Profiling User Requirements for Multi-Target e-Government Applications: a case study

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ABSTRACT
The increasing use of the Web as a software platform together with the advance of technology has promoted Web applications as a starting point for improving the communication between citizens and administration. Currently, several e-government web portals propose applications for accessing information regarding healthcare, taxation, registration, housing, agriculture, education and social services, which otherwise may be difficult to obtain. However, the adoption of services provided to citizens depends upon how such applications comply with the users needs. Unfortunately, building e-government web site doesn't guarantee that all citizens who come to use it can access its contents. These services need to be accessible to all citizens/customers equally to ensure wider reach and subsequent adoption of the e-government services. User disabilities, computer or language illiteracy (e.g. foreign language), flexibility on information access (e.g. user remotely located in rural areas, homeless, mobile users), ensure user privacy on sensible data are some of the barriers that must be taken into account when designing the User Interface (UI) of e-government applications. Whilst several initiatives (such as the W3C WAI) focus on how to promote usability and accessibility of content provided via e-government, many governments are enhancing their technology to make their services compatible with new communication channels available through multiple devices including interactive digital TVs (iTV), personal digital assistants (PDAs), and mobile phones. In this paper we focus on this latter issue, which means the development of multi-target e-government services available across several platforms. In this paper we present a case study focused on the development of multi-target e-government services available across several platforms. We discuss the major constraints underlining the importance of investment on the UI's design of e-Government applications.

Keywords
User interface design, ubiquitous services, multi-target applications, design for all

1. INTRODUCTION

The large variety of computing systems available nowadays (e.g. desktop/notebook computers, cell phone, Smartphone) has created a milestone for cost-effective development and fast delivery of multi-target applications. During the last decade, users have become accustomed to new means of service delivery in the private sector. Nowadays, users expect the same level of service availability from the public sector: they want their interactions to be convenient, and they prefer to be online rather than in line [18]. Faced to these expectations, some administrations started exploiting a variety of channels that allow users to consume their services anytime, anywhere and anyhow. However, the decision of deploying e-government services on new communication channels should accommodate competing objectives [9]: to improve the quality of public services and the way in which it serves the community *versus* to reduce the costs of services. In this context some issues highlight the importance of investment on the User Interface (UI) design of e-Government applications:

- Public administration should ensure multiple access points to e-Government applications (e.g. home access via Internet, computer-based kiosks, mobile platforms).
- The ever growing number of users of e-Government applications calls for universal access to e-Government applications. Usability has become one of the major challenges for large adoption of many e-services provided to citizens, in particular those suffering from some kinds of disability or having some literacy barriers (e.g. illiterate users, immigrants seeking information about the country).
- E-Government applications present several advantages for both front office users (e.g. citizens, associations, companies and so on) and back office people (e.g. government employees, administrative clerks) as they reduce costs of information transfer and treatment. Thus front office and back office users are two sides of the same coin. Whilst universal access should be provided to front office users, usability for back office users should not be neglected as some usability problems could cause errors and/or losses of data that might compromise the quality of the whole system.

As far as the costs of services is a major issue, it should not be counted as a simply addition of costs related to implementation, deployment and maintenance of applications but it must include the adoption rate of

services by citizens. A countless number of e-government initiatives worldwide failed because by low technology adoption levels in their communities. Concerned by these problems, a number of recent studies have investigated the general adoption of e-government services in developed countries [5, 6, 15]. It has been shown [13] that faced to the choice of e-government services available in more than one communication channel citizens tend to choose the most familiar option; however, when task complexity increases citizens change their line of reasoning to a thought elaboration between tasks to be accomplished and channel characteristics.

This paper discusses how to envisage scenario for new communication media and in particular, their deployment over many platforms. At the light of a real case study of e-procurement services for students applying for scholarships, we discuss solutions for delivering multi-target user interfaces. Our work is underlined by two main assumptions:

- By focusing on end-users' requirements we can improve the usability of the UIs and select the platforms that best suit their needs, thus reducing the risk of rejection;
- By focusing on users' tasks we can determine the complexity of the steps required to accomplish an administrative procedure and then assess the technical feasibility of deploying tasks on multiple platforms.

2. STATE OF THE ART

In this section we present a summary of the most relevant communication channels nowadays for the e-government domain.

