbal description. Recording and logging communication activities during the shadowing would of course provide an effective means to shed light on what can normally only be observed. In addition to being associated with privacy implications, legal and ethical considerations make this data collection method a less viable choice.

Long durations of time spent in close proximity to the participant can create tensions related to privacy and personal space that are less apparent during shorter sessions. Although never completely removed, these tensions have been alleviated by recruiting through our personal network of contacts; arranging informal meetings prior to the data collection time; advocating a proactive privacy policy and updating this policy in the field to cover additional parameters as circumstances allow; data consent forms signed after the participants have reviewed data about themselves; and shadowing time-outs. Over the course of the day all participants need space for personal affairs and at such points participants may want to be as far away from researchers and their recording equipment as possible. Although these sensitive moments never constitute the focus of our research, they may overlap with issues that are relevant to us. For example, some people send text messages, talk, or read while using the bathroom. The solution in this example is to provide participants with tools for self-documentation where they can decide what level of intimacy is revealed. Choosing self-documentation over direct observation has been successfully used, for example, in research concerning text messaging behavior of teenagers [3].

Shadowing in moving vehicles. Where participants go we go, so understanding how they plan to travel is of importance. All modes of transportation present problems, although travel on foot is normally the easiest to deal with. In Tokyo during rush hour, for example, we managed to lose a subway-bound male participant during shadowing [1], because we were unable to follow him through a ticket barrier reserved for a particular combination of tickets. Longer train journeys require the researchers to stay awake in spite of the motion and warmth of the train, sleeping fellow passengers, and other factors. During another study of commuter use of WLAN services on trains in Japan, participants and researchers reported being affected by motion sickness.

When studying participants using bicycles, a researcher is required to have at least the same level of fitness as the participant, must be confident cycling around a (foreign) city, and must acknowledge the fact that capturing accurate data will be difficult. Cyclists are treated differently in different cultures and the research team has had to cope with cycling on pavements in Japan, loose interpretation of road rules by car drivers in Shanghai, and the relative serenity of dedicated cycle lanes in Berlin [1].

In a car, will there be enough room, and if so where will the researcher sit? In a taxi, the participant may have to pay extra for an additional passenger, so it is important to let them know in advance that additional costs incurred due to your presence will be settled at the end of the study. The safety of our participants and research team is paramount but each environment comes with its own set of risks. Before the study we clearly state the parameters of our research, and that our insurance does not cover the participant. The safety of the team is of particular concern during car travel—for example, if a participant decides to send a text message while driving.

Security. In response to commercial espionage, security and privacy concerns shops have their own set of strict rules about recording data and have sales staff and security guards to enforce these rules [1]. During a comparison of train station infrastructure in Mumbai, Hangzhou, Milan, and New York City, our researchers were challenged and asked to stop recording data both in Milan and New York City. Currently, the incidental video recording inside public buildings in the U.S. can be interpreted as possible terrorist-related surveillance activity: during a recent study in New York City a researcher was questioned by authorities and the photos were deleted.

Exploratory user research in the mobile realm presents many challenges including: the need to carry equipment that is suitable to collect quality data across multiple contexts; the ad-hoc nature of this kind of study; the long duration spent in the participant's proximity; and participant and research team security. The

rewards for achieving the correct balance of these issues include rich insights into understanding user motivations and suitable material to inspire the concept design process.

Cross-cultural approach to mobility research. The half-billion phones sold in 2004 were purchased by consumers representing almost every country in the world. Our research covers a wide range of regions, from relatively mature mobile phone markets such as Sweden and the U.K., to emerging markets such as China, India, and Brazil (see Figure 1). The desire to localize products to these markets, the global nature of communication and vast cultural differences are acknowledged. However, there is also the need to adopt a design perspective that effectively balances the differences and similarities. The focus of our cross-cultural research is often in understanding the intersection of culture and technology adoption. We recently completed a large comparison study on mobile media use among European and Far East users [9]. Mobile phone use among non-literate users illustrates research into cultures situated at an earlier stage in the technological evolution.

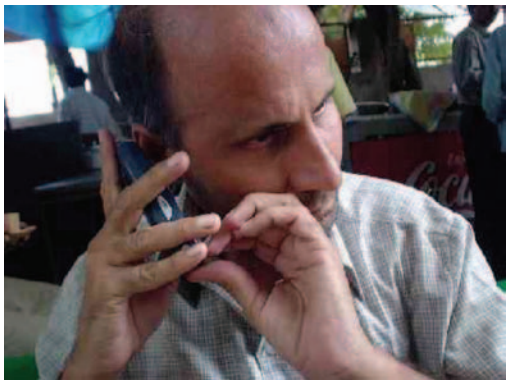

Figure 1. Exploratory research with blind participants in India.

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Technological climate. One fundamental problem is in anticipating the technological climate in the regions of the forthcoming research. This becomes an issue with cross-cultural studies comparing use of particular applications and devices. Popular media tends to report on how state-of-the-art technologies enter the market. Sales figures on well-established technologies are more difficult to obtain, however, to some extent because large corporations often regard this kind of information as commercially sensitive. Consequently, making informed decisions about which countries to study is not a straightforward matter, even working with the resources of a global organization. The risk here is that insufficient market insight can lead to the adoption of inappropriate methodological tools, which, in turn, may decrease the sensitivity of the research.

Social acceptance. Being an obvious outsider can be a hindrance or a benefit to the data being collected depending on the context. Blending in is easier when a researcher is considered a "local," but outsiders tend to have more leeway in what is socially acceptable. Approaching people on the street to conduct an interview is easier when the person approaching appears not to be a local: it is an established norm for strangers to be asking directions from locals. We often emphasize the international nature of the research, so for example street interviews might start with "Hi, I'm running an international study in country x and y to study…".

Indirect research. Issues such as arriving at the participant's home on time, interacting with participants, or operating and understanding the device or user interface being studied can be difficult enough in one's own culture let alone in a different language and using novel devices. It is of course tempting to expand the network of researchers to outsource this kind of work to subcontractors. The crux of the problem is how to maximize the validity and reliability of the research when a local researcher is hired to moderate the interviews and sometimes even to analyze the data and generate reports. The ability to be in direct control of the data collection and analysis is important. If parts of this process are outsourced, the quality of the findings is at stake. This issue is prominent in the case of cross-cultural research, which requires high levels of investment.

In the mobile media study, we used focus groups as one of our data collection methods to understand how mobile media was used in various countries. Members from our own team were present in all of the sessions, but we hired local practitioners in each country to moderate the sessions and to produce a report on their respective regions. This process led to a number of insights:

- Cross-cultural research generates vast quantities of data. The importance of certain elements in the data may only be known months or years after collection. Should a need to do further analysis on the data arise at some later point, specifying the format(s), directory structure and file naming conventions for all raw data helps subsequent retrieval processes.
- Validity of cross-cultural research can be improved by being explicit and clear about the aims of the project and by making sure the questions asked are comparable across cultures. For instance, clearly formulated research questions will be of formative help to the data analysis process.
- Studying different cultures can lead to the identification of universal behavioral patterns. Researchers should also allow for country-specific methods and findings. Each culture will have its nuances and peculiarities when it comes to mobile device use, leading to windows of opportunity for design (see Figure 2).

a

b

c

PHOTOS COURTESY OF NOKIA

Figure 2. Photos captured while studying mobile media use in South Korea (a), Japan (b), and the U.K. (c).

The examples listed here show that all parts of a cross-cultural research project are associated with challenges. During the planning stage, making informed decisions about the target cultures is not always possible. Consequently, being able to select the appropriate set of data collection methods becomes difficult. When performing the actual studies, the use of local experts is often needed, potentially leading to validity and reliability problems. Conducting cross-cultural research is an expensive endeavor, raising the importance of fine-tuning the approaches used in accord with the lessons learned from the latest projects. Thus, methodological considerations and activities ought to take place after and between projects, as well. For instance, we actively develop, maintain, and integrate our network of local experts attuned to our research needs with each completed project.

