Workflow on Mobile Phones

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Abstract

Mobile devices and services are rapidly becoming a common property. In this paper, we describe what this development implies in terms of usability of complex services. Management of workflow in the context of interactive services is focussed on. It is shown how to implement workflow on mobile phones, and how to increase the usability of complex services by application of two main categories of design guidelines are presented: Navigation and work flow, and Input and error handling. Ditto user interface design is demonstrated through a concrete case, the 'mobile tax demonstrator', which provides functionality for up-dating information required for tax calculations and consequently for ordering a new tax deduction card.

Keywords

Mobile workflow, mobile user interface, interaction design, universal accessibility, mGovernment

1. Trends

The telecommunications industry has grown rapidly over the last decade. Extensive technological improvements have been made in terms of telecom networks, bandwidth and mobile devices (ITU 2007b). Mobile broadband has grown in speed, with industry promising even higher speeds in the future. According to data from ITU - the International Telecommunications Union, the global mobile penetration is expected to exceed 50 percent this year. Market research reports that in Western Europe, the mobile phone penetration was 108 percent by mid-2007 (BNET 2008). According to the digital opportunity index 2005/2006 there is a strong growth in third generation (3G) mobile services, particularly in Asia and Europe (ITU 2007b). As shown in Figure 1, the number of mobile phone connections is increasing all over the world.

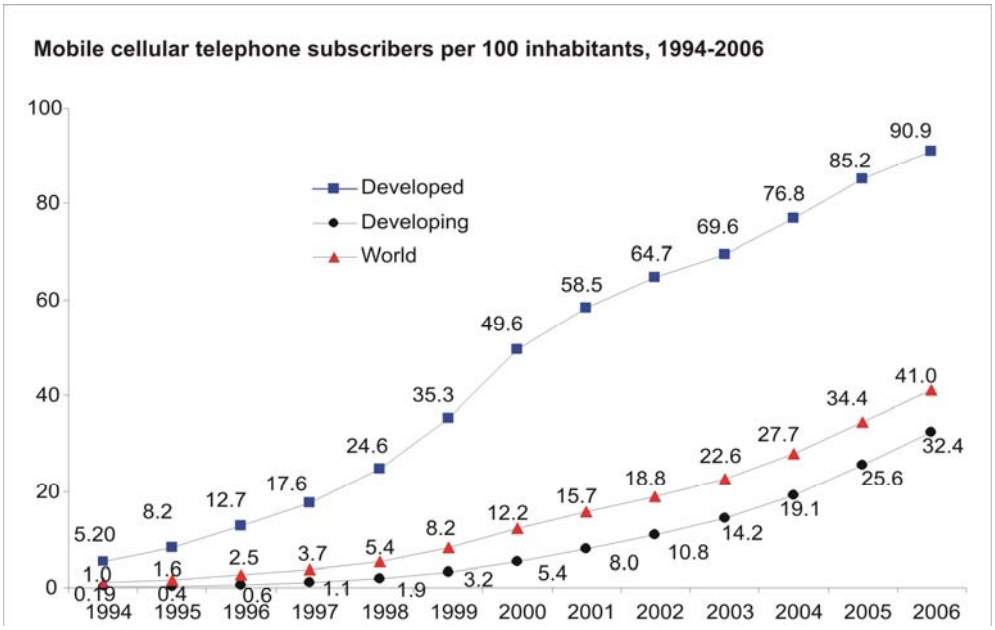

Figure 1 Number of cellular telephone subscribers per 100 inhabitants 1994-2006 (ITU 2006).

Despite major differences between the developed and the developing world, mobile services have been critical in enhancing access to telecommunications in many developing regions and rural areas, where fixed lines remain limited or non-existing (ITU 2007a). Mobile broadband (3G) services are also now offered in many developing countries throughout the central and eastern Asia, Latin America and the Caribbean (ITU 2007b, p. 145).

The development of new mobile devices and content is also increasing. Services are becoming more flexible and robust, and the functionality and capabilities of the mobile devices have gone through rapid evolution. Literally, modern mobile phones are small PCs. These devises carry modern office applications, and enable the user to access the internet, store huge amounts of data, such as music, pictures and movies etc. Convergence of internet and telecommunications is being demonstrated for both devices and content.

The combination of mobility and the internet is creating a new opportunities for industry that will deliver content-rich services to users on the move and in rural areas. Mobile data networks with increasing bandwidth, together with advanced phones and handheld computers,

are bringing a new generation of services into use. These are services situated at the cross-section between telecom and ICT.