2.1 The World Wide Web Platform

The World Wide Web was the starting point for integrating services available 24/7 while promoting faster and efficient connection between agencies, processes and systems. As far as e-government services are a concern, one can notice several stages of sophistication [3, 9] including:

- Emerging Web sites: much of the information is static and there is little interaction with citizens.
- Informational Web sites: citizens can download forms and documents including law and regulations;
- Transactional: two-way interaction between 'citizen and government' where all operations are conducted online (e.g. web-based tax declaration).
- Full-case electronic case handling including connections with actors involved in the process (e.g. central and local government agencies, direct connection between citizens and governments, and connections among stakeholders).

In the last years, several initiatives try to develop guidelines for developing usable and accessible e-government services [19]. Concerned by the ever growing use of the web as a common platform, the World Wide Web Consortium (W3C) [1] has started recently a new interest group for improving access to government through better use of the Web. Among the activities performed by this new W3C group is the recommendation for shaping up Web applications for delivering content through many communication channels. This interest group is related to previous W3C initiatives on mobile platforms and accessibility; the latter become one of the most important references for e-Inclusion initiatives undertaken by any democracy in the digital era.

2.2 Non-Traditional User Interfaces

The Web is still the primary platform for delivering e-government services but other platforms such as mobile networks and interactive TV (iTV) are quickly emerging as suitable alternatives for delivering e-government services.

The huge penetration of mobile technology (even in developing countries) has motivated many public organizations to make e-government services through mobile devices. Nowadays, there are about 3.3 billion mobile users around the world, and a growing user base, the prospects and possibilities in using the mobile phones as a two-way service delivery platform are incredible. So that the current demand for mobile applications to support e-government initiatives is huge. Mobile phones are sought to foster an innovative method for citizens to interact with Government [14]. Government can provide needed and sometimes life-saving information to citizens via phone or SMS[1] based alerts. Mobile technologies has been used for tighten communication with citizens and organization and for delivering advanced services. For example, the BlueTo application [4] deploys a location-based solution for delivering digital content previously distributed by the public administration on traditional media but including located content to citizens and tourists (e.g. basic tourist information, emergency numbers, and events in the city).

Mobile technology provides many opportunities but it has also lots of drawbacks for example, the screen size and resolution limit interactivity, cell phone can be easily lost or stolen so they are not suitable for storing private data. It became so important in these days that sometimes refer applications in this domain as m-government (for mobile government). However, many organizations are deploying huge efforts to find solutions to foster e-government initiatives through mobile technology, which is often referred as m-government or mobile government[2].

Interactive TV (iTV) is another promising communication channel for delivering e-government services. iTV combines television content with some of the interactivity we are now used to on the internet such as clicking on links. iTV channels are supplied onto a television set through a 'set top box', which sits near the TV [12]. The

[1] SMS: Short Message Service

[2] http://www.mgovernment.org/

interactive element comes from the channels having a means whereby the user can send their own signals back to the broadcaster. This allows users to request different pieces of information, still images or video clips, within a browser environment similar to but less sophisticated than a web browser. TV, after the radio, is one of the most popular and diffused communication channels even in developing country and iTV are expected to replace traditional TV systems quite soon. A typical example of iTV usage in the e-government domain is the system VOICE[3] which is employed in India to disseminate information about government activities and to enable online services (Figure 1).

Whilst the technology of iTV is recent the preliminary results look very encouraging [12]. However, there are also various potential problems with the medium, however: only small amounts of text can be used on each screen, as it is viewed at a distance; it is generally used with a remote control, which is far more restricted than a computer keyboard; and the speeds of interaction are not good. Interactive services may also not be suited to the television viewing habits of many users – unlike the web, TV is a medium often used for recreation or relaxation by several people at once [2]. Making sure that iTV contents and devices are flexible enough so that people are able to perceive, understand and interact with them is an essential requirement for the democratization of information via TV broadcasting.

Figure 1. VOICE application (i.e. ITV systems) for checking information related to birth.

2.3 Multi-Channel Delivery of Services

Most of currently available applications are deployed in a single platform but one of the most remarkable trends is the development of multi-channel services. A typical example of such initiatives is 'Looking Local[4]' (see Figure 2), a versatile application in UK which is accessible at major UK interactive TV platforms (Sky and Virgin), from mobile phones and on some kiosks.

Figure 2. Application 'Look Local' available on interactive TV (at left) and on cell phones (at right).