Conclusion

To conduct corporate mobile phone user research means understanding our customer's context, which requires conducting cross-cultural studies in unique and challenging locations. The flip side to this is that the pace is fast, design solutions need to be proposed swiftly, and it is often difficult to adopt the kind of academic rigor these investigations might deserve. The challenge areas discussed in this article are not an exhaustive list and are not fully representative of the kinds of data collection methods we use. Overall, the issues probably raise more questions than they provide answers. What can be reliably concluded, however, is that rich contextual user research provides a meaningful framework on which to build the concepts for future applications. C

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Mobile Research Strategies for a Global Market

Tracing the evolution of field methods during the proliferation of wireless device usage.

The user-centered design focus at Microsoft has evolved in parallel with emerging mobile technologies. We started with a Contextual Inquiry (CI) initiative in 1997 to gather mobile communication and information requirements in the Northwest U.S. Later, as users adopted wireless data services—Short Message Service (SMS), Wireless Application Protocol (WAP), mobile instant messenger, and email clients—the focus turned to more specific usage issues in key international markets. This article presents an overview of the evolution of

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Illustration by Lisa Haney

the qualitative field research methods that have been used to respond to increasingly global research requirements.[1]

In 1997, in my role as a Microsoft usability engineer, I conducted a field study to gather user requirements for Windows Mobile-based devices. This exploratory study was conducted at a time when mobile phones were used by U.S. residents primarily for voice communication. The participants were busy mobile professionals, commuters, and parents. I applied CI observation and data modeling techniques including flow models, sequence models, and affinity diagrams. Beyer and Holtzblatt [1] describe the CI observation method as an apprenticeship model in which the researcher assumes the role of an apprentice, learning how activities are performed from an expert. The observer enters the context in which work or activities take place to gather definitive data representing ongoing experience.

I trained a multidisciplinary site visit team including people from design, program management, and marketing. We observed each participant for two to four hours. In addition, we contracted with an ethnographer to conduct longer observations of six to eight hours. We instructed the participants to handle phone calls and messages just as they would if we were not present and to show us what they take with them and how they get organized before they leave their home or office.

Each site visit was unique. I traveled with regional sales people, rode home from work with commuters, and traveled with busy parents as they shuttled children and ran errands. The ethnographer traveled with sales representatives, a county building inspector, a large animal veterinarian, and a wildlife biologist. In one case, a sales representative described how he conducted business calls anywhere, even on the golf course. In order to gather data, our designer and ethnographer played 18 holes of golf while observing the sales representative's mobile communications activity (the ethnographer won the game).

The site visit team analyzed data using site summaries, flow models, and sequence models. We also created two affinity diagrams: one representing mobile professionals and one representing mobile "personals." An affinity diagram is developed by sorting individual data points into meaningful clusters. A hierarchy emerges inductively from the bottom up, from specific data points to high-level meaning [1]. We developed an internal Web site to share key findings, site summaries, and affinity diagrams with product teams, designers, and management. We stored the data points and headings of each affinity dia-

[1]Microsoft develops software and services for mobile devices, including Windows Mobile software and applications for Windows Mobile-based Pocket PCs and Smartphones, plus MSN® Mobile services that connect customers with MSN Messenger®, MSN Hotmail®, and the MSN Mobile portal.

gram in a database and developed an Active Server Page to render the affinity hierarchy, as shown in Figure 1.

The participants' transition into mobile space emerged as a critical focus in the study. We observed strategies for planning schedules and routes. We noted the artifacts that people carried and how they used tools in mobile environments. We found that all of the participants carried paper schedules or to-do lists, maps, and directions in their vehicles, and they prepared these items for easy access. We also discovered that each person had a staging area—a location or container in the home or office—where they would place items to take along when they went out.

Most of the participants received voice mail in two or more inboxes for home, work, and mobile phones. All of these people considered it important to control who they talked to, while being available to a select group of people. They had developed an asynchronous voice communication practice in which they exchanged voice messages with certain people rather than engaging in direct conversation. We found that people preferred asynchronous messaging for several reasons, especially when they were mobile. People would exchange a series of questions and answers via voice mail to avoid being waylaid by a real-time conversation, and to avoid being caught off-guard by questions. Due to this call-screening practice, these busy people spent considerable time checking multiple voice-mail inboxes.

Figure 1. Online mobile professionals affinity diagram.

When they did engage in synchronous conversations, some of the participants appeared to forget where they were while attending to complex problems over the phone. People were distracted from physical tasks such as driving or playing golf. We observed the social juxtaposition between mobile phone conversations and public spaces, as described by Ling [8]. When engaged in a conversation, people created boundaries between themselves and others who were present. The mobile professionals in our study displayed body language that signaled the priority of their business conversations.

At the time of this field study, voice conversations and voice mail were the primary uses of mobile phones in the U.S. Contextual observations enabled us to gain insight into people's strategies for managing data, coordinating with others, and controlling their availability while mobile. By observing the use of paper artifacts in relation to mobile phone calls and information requirements we developed a model of requirements for Windows Mobile-based products. Years later, many of the core user requirements gathered in this study are still relevant.

As we began to understand the challenges of design for mobility it became evident that we would need to conduct ongoing field studies to keep up with the rapidly changing technical developments. Management supported the hiring of an anthropologist to lead this effort. This was a breakthrough that created a new job category at Microsoft and opened the door for anthropologists to be hired in several other divisions.

International Research

While U.S.-based users talked on their cellular phones and exchanged asynchronous voice mail, Europeans and Asians were developing a quieter, less obtrusive approach to mobile communication. Most U.S. residents had not heard of SMS or GSM (Global System for Mobile communications) in 1999. Meanwhile, Europeans were rapidly adopting this communication technology, which was less expensive for them to use than voice calls. Prepaid cards made SMS accessible to teens and shielded their parents from responsibility for high phone bills [3, 6].

Field Research in Europe. It was evident we needed to broaden our scope and gain more understanding of global customers in the context of their cultures [12]. Our marketing team developed a global market research plan to collect data on mobile phone use by mobile professionals. I seized the opportunity and planned field research to follow up with a subset of the market research participants. These contextual observations would enable us to understand the actual mobile work practice underlying the data collected in market research interviews. I contracted with research vendors in the U.K., Finland, and Sweden to conduct site visits in 1999 and 2000.

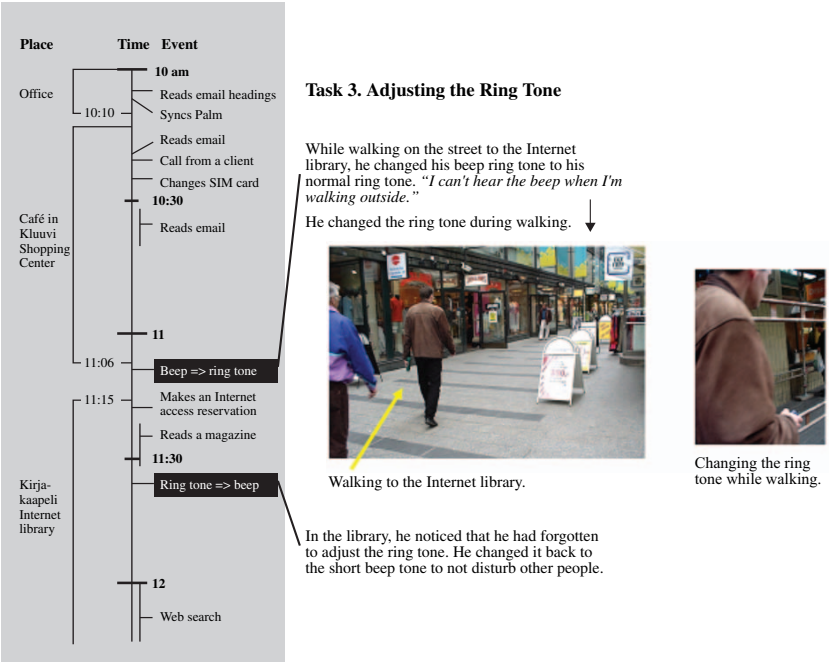

Figure 2. Activity sequences in relation to timeline.

This collaboration between market research and qualitative field research was an optimal alliance. The field researchers observed market research interviews and selected participants for follow-up site visits. We understood the context of each participant's mobile work practice prior to the site visits, which enabled us to target the field observations to the most relevant situations. In addition to the mobile professionals in the market research study, we recruited some teens and young adults for the field study, to see how people were using SMS for both business and personal communication.