In summary, the mobile phone is rapidly becoming common property in the western world, and it offers a great opportunity for offering services directed to large user groups in new contexts and situations. Mobile services have the potential of bridging the digital divide in many development countries and for diverse user groups. To what extent this will happen however, will depend upon whether the services are accessible and easy to use for all. It makes good business and marketing sense, as well as being consistent with social and political goals to ensure that everyone can enjoy the benefits of the information society.

2. Workflow on mobile phones

As part of the strategy of increasing efficiency and producing new and better services, both private and public enterprises are looking for means to streamline their production processes. One way of increasing the efficiency is self-service. This means pushing the 'information work' down to the "production workers", such as customers or citizens. Obviously, both the service provider and the customer benefit from this. For the user the opportunity to control the timing and method of transactions is rational. The driving force for the service provider is the opportunity to reduce administrative overhead and still give a better service.

Organizing services in this manner requires conscious management of the information flow. For many purposes, such as quality and relevance, the information should be collected and refined as close to the point of origin as possible. This is, of course, already happening, and examples are many: Daily we get cash dispensed by automatic teller machines, we buy train tickets at self-service kiosks, we keep our own banking accounts over the internet, we file our final tax statement electronically, and we report the electricity-meter reading over the net. In other words, doing business over the internet is nothing new.

The need for mobile services is also increasing as the workforce is being mobilized in addition to the increasing need to be constantly connected to the enterprise's business processes. In fact, we are witnessing a new and rapid development of business process re-engineering. Enterprises explore how to make use of new channels and devices, such as mobile phones and other hand-helds. In doing so, enterprises must on the one hand focus on the organizational landscape of their business processes including organization of work and work flow, logistics and distribution, and the front-end functions. On the other side, the analysis has to be directed towards the suitability of mobile services for the business processes and the work flow.

It is reasonable to believe that the convergence of technologies as well as the development of content and services will lead to more complex mobile services than seen until now. The service is often part of one or several business processes which may be more or less computerized. The workflow may be split into tens of tasks and hundreds of sub-tasks. The rules of case handling are comprehensive, including information exchange in a certain order, in a certain format, based on complex interdependencies. Fitting the mobile phone as an end-user device into the business process requires careful analysis of the user scenario. So, a basic requirement is that it must be meaningful to introduce the mobile phone as an alternative channel/device.

Since mobile internet services are quite novel, the research body on what makes services suitable for this channel is still small. As Stewart points out, the suitability, by him expressed as a user scenario, depends on a interplay of factors in the intersection of devices, locations, application packages and people/users (Stewart 2005). Pedersen and Ling (Pedersen & Ling 2003) give a broad and interdisciplinary overview of factors that influences uptake of mobile services, ranging from factors such as usefulness, ease of use, attitudes towards use, external and interpersonal influences, subjective factors, facilitating conditions, costs etc. Even though little is know about the relative weight of all these factors, we believe that usability and user experience is factors of great importance for the uptake of mobile services. Venkatesh (2003) found that relevance of content and ease of use was significantly more important in wireless contexts than on traditional web-pages (Venkatesh et al. 2003).

When a potentially suitable business processes (or parts of these) have been identified, the design and realization of a mobile service starts. Our contribution is to show how services, modelled as a workflow, may be implemented on a mobile phone. In Chapter 3 we present our view on what are crucial user interface design guidelines in the context of a workflow. We show what this may imply in terms of design of the mobile service. In Chapter 4 we illustrate this through a real case, and in Chapter 5 we summarise our experiences.

3. Design guidelines for mobile workflow management

The availability of different channels and the variety of available end-user devices, and the mixture of these, introduces a huge challenge when it comes to the user experience and thus the success of the application or service. We argue that improving the user experience will be one of the most critical success factors that will influence the uptake of new services on a mobile phone platform. The characteristics of mobile devices, such as the small screen and the miniature keyboard, have proven to be particularly demanding with respect to interaction design. Moreover, the physical environment and the use context of mobile services challenge the design even more.