Indeed, many governmental reports strongly recommend that e-government services must be deployed in many different platforms in order to provide better coverage of services and reach users with special needs [1, 8, 9, 16]. The study launched by the European Union (EU) [9] assessed a very broad range of communication channels supporting communication between citizen and government including: Web, iTV, mobile platforms, call-center, e-mail. It provides a detailed list of criteria for evaluation multi-channel delivery of e-government services (e.g. accessibility and inclusion, speed delivery for time-critical information, etc) and it points out to some best practices. One of the main contributions of such as a study is to classify communication channels according to benefits for end-users (i.e. citizens) but also for administrations.

The deployment of e-Government services through several communication channels can be sought as an ultimate goal for reaching all citizens. However, this diversity offers important challenges such as:

- Constructing and maintaining versions of single applications across multiple devices;
- Checking consistency between versions for guaranteeing a seamless interaction across multiple devices;
- Building into these versions the ability to dynamically respond to changes in the environment such as network connectivity, user's location, etc.

The availability of several communication channels does not mean that applications will convey the same information and services across different platforms. On one hand, technical constraint (such screen size) can prevent the display of large amounts of information. On the other hand some applications can convey information and services through the communication channel that best suits user needs. For example, support online fill-in forms via Web and notify users of approaching deadline for complete procedures via SMS.

3. CASE STUDY

In order illustrate how the difficulties and constraints for delivering services in different communication channel, we

[3] Versatile Online Information for Citizen Empowerment: http://www.ourvmc.org/

[4] http://www.digitv.gov.uk/

present in this section a case study issued by the Regional French Administration Midi-Pyrenées (RMP), one of the partners in the MyCitizSpace consortium. Due to some private issues, some internal aspects are voluntary removed. We introduce all actors involved and their interactions along the process which is enough for our purpose. Our focus is on end-users' (i.e. citizens') requirements for adapting the UI according to different contexts of use.

3.1 Informal description

Vocational high schools offer hands-on training to students and prepare them for careers in fields such as information technology, marketing, business, engineering and the medical professions. However, to attend some technical programs such as Plumbing, Electricity or Cooking, students should bring their own equipment to classes (e.g. purchase of knives, aprons and suits for inn students). BRPE (French acronym for "Regional Scholarship for First Equipment") is a program of RMP which provides students with a scholarship for buying such equipments.

A student can only apply to this scholarship once whilst attending a specific technical program in a vocational high school. However, a second application is illegible if students change to a different technical program. High school's principals are in charge of advertising students about the calendar and procedures and help them to prepare applications. BRPE applicants get forms from high school principals. For students under the age of majority, their parents or legal tutor are the ones allowed to firm the form. The forms and required documents (e.g. bank account statement) are given back to high school principals who are in charge of controlling the completeness of forms and sending the complete ones to RMP. On receipt, RMP agents treat BRPE applications. If the application is accepted by RMP, the accounts department (a state institution distinct from RMP) pays the BRPE scholarship through bank transfer to the bank account of the student (or his parents).

3.2 Analyzing Users' tasks in the procedure

The general procedure required for implementing a BRPE application can be summarized by Figure 3. Like many other governmental programs, BRPE is a complex program that integrates actors with diverse juridical status such as citizens (i.e. students/parents), units of the regional governmental (i.e. RMP), state governmental (i.e. accounts department), and educational units (i.e. high schools) [18]. Educational units are controlled by Education Offices (i.e. "rectorat" in the French system), which discuss BRPE scholarships amounts with RMP once a year. For the sake of simplicity, Education Offices and accounts departments and National Banks will be considered as "state units".

From an administrative point of view, the procedure starts with the annual definition of money allocation for a scholarship which varies according to the technical program. It is important to note that the scholarships are subject to the annual budget approval from the RMP's council (step 2). Citizens do not request BRPE scholarship directly to RMP: the process is mediated by the high school's principal who notifies students (step 4) and explains how they should fill in the form (step 5). Principals are also responsible for checking the completeness (i.e. no required document is missing) and correctness of requests (e.g. attest that students are regularly attending a vocational high school) he gets back from students (step 6). RMP receives student's applications and verifies their correctness and eligibility again (step 8). Problems (e.g. fraud, missing information) are reported to high school principals (step 7) who also can monitor (step 6) the status of applications of students attending program at his school. Eligible applications are duly recorded, and letters of credits are sent to beneficiaries (step 9). Finally, RMP addresses a payment request (step 10) to the accounts department (step 11).