I developed a research design and provided a checklist of research issues, but allowed each of the research vendors to employ their own observation and data analysis methods. I asked for site summaries, activity sequences, and digital photos showing the context of mobile situations. The vendors delivered a rich set of data in formats that enabled me to conduct further analysis and to develop reports and presentations. The combination of summaries, sequences, and pictures brought the story of each person to life for the product teams.

A new method, Discount User Observations (DUO) emerged in my collaboration with Karri Laakso and Sari Laakso in Finland. The CI sequence model evolved into a timeline associated with data points, location and social context, and photos [12]. This layout, shown in Figure 2, proved to be an efficient tool for the field research team to deliver contextual observation data to a remote research associate and product team.

The observations and pictures of mobile phone use in the contexts of social interactions and workgroup collaboration brought the differences of European mobile phone use to life for the product teams back in the U.S. As the researchers delivered site summaries, communication sequences, and pictures, the teams and managers realized the value of international field research. Beyond market research, we learned what really motivated these people.

We discovered that unlike most U.S. residents at the time, these Europeans used their mobile phones as their primary point of contact. In offices we saw mobile phones used more often than the land-line phones. The implication was that people were free to move about, and they were not wasting time checking multiple voice-mail inboxes.

We learned that the acronym SMS was used as a verb, spanning multiple languages. We observed people who kept in touch with friends, loved ones, and colleagues with SMS, even while sitting at a PC. In London, we followed an IT professional who pro-

vided network support for client companies. We observed collaborative work supported by SMS as he and his coworkers used it to ask quick questions. To initiate more complex conversations SMS was frequently used to ask, "Where are you? Can you talk?"

For personal contacts, SMS afforded private contact in almost any situation. The mobile phone was treated as a private, personal device unless the display was deliberately shared with others. Our researchers followed a group of teenage girls shopping in Helsinki, and a group of young adults out for an evening in London. In both cases SMS was used extensively to coordinate meeting places and to maintain friendships.

This contextual research in Europe provided us with a snapshot of early adopters of a new technology. After observing the relative ease and input speed employed by European teens and young professionals, it was difficult to predict the likelihood of U.S.-based users typing messages on mobile phones. It did not seem likely that middle-aged U.S. residents would start entering text messages; however, teens and young adults were becoming intrigued.

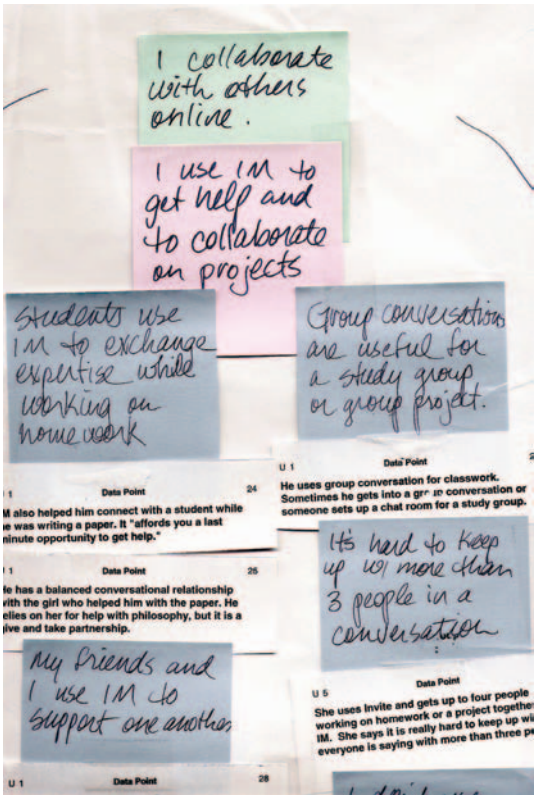

Figure 3. Affinity diagram.

Field Research in South Korea. In 2002 and 2003, I conducted a usability study and a qualitative field study for MSN Mobile and MSN Messenger in Seoul, South Korea. Our goals for user research projects in Korea are twofold. We study teens and young adults in this leading-edge market to see the latest trends. We release some of our most advanced MSN Mobile products in South Korea, so contextual research supports local design for Koreans as well as leading our international design process.

I conducted site visits with the help of a Korean research vendor. In these mobile observations we followed young people in several diverse environments including a high school, a university campus, a shopping mall, and a game tournament. Throughout the observations the SMS messages never ceased. The high school student used SMS to maintain a peripheral awareness of her close friends who attended different schools. This is described by Ito and Okabe [5] as "a persistent social space constituted through the periodic exchange of text messages." A high school teacher commented, "I know that at any given time a certain percentage of

This contextual research in Europe provided us with a snapshot of early adopters of a new technology. After observing the relative ease and input speed employed by European teens and young professionals, it was difficult to predict the likelihood of U.S.-based users typing messages on mobile phones.

my students are keying messages on their phones. But I can't tell which students are doing it because they maintain eye contact with me while they do it!" In a 1999 study of Norwegian teens, Ling found that one in four of the students had sent or received text messages in class [7].

The participants in Korea had considerably more names in their instant messaging (IM) buddy lists than we had seen in the U.S. They communicated with many of the same people in both IM and SMS, depending on the situation. When either one was offline they would send SMS from phone to phone, but they would switch media and connect in IM when they saw each other online. Intermittent IM contact contributed to their sense of shared social space, but they maintained peripheral awareness of one another through SMS as they moved through school and public environments.

From our U.S.-based perspective there is a tendency to think that we can design a better solution for global customers. My first impression in the field was to see a breakdown between IM and SMS and to think of solutions to improve the experience. However, after more thorough analysis I understood that young people do not find their messaging practice particularly inconvenient. They are willing to put up with a bit of inconvenience to be empowered by a technology that sets them apart from their parents and teachers. It is the perceived inconvenience by adults that enables the young to maintain an autonomous space outside the scope of adult supervision [5]. The qualitative field research in Korea provided a cultural context for the product team in the U.S. to transcend ethnocentric thinking and imagine what will inspire people in several international markets.

Circle of Friends Study

After MSN Mobile released WAP and SMS-based services in the U.S., I conducted a field study named "Circle of Friends" to study the adoption of mobile email, instant messaging, and the mobile Web among a group of university students. This study was conducted in cooperation with the faculty from the Department of Technical Communication in the College of Engineering at the University of Washington. We recruited a group of six undergraduate students who frequently used IM. A graduate research assistant functioned as a member of the circle and collected data in context of social interactions within the group. I developed the research design to study an existing social network, unaware that a similar research design was developed concurrently at Nokia by Blom et al. [2]. The Circle of Friends study was conducted in four phases.

Phase 1: Site visits. First, we conducted site visits to study the participants' current IM and SMS activity in their own home and/or school environments. We employed the CI observation method during two-hour site visits. We documented our observations in site summaries with pictures and sequence models, and we created an affinity diagram, shown in Figure 3.

Phase 2: Usability study. We gave each member of the circle a WAP phone with MSN Mobile service. We observed each participant's "out of box" experience and first use of MSN Mobile in a usability lab.

Phase 3: Field trial. The participants were encouraged to try out the mobile services in the course of their daily activities for one month. The graduate research assistant conducted opportunistic observations during the month, in person and through instant messaging.

Phase 4: Focus group. We concluded the study with a focus group and round table discussions in which the participants met with MSN Messenger and MSN Mobile product team members.

The students did not find IM, Hotmail, SMS, or the mobile Web particularly compelling on mobile phones. We learned in the contextual observations in Phase 1 that these participants had frequent opportunities to log into IM on PCs at home, at work, and in university computer labs. Most of them were already online so much they did not feel compelled to log into IM on mobile phones as they traveled between home, school, and work. We also understood there was a lot more going on in their IM besides transmitting text. These students used IM to associate with nearby and distant friends by multitasking between IM and school projects [4]. They checked their buddy lists just to see who was "around" [9], and they found details of their friends' moods and activities transmitted in display names and away messages.

In the Circle of Friends study we extended our observation focus to the social network. We began to think of groups of friends and the design implications for groups. There were several differences between these young people and those we had observed in Europe and Asia. Only half of the students in the Circle of Friends study were SMS users prior to this research. None of them used SMS as frequently as typical Europeans or Asians in their age group. We need to focus on social networks of heavy SMS users in Europe and Asia to gather requirements for new mobile services.