According to Buchanan et. al, is possible to build useful and usable mobile services if careful consideration is given to the interaction design (Buchanan et al. 2001). The size of the screen, the structure of the site including the navigation, and the input methods were identified as the three most important usability factors when developing applications for mobile devices (Buchanan et al. 2001).
Other advices on how to design the mobile user interface are available in the basic guidelines recommended by the W3C (W3C Mobile BP 2006) and by Little springs design (2005). The W3C Ubiquitous Web activities are also interesting and relevant for the design of mobile applications. Other advices are suggested by Nikkanen (2004) and Hays (2007). Easy navigation, layout and content, and limited input methods are important matters in these guidelines.

Research in mobile workflow has mainly focused on technical aspects, such as seamless integration, coping with constrained recourses, and how to support protocols such as SMS, MMS, Bluetooth, email, and HTTP (Pajunen & Chande 2007). The mobile devices are often seen as a new interface to existing processes of organizations and traditional work practices (Pajunen et al. 2007). (Chande & Pajunen 2007) advocates a more mobile device centric development process, and presents a layered architecture where the user interface is separated from the integration logic that composes the underlying applications. We find that there is

also a need for more user oriented research on how the user interaction and user interface of mobile workflow should be designed.

In order to manage the workflow in mobile services, we focus on two main aspects of the user interface. The one is the organization and management of the work flow as such. The other is input and recovering from error situations such as invalid input or unfinished tasks. Below, we discuss what we believe is the most basic requirements to the mobile user interface design within these two areas.

3.1 Navigation and work flow

The business processes and the workflow of a service force a division of labour between the service provider and the user. The rules, the interdependencies between tasks and sub-tasks, and the information flow all together pose an extra challenge to the mobile use context. Information may have to be retrieved from several sources, a small screen is available for the presentation of the information, and on top of it all, a finalizing action such as sending, ordering, or submitting is often required. In addition, the mobile use context *inherently* increases the probability of short sessions and disturbances. As we see it, good navigation mechanisms make the service and its workflow work. Hence, we regard the following requirements as essential:

1. The main navigation should be placed consistently at the same place through out the application user interface. Critical functions should never disappear.
2. The service should clearly express where the user is in the dialogue, and which tasks are active. During complex tasks the system should inform the user about his/her progression.
3. The system should make it possible to go back to earlier phases of the dialogue, and it should be possible to end or terminate the dialogue at all times without loosing work done.
4. The small size of the screen implies splitting the task between a number of pages or ‘cards’. However, one page or card should only contain related elements, and actions which are implemented as a series of pages or cards should be organized as a path of pages or cards, not a network.
5. The order of tasks, controls and input fields should be logical.
6. Vertical scrolling should be reduced to a minimum and horizontal scrolling should be avoided.
7. In order to allow multiple navigation modalities and devices, the system should allow navigation by the device’s physical keys and by menu buttons on the screen.
8. In electronic forms, it should be possible to proceed between (uniquely named) fields by using the Tab-key.
9. If the user can initiate several simultaneous tasks, the method of initiation should differ from ordinary navigation and input.

3.2 Input and error handling

The interaction mechanisms on mobile devices are usually limited. Therefore much effort should be put into minimizing the need for entering information, and in accommodating or, if possible, preventing user errors. In order to make the user experience smother, we put forward the following requirements:

3.3 Explore the possibility of utilising existing information by integrating common mobile applications such as calendar, phone book, map, browser, messaging, etc.
3.4 Provide prewritten values to chose from and pre-selected values whenever possible
3.5 Error messages that are connected to the use of the service should be explanatory, easily read and presented in the user's mother tongue or the language he/she prefers.
3.6 If the information is intended for the technical support personnel, this should be explicitly stated.
3.7 Error messages should be shown immediately after the occurrence of the error.
3.8 The error message should indicate how the user may solve the issue. (For example by changing input data or a device setting, or whether it is an issue that can be escalated to the content provider or network operator.)
3.9 It must be possible for the user to escape from an error condition. The user should either be able move backwards or onwards to a part of the service from where they can retry or alter the transaction they were attempting.
3.10 In case of repeated errors, the system should offer additional information or propose an alternative way to proceed.
3.11 If any input is out of range or illegally formatted, the system should accept the valid input, and only invalid input and /or uncompleted input fields should be shown to the user.

4. The case: The change of tax card demonstrator

Improvement of the information and services provided to taxpayers is a strategic goal for the Norwegian Tax Authorities (SKD). Introducing new, alternative and better public services makes it easier for taxpayers to comply with the rules that the SKD administer. In order to learn about different aspects of services based on mobile technology, the process of changing tax card information was selected as a case.