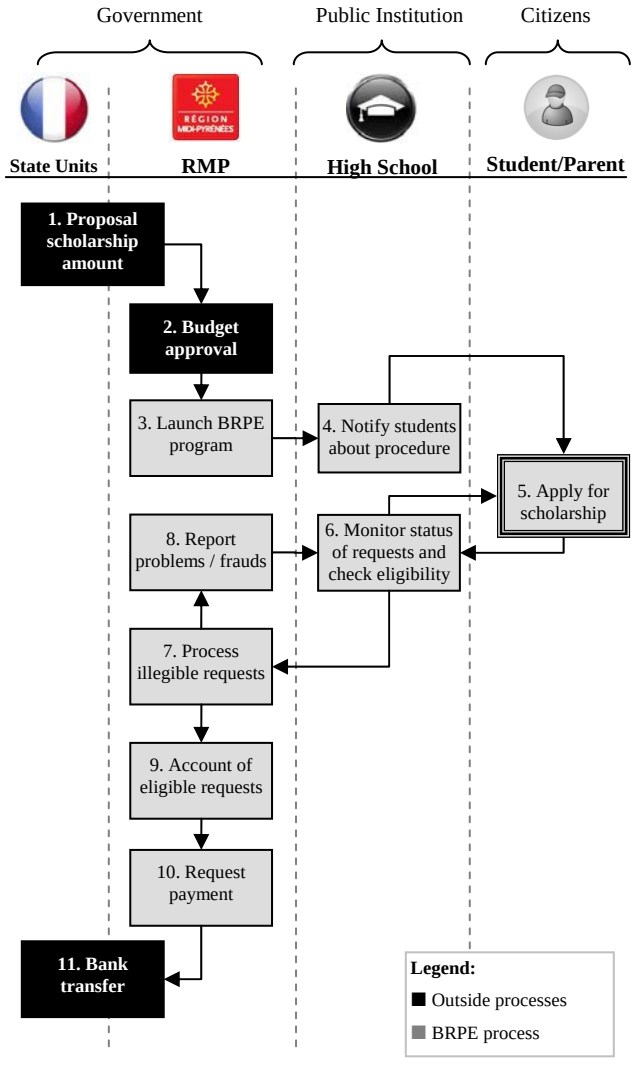

Figure 3. Overview of the BRPE application.

The most important task for users is to 'Apply for scholarship'. Users are requested to perform a set of sub-

tasks to accomplish an application as shown by Figure 4. Notice that tasks can be performed either online or by other means, e.g. 'provide paper-based certificates' (B2).

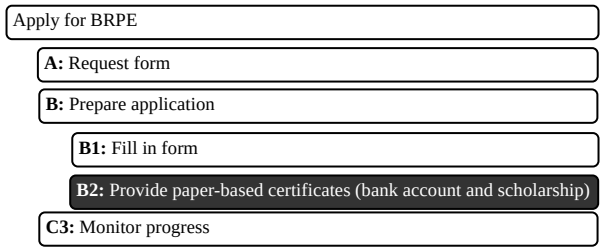

Figure 4. Users' tasks with the BRPE application.

3.3 Indentifying Special Users' Requirements

Much of the success or failure of Information Technologies implementation programs such as BRPE relies on the adoption rate of the applications by the end-users. However, it is clear that some actors involved might have conflicting requirements. For example, citizens would like to have a close contact with stakeholders which might delay the treatment of requests. Table 1 presents some requirements for the three main actors of BRPE. Some requirements such as "ensure eligibility of applications" can be a common motivation to both stakeholders and citizens.

Table 1: Requirements affecting adoption of the BRPE.