Conclusion

Our earliest efforts to gather requirements for mobile devices and services were limited to our local region in the Pacific Northwest of the U.S. Many of our initial expectations about mobility were associated with our own automobile-based culture. A CI-based study of mobile professionals, commuters, and parents yielded insight into core requirements that have endured through many technological changes. The initial CI served as a catalyst to convince product teams and managers that they are not the customer. It opened our minds to understand the differences in work practice between mobile professionals and ourselves.

We worked with an ethnographer in parallel with the CI and found value in sending an observer out to collect more detailed ethnographic data on mobile professionals who moved through a series of mobile work situations all day. Management decided to hire full time anthropologists, creating a specialized ethnography role. As we have broadened our scope to focus on global markets, the anthropologists travel frequently. It is a bit like having a team of foreign correspondents who share breaking news from the field.

As we expanded our research initiatives to focus on Europe and Asia, we found it efficient and cost-effective to hire vendors to conduct site visits in their local regions. I have traveled to accompany them on site visits and in some cases members of product teams have observed as well. We weigh the costs and benefits in relation to the objectives of each study to evaluate the value of people traveling to observe site visits in person.

Some of our earlier research objectives seem quite naive in retrospect. For example, we set out to study the abbreviations and slang young people use in IM and SMS [11], with the objective to provide a selection of quick phases on the phone. After studying teens and young adults in context with their social networks we realized that they create their own language as a playful, creative expression. It is an expression of personal style. It is subversive in that it creates solidarity among peers [5, 7, 10] while alienating the establishment represented by parents, teachers, and corporations such as Microsoft. Consequently, any attempt we make to speak their language would be doomed.

Qualitative field research has expanded our understanding of mobile requirements in leading-edge markets in Europe and Asia and in our trailing U.S. market as well. Contextual observations have enabled us to predict the implications of new designs and technologies for teens and young adults as well as mobile professionals. We could not localize products effectively without understanding the cultural contexts in which they will be used in homes, schools, workplaces, and mobile environments internationally. Our research focus will continue to evolve in parallel with the emergence of wireless broadband. As it becomes possible to deliver more graphics and personalized, location-based content on a mobile device, our new challenge is to understand which elements are most important and personally relevant to busy mobile people. C

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Applying User-Centered Design to Mobile Application Development

Two case studies demonstrate the need for mobile usability testing methods given the challenges of the mobile software market.

Digia was among the first companies to develop third-party software applications that can be installed in Symbian smart phones by service providers or end users [3]. In 2001, Digia was searching for new product ideas for the nascent smart phone market. At the same time, the User Experience (UE) Group was established in the company and we began to work together with software engineers to transform product ideas into final products. The first product we worked on was the navigation software for Nokia Communicators known as Genimap Navigator, which utilized a Global Positioning System connection and a map database on a network server.

By EEVA KANGAS *and* TIMO KINNUNEN

Illustration by Lisa Haney

When mobile phones started to include cameras and Multimedia Messaging (MMS) capabilities, we discovered in a Contextual Design (CD) study [1] that users would also like to edit the images on their mobile phones. For example, they would prefer to send their digital images via MMS rather than using another method. The second product we designed was an application called ImagePlus, where users can, for example, add a text balloon with a message to the picture and send it directly from their mobile phones.

In this article, we discuss the User-Centered Design (UCD) process we used for the Genimap Navigator and ImagePlus products (see Figure 1). Genimap Navigator is presented here due to its mobile context of use and ImagePlus due to its direct manipulation interaction that was new to the phones at the time it was introduced. Both products have been adopted by the market. Genimap Navigator was licensed by Genimap, which is selling and distributing the product under its own brand. ImagePlus is licensed by several mobile phone manufacturers and also sold directly to end users via the Web.

For each project we used a slightly different process (see Figures 2 and 3). For Genimap Navigator, technology development was performed first and UCD came to the process after the concept and initial requirements were already determined by product management and the customer. In the ImagePlus development process, we were able to start at an early phase making a Contextual Inquiry (CI) study on end-user needs before setting the product targets and requirements. Both projects had major time and cost constraints, which affected the selection of the methods and the willingness to make changes, based on the usability recommendations. These projects were the first UCD projects in the company, so we sometimes faced organizational resistance against our usability design activities. We use these two examples to examine what worked, what did not work, and what we would do differently in retrospect.

Case 1: Genimap Navigator

Technology development for the Genimap Navigator started several months before Digia's UE group was established and brought into the project. Product management had set the high-level requirements with the customer (licensee) and technological partners. There was no chance to conduct any user needs study. We were expected to create the user interface (UI) specification for a pilot product running on the Communicator. This pilot product would be used by the customer organization and field test users before committing to a commercial product.

Since the pilot implementation project had already started, we had to create the UI specifications as quickly as possible. To guide our designs, we had feature requirements from the customer and the UI style guide for the Nokia Communicator. We decided to have a three-day UI design workshop with engineers and make a quick paper prototype test with co-workers at the office. The design seemed to work for co-workers so we documented it in the UI specification document. This design was not completely followed by the project engineers because they had already started implementation while we were still working on the document.

At this point, our feeling was that we and our customer did not know enough about the real needs of the end users. We decided to use pilot testing to get real user-needs data. After the pilot product was ready for testing, 20 participants used the pilot version for three weeks and kept a diary of their experiences [7]. After the test period, the diaries were analyzed and our usability specialist interviewed the users. This provided us with the facts about the importance of the features during actual use as well as the usability problems in the product.

The pilot study revealed the needs that arise from the mobile context of use were not supported by the product. For example, Genimap Navigator has a "yellow pages" service search for locating services based on a text string. In the pilot test we discovered that users wanted to know about the location of the nearest taxi station, but the service search provided the location of the taxi owner's home or office. The service was not context-aware at all. It was also discovered that the limited context of services was one of the main reasons why users considered the services not useful. Information and service needs vary, not only according to the location but also according the user and the usage situation [6].

Based on the pilot test results, we revised the UI of the commercial version. We provided access to the three most frequently used features from the application command buttons, and moved the less-used features to the menu, since we were not able to convince the customer to omit them. To confirm the design changes, we conducted a one-day paper prototype test with three end users. We also reported the service-related usability problems to the customer.

Finally, when the commercial version was completed and delivered to customer, we organized a usability test with the real product to get feedback

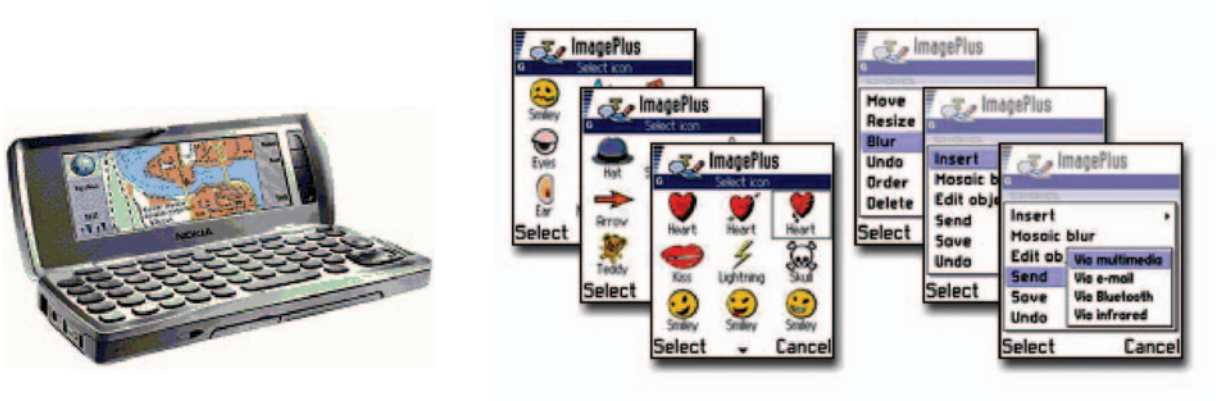

Figure 1. Genimap Navigator and ImagePlus.

for potential future product versions. Again, we did not have a large budget for an as-yet unclear business case, so the test was conducted in a laboratory setting, not in mobile environment. The usability test revealed several problems in the product, but improvement recommendations were too late for the delivered product.