Employers in Norway are obliged to calculate and withhold tax from the salary of each employee before payment of wages. In order to determine the amount of tax each employee must have a valid tax card. Normally, the tax card is automatically produced by the local tax office in December, and sent by ordinary mail to all potential tax payers in Norway. It is then the responsibility of each individual to deliver the tax card to the employer who then updates the salary system. If he employer has not received the tax card 50 percent tax will be withheld from the salary.

It is the obligation of each individual to assess the need for a new tax card. A new tax card may be needed if the information on the tax card is incorrect. Changes in the level of income, higher or lower loans, changes in family situation etc, are common reasons for updating the tax card. Then, through the existing channels, for instance by visiting the local tax office, sending a paper form or using the internet service, the individual has to report the correct information and obtain a new tax card.

The '*mobile tax demonstrator*' shall provide functionality for updating information required for tax calculations and consequently for ordering a new tax deduction card. This is a suitable service for demonstrating the design principles, as it genuinely represents a service for a large and diverse user groups.

4.1 The case environment

The tax demonstrator for mobile phones runs using the IP protocol over the GPS/GPRS mobile network. The main application (forms engine) runs on a server, and the user interface part is executed locally on the mobile phone.

The demonstrator has been developed with the use of ServiceFrame. ServiceFrame is an application execution and creation framework based on Java. It provides functionality for communication with users connected through different types of terminals such as mobile phones, PCs or PDAs. ServiceFrame has been developed by Tellu AS (Tellu 2008) together with Ericsson NorARC as part of the ARTS research project (ARTS 2003). It was created to support rapid development of internet and telecom services.

4.2 The user interface design

Below we will illustrate how the two categories of guidelines affect the design of our case application: the mobile phone demonstrator for the Norwegian Tax Authorities (Skatteetaten 2008). The screen shots which have been produce by using a mobile emulator on a PC, show the demonstrator's user interface with dummy data.

As stated earlier, one of the most important areas in the context of services is that of managing the work flow. In Figure 2 the use of 'cards' is illustrated. The phases of the current task are organized as task cards, with a numbered tab for each card. The user maintains an understanding of position and progression. The number of the active card is clearly marked.

Figure 2 Task cards and marking of the active card, i.e. the active subtask in the workflow.

Modern mobile devices have a joystick, a physical button or a touch-screen pen for input, and thus navigation. Naturally enough, one of these mechanisms has to be is used for navigating between the cards. By moving between the task cards the user gets an overview of the sequence of (sub-)tasks, and an indication of the amount of work that is required. Pilot-user tests indicate that this way of visualisation works according to the intuition of the users. Some of the users first leaf through all the cards in order to get an overview of the workflow.

Within one task the information may often be more comprehensive than the size of the screen. We take it for granted that two-dimensional scrolling within each card should be avoided. We allow vertical scrolling, but we make an effort to manifest the position by a clearly visible scroll bar. The scroll bar also illustrates the relative vertical position on the card. The size of the scrollbar indicates the relative size of the visible content in contrast to the *available*

content. Also for vertical navigation the user can apply the joystick, the navigation button or the touch-screen pen. In Figure 3, the *elastic* scroll bar is illustrated.

Figure 3 Elastic scroll bar showing the relative position.

In a flow of tasks and in a sequence of dialogue activities the user needs a focal point. This may be connected to input or output, or to any information that the user manipulates. In our demonstrator, this challenge is solved by implementing a focal frame. This *frame* follows the active area of input or output as illustrated in Figure 4. Context sensitive *help*, that is information related to the focal frame, is available at all times (menu at the bottom left).

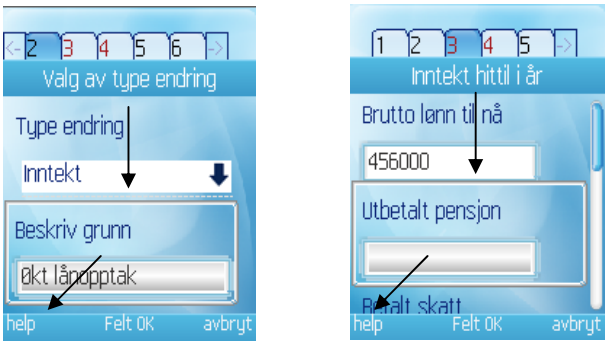

Figure 4 Working area is accentuated by a frame.