Users	Criteria
RMP stakeholders	Costs
	Prevent frauds
	Time for checking eligible applications
	Traceability of applications
High school's principals	Visibility on students applying for the scholarship in his/her institution
	Time for checking eligible applications (e.g. no required information is missing)
	Time for assisting students to filling in the forms
	Pedagogical value of procedures in daily life
Citizens	Ensure eligibility of application
	Time for filling in the forms
	Time for obtaining the scholarship
	Full transparency

Due to space constraints we focus hereafter only on a particular category of users, i.e. citizens. Once citizens agreed on the advantages of applying to a BRPE, we can start investigating how to better provide access to this service and what would motivate them to move from paper based applications to procedures based on new information technologies. Inside the community of users we can identify three main user groups: parents (or legal tutors), students under the majority age and young adults. In order to understand the diversity of users and capture their needs, we have created user archetypes using the "Persona" technique [7]. A persona is a description of a user archetype that is mainly used to communicate requirements with the development team during the design process. A persona archetype can be synthesized from a series of field activities such as interviews and work observations resulting in a representation of an individual that embodies the characteristics of a target user population [11]. For the purpose of this paper, we have created user archetypes (i.e. fictional characters) for describing the main target population of students that might be interested in a BRPE. User archetypes are named after a fictional character to help designers to talk about a specific user profile without having to describe all their attributes. Table 2 and Table 3 provide a example user profiling.

Table 2: Persona "Rémi": archetype of students with no special motivation for using new Information Technologies.

First name	Rémi, the nature boy
Age	16 years old
Nationality	French
Family status	Single, living with his parents in a farmer.
Education	Repeating first year at the vocational high school Saint Paul on Veterinary Scholar Program after failing a first year in a traditional high school.
Information Technology skills	He prefers to surf the Web at school because of the low Internet bandwidth in the rural area where he lives. He gave up with cell phones because of the poor mobile network in the farmer.
Motivation for using new information technologies	He does not have any specific motivation but he knows how to use computer to check his assignments at the electronic kiosk available at the school.
Professional projects	To finish high school and go back to the farm to work with his father.

Table 3: Persona "Sarah": archetype for students that like new Information Technologies.

First name	Sarah, the blogger girl
Age	17 years old
Nationality	Lebanese
Family status	Single, living with his uncle (30 years old) which is his legal tutor in France. Her parents still live in Lebam.
Education	Second year of cooking program in the vocational high school George Sands.
Information Technology skills	She has created her own web site and she maintains a regular blog.
Motivation for using new information technologies	She makes good use of IT for communicating (e.g. email, skype) her parents and friends staying in Lebam. Since she got an iPhone from her birthday, she is using it for surfing on the Web and read emails.
Professional projects	She plans to open her own restaurant.

3.4 Context of Use for the BRPE application

The description of the BRPE application does not imply any particular communication channel. However, we must ensure that implementations of BRPE will fulfill specific users' requirements. Hereafter we present some scenarios that illustrate how the application BRPE could evolve over the platforms Web and mobile (i.e. iPhone) and according to the users profiling described above.

Basic scenario: Rémi is informed about that BRPE system is now receiving new applications. He goes to the school library that is equipped with computers and Internet access. He launches the web application e-BRPE and opens a session. Once registered, he fills in his personal data and selects a scholar program. The next part of the form has to be filled in by his parents as he is under the age of majority. Rémi saves his session. Once back home he can finish the procedure. The system indicates that his application has been submitted to the high school principal. Rémi then provides the principal with specific paper-based certificates. One week later, Rémi is interested to know the state of his application. He goes to the kiosk in his high school where e-BRPE is available. The system indicates that his application is complete and that it will be sent to the RMP. One month later, Rémi receives a letter telling him that his request will be funded. Figure 5 shows the UI for this scenario. The UI remains classic in that it is form-based and centralized in a unique desktop. There is neither adaptation to the user nor to the environment: adaptation is limited to the screen size. It is performed when the user launches the application. The state recovery is the user's session.

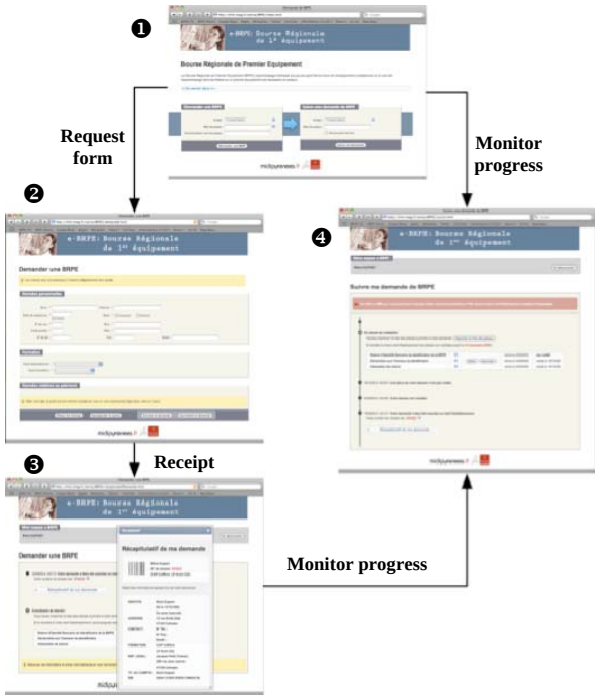

Figure 5. BRPE as it is available on the Web.