Case 2: ImagePlus

Parallel with the Genimap Navigator development we convinced company management there is a process very suitable for undertaking front-end research for product ideas. We conducted a two-month CD study, in which eight persons from UE, engineering, and marketing participated. The study focused on mobile messaging among professionals and teenagers and included both CI and concept design for several applications.

One of the concepts from the study was an integrated image or multimedia message editor in the phone. The visual and emotional communication between teenagers prompted this idea. When the first Series 60 camera phone with MMS (the Nokia 7650 model) was introduced, it did not have image editing capabilities, so the company considered the concept an idea worth developing.

In addition to inquiry findings, we examined various PC image editing software to gain more understanding of the features and interaction. We easily created a long feature list by compiling the basic image editing features of the PC software. Then we focused on designing the basic user interaction using the Series 60 UI style. We decided to apply the direct manipulation concept of a PC-based mouse to the phone's joystick key. We tested the design proposal with a paper prototype and iterated the basic menu structure and editing tool selection to improve the UI. After the paper prototype test we documented the functional and UI specification using User Environment Design (UED) notation [1], which also included interaction design proposals for all the required features.

Project management used the UED overview to estimate implementation effort for each feature. Business and time-to-market calculations required that the project was completed within half a year, therefore we had to eliminate some features. Based on the findings of the earlier CD study, we decided to create a simple PowerPoint-like application for informal multimedia messaging rather than a full-featured Photoshop-like application for serious image editing.

We defined usability requirements for the main tasks and used these to create a usability verification plan. Due to the small budget, we decided not to develop a UI prototype for usability verification, but instead used the actual software implemented in each increment. During the development period, the UE team concentrated on refining the interaction details especially for direct manipulation tasks—

The most important aspect of the design process is to provide the user with the real usage context. For mobile phones this means users need to be able to touch the buttons and see software that feels like it is actually working.

resizing, rotating, or moving—of inserted icons, text boxes, and frames. Soon we noticed that interaction copied from the PC mouse did not work with the phone's joystick. One of the project engineers invented a better way for resizing and rotating, which proved to be successful in usability tests.

We organized two usability test rounds that caused several change requests to bring direct manipulation to the required usability level. A lot of effort and iterations were required to get a what-you-see-is-what-you-get experience when creating a cartoon-like text box on top of the image. It was also determined by Ketola that many rounds of iteration are often needed to get the UI details right in mobile phone design [8]. In addition, one of our competitors launched their product before us, and we were able to reuse one interaction idea that made direct manipulation finally acceptable. The project was completed three months later than the initial schedule. This delay was caused by both a lack of engineering resources and the change requests from the usability tests.

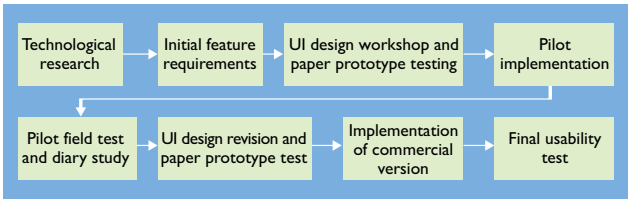

Figure 2. Genimap Navigator design process.

Lessons Learned

The Genimap Navigator and ImagePlus projects taught us a lot about how to apply UCD within tight budgets and schedules. After the projects, we developed our software engineering process so that we could apply UCD more effectively to the upcoming projects. Here, we discuss the UCD activities we consider especially useful in mobile application development.

Focused CI studies. Even though ImagePlus is a successful product, we have not used such large CI studies in every development project. For a small company or customer, it seems quite challenging to invest in user-needs research, since the budget is often planned to cover only the implementation costs. If we have had a design case where we lack user-needs understanding, we have made a focused CI study by two or three UE designers instead of a large user needs study conducted by a cross-organizational team. We have conducted the study in a light way, interviewing only 6–8 people and analyzing the data by creating affinity diagram, sequence models, and personas [2]. Often when a budget has been extremely small, we only use the contextual paper prototype tests in the specification phase of the project to get the necessary insight on user needs. Users are interviewed in the beginning of the session before presenting the prototype and when going through the mock-up, test tasks are created based on the interview. Hurst calls this method of getting the test tasks from users a listening lab [4].

Realistic UI prototypes for mobile applications. With both Genimap Navigator and ImagePlus, paper prototyping helped to get end-user feedback before anything was implemented. It was easy to add and remove features—even halfway through a test. It is a method that every interaction designer at Digia uses when designing the first proposal of a new software application before writing the UI specifications. When the application is simple and interaction is based on standard UI style components, a paper prototype test is a sufficient method for verifying usability before the actual implementation. However, whenever we create new, more sophisticated interaction without a clear design reference, such as map zooming in Genimap Navigator or direct manipulation in ImagePlus, a more realistic UI prototype is needed.

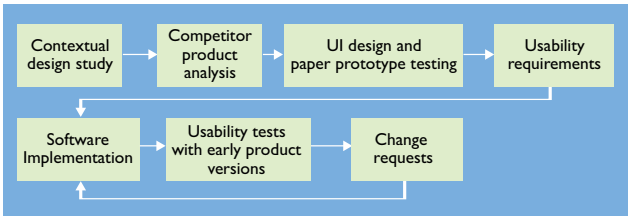

Figure 3. ImagePlus design process.

In the ImagePlus project we were able to iterate the UI details by making the changes to the actual code. Even though the final usability of the product was good, the constant change requests caused delays and frustration in the project. We have not calculated the money spent on iterations, but our current understanding is that we should find the usability problems in interaction design earlier—before the implementation—to avoid unnecessary change requests. In PC and Web environments, UI prototypes can be created and quickly modified with current tools parallel to specification work. PC demos can also be created for mobile applications faster and with less effort than actual coding in the phone, but they cannot be used very well for getting the real feeling from the keypad and display interaction. PC demos are more useful for visual UI testing,

or when testing devices involving stylus interaction.

After ImagePlus we made a UI prototype for one project just by "hacking" a demo into the actual phone with C++ code. The demo focused on the usability issues identified in paper prototype phase so it did not include all the features. Even though the development of the demo took six person-weeks to implement, it helped us to define the detailed interaction during the specification phase. Our biggest concern is finding better tools to make quick UI prototypes with less cost than actual coding. Mobile device manufacturers have worked in this area as well [9–11].

Usability testing in the mobile context. In the ImagePlus project, usability testing of the product was conducted in the meeting room (usability lab) environment. The tests and results were useful and suited to this application because the end-user tasks were not related to a specific mobile context.

For Genimap Navigator, traditional usability tests were not very useful because simulating the relevant use cases was not possible in the office. We conducted a large pilot study in the middle of development, which gave us a large amount of information that was missing at the start. However, a large pilot study is too expensive and occurs too late to get end-user requirements for the product. The diary method was good for gathering information about the usage of the functions, but not very efficient for gathering the detailed usability issues on the go. We were missing the important insight from the ongoing tasks that is useful in traditional usability tests. In future projects that have a mobile context, we will also include an observational part during field testing. Replacing the video cameras used in a usability lab with something more portable is one area that needs to be developed. For example, Isomursu et al. [5] have studied using camera phones to support observations in a mobile context.

Conclusion

When designing any product, mobile or not, good UCD practices help to ensure the product works. No feature should be added to the product only because it is easy and cheap to implement, or because you think it is a good idea. The most important aspect of the design process is to provide the user with the real usage context. For mobile phones this means users need to be able to touch the buttons and see software that feels like it is actually working. Paper prototypes are good because they can be used for verifying the product requirements without any investments in technology or development. They can also be used in a real context to get a relevant testing environment, but they are not sufficient for solving the usability issues of the final product, especially detailed interaction or performance.

We are planning to work on practices that speed up the construction of realistic prototypes for mobile phones [12]. This will allow us to test as if we had the final product, but the prototype can be provided earlier and less expensively. In addition, methods and tools for observing and testing in the mobile context needs to be developed further. Our experience shows that realistic prototypes are even more important for understanding the detailed requirements of mobile software when compared to traditional software. Even though we have had mobile phones and other mobile devices for some time, there will be an increasing number of opportunities for application developers. We are confident we can continue to use traditional proven design practices as we improve them and increase their flexibility for a more mobile environment. C

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A Carrier's Perspective on Creating a Mobile Multimedia Service

Looking at cell-phone connectivity from the other side of the screen.