Before completion, a field or a card is identified in a colour that differs from the ordinary colour scheme of the design. At any time, the user can at a glance know which cards are not completed. This mechanism also ensures the quality of input data as showed in Figure 5. The colour scheme changes, here from red to black, when the field is completed correctly. The intention is to give the user an overview of which cards are not completed, and feedback about the correctness of the input data.

Figure 5 Changes in the colour scheme indicate invalid input; input field containing '12' and card number '4'.

4.3 Usability and accessibility

Both the web service and the mobile prototype for ordering a new tax deduction card are based on the concept of self-service. An ultimate goal of e-Government-services is to be accessible to all citizens, regardless of their abilities. Therefore special attention must be given to the interaction design and accessibility of the user interface. According to (Obrenovic, Abascal & Starcevic 2007), there is a fundamental connection between multimodal interface design and universal accessibility. A person with low hearing is dependent on visual or haptic information in stead of e.g. audio (e.g. beeps). A visually impaired person needs information presented as audio or haptic (e.g. Braille). It is also advised to utilize several types of media and modalities to ease the comprehension for people with cognitive disabilities

The tax card prototype is developed in a series of iterations. The above description has been developed during the early iterations. To uncover problems with the design, a heuristic evaluation (Molich et al. 2004) and a usability test with 5 young (17-21 years) participants were conducted (Bakken et al. 2007).

In the current version of the prototype, features to accommodate user abilities and preferences are included. The focus is on colours and contrasts, text size and use of audio based help information.

Figure 6 Alternative skin, context sensitive help, audio help information and magnifying current field information.

The colour scheme is connected to the definition of a so-called 'skin', i.e. different colour palettes for the UI. The user can choose between some predefined skins. It is also possible to select among three different font sizes for the application user interface. In addition, several functions are available for the active working area. This is information related to formatting, context sensitive help, a magnifying function for larger text in the active field, and the possibility to get the help information read aloud by choosing the audio icon (Figure 6). Usability walkthroughs have been conducted with 14 users (Hellman 2008). Improvements based on these evaluations are being implemented in the demonstrator.

Making the application accessible to all citizens, disabled and elderly, people with diverse skills and cultural backgrounds require further efforts. In order to accommodate the diversity of needs and use contexts, mobile services should be flexible with regard to modalities and follow accessibility and universal design/design for all standards. A major challenge is to achieve this flexibility without increasing the user interface complexity and thus make the service hard to use.

Another challenge is the interoperability with assistive technology. For example there is text to speech converters which can help visually impaired users hear the content on the device, and other assistive technology which allow for alternative operation (e.g. Braille input and output for blind users). There is a need for open standards and clear advices on how to make services interoperable with assistive technology.

5. CONCLUDING REMARKS

There are a number of factors affecting whether a service provider decides to invest in the mobile channel or not, and whether the user decides to use an electronic service or not. Among these are the relationship with the service provider and the properties of the service itself. Most services are based on voluntary use. Some services such as some governmental services must be designed to be accessible and usable by all users. However, in order to broaden the potential target user population, it makes good business sense for most services to aim at universal accessibility and design for all.

Sometimes it is argued that suitable tasks to be accomplished on the mobile phone are those which can be accomplished quickly, and with little effort. However, one of the advantages of the mobile device is the flexibility and possibility to do bits of work anywhere at any time. By offering electronic services for mobile phones as an alternative to PC-based servers, these services may become accessible for people in diverse situations, and for people that do not have easily access to a PC.

Getting an overview, being able to go back and forth in the workflow and doing bits and pieces, and skipping parts that can wait, all have to do with the workflow and navigation. Rapid feedback and clear error messages which appear as soon as possible after that the error has occurred, support the use of complex services.

In order to accommodate the diversity of needs and use contexts, mobile services should be flexible with regard to modalities and follow accessibility and universal design/design for all standards. A major challenge is to achieve this flexibility without increasing the user interface complexity and thus make the service hard to use. Good standards are necessary both in order to create easily recognizable human/machine interfaces, but good standards should also

contain possibility for profiling and special tailoring of services according to needs and abilities.

The aim of this paper has been to present and discuss central challenges with the design of complex electronic services for mobile devices. We have described a prototype witch implements some ideas. The next steps include further accessibility investigations, profound usability testing, and the development of commercial services for a variety of mobile devices with different functionality, capacity, operating system, screen technology and so on.

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