Multi-platform scenario: refers to applications that provide is available over many different platforms. In our example, we might consider an e-government service that is available over the Web but can also be accessed via a cell phone. This scenario illustrates adaptation to the platform with effects on distribution and interaction styles. Figure 6 presents an adapted version of the application to be displayed on iPhone. Notice that the form fill is presented in several screens (i.e. 2.a, 2.b, 2.c). On one hand, the limited number of form fields per screen reduces the need of scrolling whilst keeping the text legible. On the other hand, the system can record the information filled across the pages so that Sarah does not have to start from the beginning if he is interrupted by a phone call. In addition, a vocal service is offered with phone platforms. The e-BRPE service is also available over the Web, as presented in the basic scenario (Figure 5).

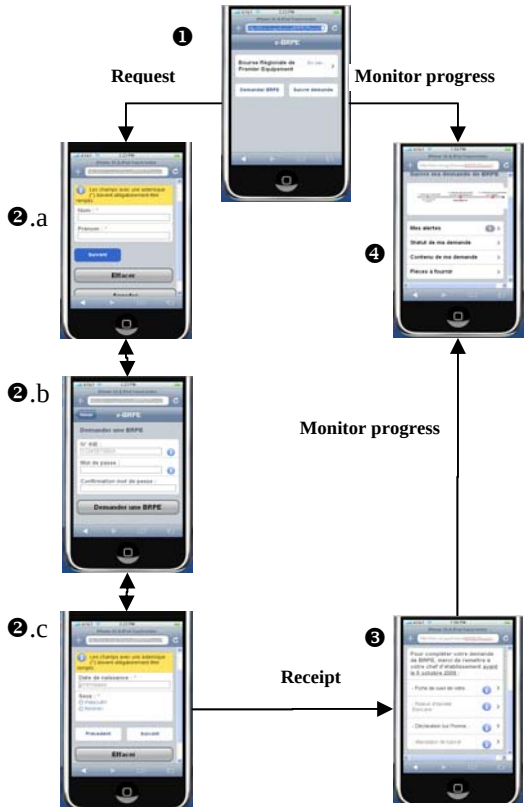

Figure 6. BRPE as it is available on iPhone.

Advanced scenario: in this scenario, the application was conceived to support continuous interaction across more than one interaction technique (e.g. command-line in the web-based version and speech recognition on the cell phone version). The context of use should take into account the changes on user tasks accordingly to the platform. The adaption of the user interface might take into account some unplanned tasks that occur accordingly to, for example, environmental conditions. In this scenario, users can not only decide which platform to use to access the service (the Web browser or a cell phone) but also to interrupt a task on a platform (for example fill in an application form over the

Web) and resume it in another one (for example, monitor progress of applications on a cell phone). For example, the student is informed about the availability of the BRPE at the school and on his way back home he uses his iPhone to apply for a scholarship (Figure 7.1). He starts filling the forms (Figure 7.2.a) but as his battery was too low, he could not fill in all the forms fields. Arriving at home, He decides to resume the BRPE using the Web version because his computer desktop provides her with a larger screen (Figure 7.3.b).

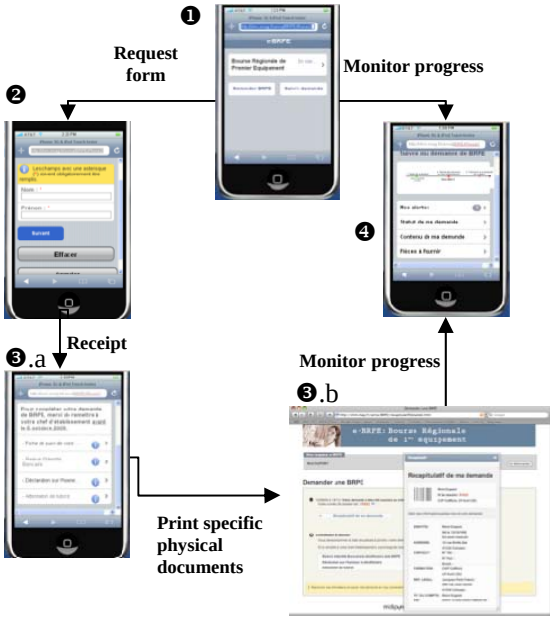

Figure 7. UI migration in BRPPE application.