Carriers sit at the center of the complex intercompany ecosystems that bring mobile products and services to the consumer mass market. In fact, to a large extent, carriers create, shape, and coordinate these systems. Carriers provide the large monetary investments needed to begin development and are responsible for creating and maintaining the long-term customer relationships that sustain products once they are launched. This article describes the creation of Sprint PCS Vision Multimedia Services launched in August 2004 from the view of the design team within the carrier. This view provides insight into how business and research constraints play out to influence the design of mass market services.

By T.S. Balaji, Brian Landers, Jesse Kates, and Bob Moritz

Illustration by Lisa Haney

Designing for the Consumer Mass Market

Carriers seek to design and develop mobile products and services that are successful in the marketplace. Success follows only if the product solves customer problems or fulfills unmet needs. Furthermore, carriers only invest in products and services that operate on a scale large enough to recover the cost of investment and return a profit. The carrier's initial investments include:

- Product Development: Network and infrastructure built out on a nationwide scale. Usually measured in billions of dollars.
- Customer Acquisition: The cost of advertising, direct sales, payments to third-party resellers, and phone subsidies that reduce costs for the consumer. Usually measured in hundreds of millions of dollars.
- Customer Retention: The cost of customer care and ongoing product maintenance. Usually measured in hundreds of millions of dollars.

Within a carrier, mobile product and service designers are constantly reminded of these investments, and must act to ensure that products perform as expected for both consumers and business owners.

Technological and cultural change are the only "constants" in the work of mobile product and service designers. For example, in 1997, the only services that Sprint PCS provided were standard voice calling and voice mail. The most revolutionary product features were Sprint's digital network and the marketing offers that included "first incoming minute free" and "no contracts."

In the intervening years, much has changed in the wireless telephony realm. Customers can now browse the Internet, take pictures and video, send text messages, access email, download games, ring tones and screen savers, or watch live TV through their cell phones. In the U.S., Sprint tends to lead in advanced data service adoption, with more than seven million customers using wireless data services [5].

Creating the Ecosystem

Most mobile products and services rely on four key components to be successful, including:

- A business (billing) model that gels with the service's natural usage patterns;
- Devices that deliver new features that meet customer needs;
- Device-level applications that leverage the new features; and
- Content designed for consumption within mobile usage scenarios.

When we began work on the mobile streaming media service we had little or no information regarding device or content specifics. Thus, we focused initially on the business model and corresponding application design.

Research Constraints

At Sprint, we conduct customer research to reduce the risk of product failure. However, our ability to conduct research is often constrained by the novel nature of the product offerings that we pursue. In this case, we began high-level design activities for Sprint PCS Vision Multimedia Services nearly three years prior to the launch of the product. At that time there were no competitive products to benchmark against. DVD players or portable handheld TVs existed, but the market for portable DVDs was small and didn't reflect the usage patterns or product consumption process of mobile phone customers.

We also faced many of the issues identified by the Nokia team [2]. For example, mobile product consumption is characterized by infrequent and opportunistic use within an environment that doesn't often afford ethnographic observation. For example, the ability for a teenager to hide a mobile phone under a pillow makes sending text messages in bed at 2:00 A.M. a viable option.

Sprint's Marketing Vision

Today, there are two consumer screens: the television and the PC. Sprint's marketing vision was to create a third screen that consumers would integrate into their daily lives. This new screen needed to entertain and inform, and it needed to have an associated "cool" factor to support mass-market advertising.

We quickly recognized that the quality of the video stream would make or break the product's ability to entertain and inform. Before development began, we worked with our Technology, Research, and Development team to prototype the quality of the service in the lab. We did this to understand how the wireless data network parameters might influence the perception of streaming video quality within a mobile data network. Specifically, we varied frame rate and data network speed to isolate the minimum values that led to an acceptable customer experience for each type of content (such as Anima-

tion vs. Live Action). The results of these studies are presented in detail in [3].

The Business Model

Understanding the business model was critical to our success. Customers would purchase content on a per-event basis or license content through a monthly recurring charge. The user interface also had to support branding elements from the third-party content partners (such as the word mark CNN).

Technically, the service had to leverage Sprint's existing content vending infrastructure for payment and distribution. Reusing the existing infrastructure allowed Sprint to speed up development, reuse existing content licensing models, and leverage interface concepts established in our existing product set.

Figure 1. Final service design.

User Interface Design

We set out to create a user interface concept for mobile streaming media that would fit the business model and support content discovery and rendering. Initially, we investigated multiple interface approaches with different navigational schemes. We employed various informal and formal design techniques, including McGrew's Parallel Design Process Based on a Genetic Algorithm, to generate these concepts [4].

Some designs used a standard list view while others used side scroll navigation to access the content categories. We investigated category structures and the implications of nesting content within folders. We also needed to account for both real-time video streams and prerecorded clips. Above all, we needed to make sure that customers could get a sense of the video experience quickly, without a lot of cumbersome exploration.

Through the design and evaluation process, we decided that content providers would be assigned channel numbers (see Figure 1). By leveraging the concept of channel numbers, we were able to connect the novel mobile media service to the television experience that customers already understand.

We also leveraged prior learning to avoid mobile usability pitfalls. For example, we once released a version of our mobile browsing service that supported content navigation through a set of user interface tabs. Tab paradigms are well known and used frequently on wired Web sites. However, the tab design did not map well into a mobile phone where there are two soft keys, a four-way rocker key, and a select key. We experienced latency problems from multiple image files (including the images for the tabs). Due to poor performance, this version of the browsing service was quickly removed from production and replaced. In sum, our past experience allowed us to eliminate the idea of a tabbed user interface early in the design process, and we avoided using images unless they were absolutely necessary.

In our final design, the application parses an XML file to construct the user interface. This XML document is called the Media Channel Descriptor (MCD). The MCD allows Sprint to easily change the nomenclature and content tree within the user interface. For example, if CNN and FOX merged and desired to present their content side-by-side, we could easily adapt our mobile user interface presentation. The interface itself is based on a split screen grid.

Our ability to conduct research is often constrained by the novel nature of the product offerings that we pursue.

The channels that the user has purchased are displayed on top and the channels available for purchase are displayed underneath. The two grid spaces are separated by non-selectable information headers. Icons distinguish between the different media types and folders are used to depict hierarchies.

Design Validation

We conducted a traditional usability test to validate our design, which scored in the top 10th percentile and exceeded the participants' expectations regarding ease of use. Note, that as a carrier, we have augmented our usability testing program to leverage our unique position within the telecom industry. For example, the User Research and Metrics team at Sprint has norm-referenced our usability scale to other telecommunications products.

identifies some of the partner corporations within the streaming multimedia ecosystem that Sprint created. Both Sprint and the partnering organizations benefit from the cross-brand promotion enabled by these types of collaborations.

Research Opportunities

To create a profitable product, carriers must be able to anticipate the future or at least be very confident in their investments. Some carriers have made poor decisions (for example, those that bet on TDMA technology) causing them to replace a bad technology choice at great expense.

To improve the odds, carriers must deliver services that meet real customer needs through a user interface that delivers an acceptable experience. However, current customer experience research methodologies are limited in the mobile domain.

Figure 2. Advertising represents the ecosystem the carrier creates.

In addition to lab testing, we conducted market trials with early JAVA (J2ME) implementations of the streaming service to assess market acceptance. These applications pushed the limits of device memory and processor speed. In some cases the video stream could only produce frame rates of one or two frames per second. To our surprise, customers were willing to use these applications even though performance was sub-optimal.

Service Launch

On August 13, 2004, Sprint announced the launch of Sprint PCS Vision Multimedia Services, a service that offers streaming video and audio content available in the U.S. The Sprint PCS Vision Multimedia Phone MM-A700 by Samsung was the first CDMA device in the U.S. to deliver streaming audio and video content from familiar sources such as CNN, NBC Universal, FOX Sports, The Weather Channel, E! Entertainment, mFlix, Twentieth Century Fox, AccuWeather and 1KTV. In addition, on Nov. 10th, 2004, Sprint announced the Sprint PCS Vision Multimedia Phone MM-7400 manufactured by Sanyo.

The banner advertisement shown in Figure 2

For example, methods that make corporate desktop software successful are likely to provide underwhelming results when applied to the mobile products and services market. As described previously, some of the key challenges to research include the unpredictable mobile environment, unavailable or prototypical technology, and the pressing need to create interface designs early in the development process.

Many ethnographic techniques fail to overcome the infrequent usage profile for wireless services. Carriers report that voice usage averages about 600 minutes per month. Accordingly, during the course of an average month a typical user places about 20 minutes of voice calls per day. Wireless data services are used even more sporadically, making ethnographic observation difficult.

Research Informs Design

At Sprint, we have developed research programs that align and integrate traditional design and usability techniques with large-scale field surveys. These methods are well detailed in [1] and are summarized here.

We use large-scale surveys to understand the cus-

tomer experience throughout the product life cycle. For example, with the launch of Sprint PCS Vision Multimedia Services we will measure product usability and satisfaction through an extensive tracking program. Surveys will be conducted at two months, four months, and 10 months from first product use.

We use our field surveys to drive design and to prioritize new functions. We are also able to link survey results back to lab data quantitatively such that we can now model and predict the customer's real-world experience based on lab results.

Even with a robust field evaluation and lab testing program, driving design based on data is still difficult due to development timelines. For example, second-generation design iterations began for Sprint PCS Vision Multimedia Services prior to its public launch.

Conclusion

Wireless carriers faces a unique set of design and research challenges. This article demonstrates how carriers successfully design novel services 18 to 36 months prior to market launch. Keys to carrier success include leveraging prior knowledge about existing products and services, traditional in-lab usability testing and large-scale field research. The challenge remains to adapt ethnographic methods that are highly effective in other domains to the mobile realm. C

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For Mobile Applications, Branding is Experience

Exploring the intricacies of the relationship between branding and the design of mobile applications.

Mobile technology is everywhere—with new types of mobile devices appearing regularly. While branding of the devices themselves can draw upon a long history of product branding, the branding of mobile applications presents new questions and challenges. I became aware of some of these challenges during InContext Enterprises' development of the mSports mobile sports application, which allows users to follow the play-by-play action of Major League Baseball on a variety

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Illustration by Lisa Haney

of mobile phones. We gathered customer data to develop the concepts and designed application interfaces for a variety of devices. Focusing on baseball for mobile phones, we tested and iterated the design with users. The design was implemented and released in 2003 in partnership with Sports Illustrated.com under the ScoreCast brand.

For the initial release, the main challenge was that the mSports brand had to coexist on the device along with the brands of our partner, as well as the brands of the cell carrier and phone manufacturer. The larger concept designs highlighted even more challenges looming in the future: application interfaces to support a variety of sports on a variety of devices—mobile phones, PDAs, notebook and desktop computers, and interactive television—that would be used in a variety of settings—at home, while traveling, or at the sports stadium. Branded content, like merchandising and advertising, would also be integrated into the application, adding to the challenges.

Our experience raised many of questions about branding and mobile applications. This article will highlight some key challenges and potential branding strategies by examining the relationship between branding and the design of mobile applications.

What is Branding?

In "A Model of Brand" [2], Hugh Dubberly describes a brand as a sign that is formed by words, sounds, or graphics that represent or signify the brand and perceptions of the brand as shaped by experience. These perceptions are created by the brand steward, who provides the product and marketing message, and also by the people that experience the brand.

As an example, Coca-Cola is a product brand, which is represented or signified by a name, a logo, a glass bottle, and a slogan, among other things. The perception of the Coca-Cola brand is created not only through our experience of drinking it (the unique taste and shape of the glass bottle), but also through our experience with television commercials and their messages. These perceptions are then remembered and reinforced each time we encounter things that represent Coca-Cola. This example also points out the two different types of experience that shape our perception of a brand: indirect experience and direct experience [3].

Indirect Experience

A brand is experienced indirectly when others tell us about the product or service. Usually this is a marketing message delivered through advertising, public relations, and other promotions, but it can also be a message delivered by friends, experts, or competitors who have something to say about the product [3]. Since the individual is passive in this experience, the message needs repeated exposure in order to affect brand perception [10].

Traditional advertising of a mobile application is of course, an option that can be considered. More pertinent to this discussion though, is the prospect of delivering marketing messages for other products via the mobile phone. But it's not clear how the device's screen limitations (small size, limited colors, and variable quality), combined with constantly changing contexts of use will affect marketing messages. Also unknown is how users will perceive advertising they receive on a device that is so personal or how they will feel about paying to download that advertising.

Direct Experience

When individuals go to the store to look at a product, when they buy it, and when they use it, they have a direct experience that affects their perception of the brand. Since people attribute emotions directly from their experience, this has a greater affect on brand perception than indirect experience. For example, when using a mobile phone or shopping on a Web site, people have a direct experience with that product or service, which influences their feelings about it [10]. Therefore, a "good" experience translates to "good" brand perception. This idea is supported in a study conducted by Jared Spool, which shows that a more successful user experience is created when Web sites help users achieve their goals,

The best way to establish a brand

is to create a positive direct experience that can only be achieved through the design of the application.

which in turn translates into improved brand perception [9].

This direct experience can be subdivided into three parts: physical perception (visual, aural, tactile), actual use (usability), and value (usefulness).

Physical Perception: With mobile devices, the device itself is branded; the color, shape, sounds, and texture of the device all contribute to the direct experience. What receives less attention is the software interface. Since it is graphic in nature, it can obviously influence the direct experience through visual perception. Desktop and Web applications are already branded in just this way: SAP has written about user interface branding and the company's belief that the visual aspects of the interface are part of its communications strategy [4]. There is also research to suggest the aesthetic attractiveness of a software interface positively affects its perceived usability [6, 11].

Figure 1. Apple's iPod.

Visual design elements such as color, line, shape, and font can be used not only to increase aesthetic attractiveness, but also to enhance usability. Visual elements can affect (either positively or negatively), both at the same time. Elements of sound (ring tones and alert sounds) and touch (vibrating) can also be used in the same way.

Usability: Usability, or quality in use, is often the main focus for most design efforts. However, as Gilbert Cockton argues, usability is limited. It only assesses functions that have already been implemented and doesn't address functions that are missing. It also can't evaluate how well the system fits the context of use nor can it measure value [1]. This is not to imply that ease of use has no benefit; it certainly does.

Usefulness: Cockton proclaims, "The most important goal is to achieve value" [1]. Arguably, usefulness has a greater impact on direct experience and brand perception than usability. This is also supported by Moritz, who found that the ability to download television to a mobile phone is so compelling that people will put up with slow download speeds [5]. Problems with usability can be overlooked if a product is considered useful, but no amount of good usability can make up for a product that is seen as useless.

Using this information, we can propose some general strategies for branding:

- Provide a positive direct experience by creating an application that is first useful and then usable;
- Further enhance the experience by making the application aesthetically attractive; and
- Use visual brand signifiers to leverage an established brand or co-brand.

This is a first attempt at proposing strategies; it's not clear how well these strategies will actually apply to mobile applications. More questions also need to be answered: What is the impact of attractiveness, usability, and usefulness on mobile interfaces and how do they affect each other? How do design constraints—like screen size, competing brands, or type of device—influence the direct experience?

Design Constraints

The best way to establish a brand is to create a positive direct experience that can only be achieved through the design of the application. Therefore, anything that complicates or constrains application design will also affect the direct experience. During the development of mSports, we encountered these key constraints:

Physical constraints: Due to their small size, mobile devices are constrained by small screen size and limited user input mechanisms. This alone severely limits what can be accomplished on a mobile application interface.

Platform and device variation: Interface screens vary in size, resolution, color depth, and quality. Buttons vary in number, type, and placement. Finally, operating systems use different navigation paradigms and fonts. Each variation that needs to be supported adds complexity to the design and the direct experience.

Number of primary uses: Each additional primary use (for example: a phone with a camera) increases the complexity of the interface design. If the device and platform aren't flexible enough to equally support them, the user experience will suffer.

Brand competition: Many players compete for brand awareness: the device, wireless carrier, data service provider, delivery network, content

providers, device platform, third-party software provider, and third-party software creator. Each contributes to the experience of using the device, but which does the user attribute their experience to? The fight for control of the user and brand experience has already begun between device manufacturers and carriers.

Support for third-party software: The potential number and type of primary purposes that a device may support increases and the amount of brand competition also increases.

Based on these design constraints, we can sort mobile devices into separate categories, and then propose branding strategies relevant to each category, instead of for each device (see the table here).

Single-Purpose Devices

With only one primary use and no third-party applications, the interface only needs to support a limited set of functions that are all closely related. Combined with minimal device variation, this means the designer has greater control of the interface. The lack of third-party applications results in little or no brand competition and the limited input mechanisms (only a small number of keys or click-wheel), are not much of a constraint because they support only one primary use.

Branding Strategy. With these types of devices, the manufacturer has total control over the design of the device and the software interface, as well as control of all or most of the branding. This results in total control of the direct experience and the brand message.

Since the whole product embodies the brand, visual branding can be kept to a minimum in the application interface. A good example of this is Apple's digital music player, the iPod (see Figure 1). Apple has successfully branded the iPod to become the number-one selling digital music player. This is not only because it looks "cool," but arguably because it is useful and easy to use. Notice that branding is concentrated on the device itself, not on the interface screen. The texture, size, color, and appearance of the device are all part of the branding and the physical perceptions of the direct experience. Branding on the screen consists only of a simple Apple logo, displayed at startup and the word "iPod" on the main menu screen.

Multipurpose Device

These devices support third-party applications and multiple primary uses. They have an operating system and software interface that are robust and flexible. The input mechanisms support complex designs with a full keyboard, a stylus, or both. There are few platforms: PDAs and smart phones use Palm, Windows, or Symbian, while the Blackberry has its own platform. Platforms often have hardware specifications, which reduce the amount of variation across devices and simplifies the interface design.

	Single Purpose	Multipurpose	"Enhanced" Mobile Phone
Devices	Digital music player, digital video player, portable GPS device, and "basic" mobile phones	PDA, Blackberry, and smart phone	Mobile phones that allow third-party applications
Primary uses	One	Multiple	Multiple
Input mechanisms	Limited	Robust	Limited
Device variation	Little or none	Minor	Major
Brand competition	None	Major	Major
Third-party software	No	Yes	Yes

Categories for mobile devices.

The direct experience of these devices is controlled by multiple parties. Platform developers, device manufacturers, and software developers are each responsible for their part, which introduces brand competition. It's not clear how a positive or negative experience with one will affect brand perception of the others.

Brand competition is also prevalent on these devices, with the device, wireless carrier, data provider, third-party software creator, and many others trying to gain brand presence in an already complicated interface.

The increased number of uses and functions supported also increases the complexity of the user interface, but this is offset by the amount of control provided by the robust platforms and the lack of variation across devices.

Branding Strategy. Support for third-party applications creates a great deal of competition on these devices, so differentiating one brand from another becomes more important. Usefulness is likely to be the best way to do this. If an application is not useful, it won't get used—if it doesn't get used, it will eventually be deleted from the device to make room for a more useful application. This probably does not result in the brand perception that marketing was trying to create for the application.

Visual branding of the direct experience also becomes desirable because of brand competition. Color, line, shapes, and font can be used to help differentiate the product from competitors but the visual elements can't adversely affect usability. Small brand signifiers might be used on all screens or a larger brand signifier can appear on the loading screen.

As an example, let's use a comparison of two wine tracking applications for a PalmOS PDA (see Figure 2). Both applications support the same use, display the same amount of information, and have similar functions.

Figure 2. Wine tracking applications for a Palm-based PDA.

The application on the left (Winemate 4.10) uses color for visual branding and information design. To distinguish it from other applications, red text and lines on a light yellow background are used instead of traditional black on a white background. Different text colors also indicate the type of wine, even though that is already displayed. Visually, the interface looks jumbled and busy, and though it was probably not intentional, this is how the brand may be perceived. Usability may also suffer, as the multicolored text is more difficult to scan and read, which may have a negative effect on brand perception.

In contrast, the application on the right (Wine Enthusiast Guide 2004) uses color for the same purpose, but also adds a graphic for visual branding. The small graphic of a wine glass is a brand signifier, which also distinguishes it from other applications. The graphic, along with restrained colors and a clean, simple layout, gives the perception that this is a clean, elegant, and simple to use application.

Although here I am offering an untested analysis that usability testing must validate, this side-by-side comparison shows the brand challenges software developers face when designing for these platforms.

Enhanced Mobile Phone

An enhanced mobile phone is capable of running third-party software, which means it supports multiple primary uses. Unfortunately, it still doesn't fit into the multipurpose category, because the device was designed initially to support only one primary purpose—that of a phone. It wasn't intended to support multiple purposes.

As long as the first priority is to be a phone, creating an interaction design for other uses will be difficult; any design must conform to the limited interaction paradigm of the phone. As we discovered in the development of mSports, this constraint makes the cell phone the most difficult type of mobile device on which to design a good user experience.

Beyond the typical constraints of small devices—very small screen, limited number of keys, and lack of keyboard or other input mechanism—variation between phones complicates matters even further. Platforms have different navigation paradigms, and devices have navigation keys that vary in number, type, placement, and size. Smaller screen sizes also force removal of content and function on some phones that can be included on others. There are even different limits for maximum application size, again resulting in the removal of content and function. All of this makes it impossible to use the exact same interface design on all phones. Depending on the trade-offs made, user experiences can vary widely on different phones.

Brand competition is also prevalent on these

devices, with the device, wireless carrier, data provider, third-party software creator, and many others trying to gain brand presence in an already complicated interface.

Branding Strategy. Because of the numerous design constraints, it is extremely difficult to create applications that are useful and usable. The best approach may be to strike a balance between maximizing the usefulness that will fit on the phone and minimizing the usability problems inherent in this type of device. The effect of the user experience on brand perception is also critical because of the intense brand competition.

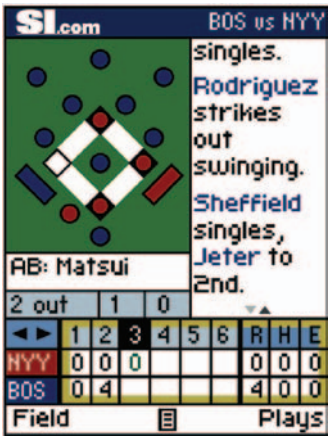

Figure 3. mSports baseball screen display.

One way to minimize usability problems, which we chose for mSports, is to keep the user interface as simple as possible: Focus the software interface on supporting use of the application and keep visual branding to an absolute minimum. Color and design elements can be used minimally and only to make the application easier to use. Branding elements can be restricted to only small brand signifiers on screens and larger elements on the loading screen. The visual branding can be tested with users to ensure it doesn't interfere with usability and that it communicates the right brand message.

Usefulness may override negative experiences for a time—if users' expectations for applications on these devices are low. As expectations rise, however, the whole concept of usefulness will need more exploration. Most applications available today are games and various productivity or information management applications, which don't provide value around the "mobile-ness" of the device. Exploiting the "mobile-ness" of the device would create new value by allowing people to do things they never could before. Some key areas to explore are location-based services, time-based services [8], integration with interactive television [7], and services that support social interactions.

In the mSports screen example shown in Figure 3, visual branding is kept to a minimum. Development of the design focused almost entirely on usefulness and usability and the design uses only a small logo and a blue color in the top bar, to represent SI.com, our branding partner. All other visual design is restricted to supporting the usability of the application. We intentionally left mSports branding off the main screens, so that the design would not conflict with any potential branding partners.

Conclusion

This article has described a framework and outlined potential branding strategies to consider when designing applications for mobile devices. More importantly, I hope it may be the first step toward a larger discussion about the complexities of branding on mobile devices and lead to answers for some of the questions that remain: How much influence do various brand competitors have on brand perception? Which has greater effect on brand perception: product design, visual design, usability, or usefulness? Should branding strategies change for different situations and contexts of use? How these questions are addressed will determine the degree of success of future branding initiatives. C

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