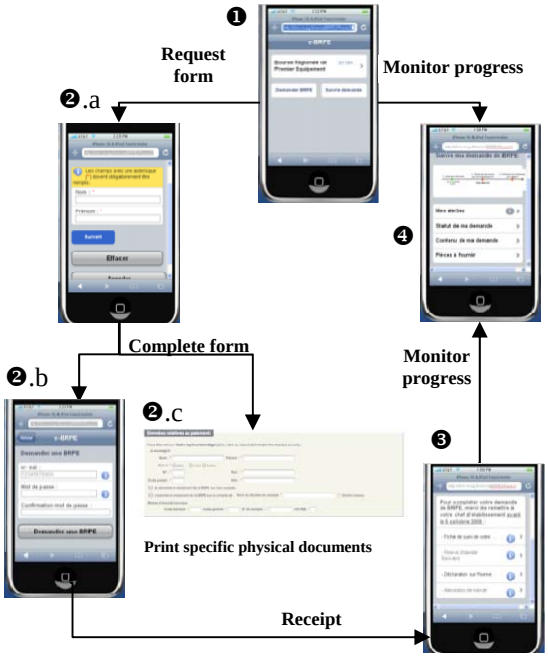

Figure 8 Continuous interaction with BRPE across devices.

These scenarios could evolve to integrate even more advanced interaction techniques, such as the user interface migration from devices. User interface migration refers to smart applications that can migrate via the network from a platform to another [10, 17]. Such as application can adapt the user interface according to the devices constraints (e.g. screen resolution, input devices available, etc.). In this context, the application becomes distributed onto several devices, with different levels of interaction style. The adaptation specifications are weaved into the UI and the user is able to specify the distribution organization. Figure 8 shows the continuous interaction across theses adaptations. This scenario addresses early adopter's needs that are keen to explore the full potential of interaction techniques and devices.

4. DISCUSSION AND FUTURE WORK

In this paper we have presented a case study describing user needs and technical constraints related to the development of multi-target user interfaces for the e-government domain. As we shall see, deploying services on multiple communication channels is not just a matter of technological platform. On one hand it requires a deeper understanding of user needs to propose solutions that fulfill their needs and thus has a better chance to get adopted by the community. On the other hand, there are many platforms available and the best user interface depends on the adaptation of services accordingly to platforms constraints. Currently there is no single answer to the questions such as: 'Which is the best the user interface?' or 'Which is the best communication channel for deploying e-government services?' So that we need a multidimensional space for supporting decision-making. End-user requirements and user interface are useful criteria for grounding decisions but they certainly should be considered in a larger picture than presented here. However, user interface is a key aspect that it worth to be studied on its own dimension before be aligned with business processes constraints, political/social wills, and so on etc.

Faced to the complexity of such as tasks, it seems clear that deciders need some help to find the most cost-effective solutions to delivering services. In the present work, we have grounded our research on a deep review on end-users' requirements which are formalized by the means of Persona archetypes. One of the main advantages of Persona is that archetypes can be easily understood by all people involved in the development of e-government services, from administrative stakeholders, IT experts, decision-makers and even citizens. Based on such as description we can assess credible scenarios that worth the investment on new development.

The case study for the development of the BRPE has lead to successful implementations on two platforms (i.e. mobile and Web). The scenarios presented in the present case study allow us to visualize the continuous interaction

across different platforms. However, it is clear that the development of such as multi-target applications is not seamless and requests an intricate composition of services hosted and distributed among the platform used by the user (e.g. mobile) and on the server. As we shall see, such as distribution is also subject to administrative constraints (in our case study the need of paper-based certificates) that might prevent any kind of electronic process and thus some task should be composed with more traditional administrative procedures.

Our goal is not propose a definite solution to the problem but rather to exemplify some challenges one is faced to whilst trying to conceive multi-target user interface for e-government services.

This work is part of large national project which aims is to provide a framework for developing the next generation of user interfaces for application in the e-government domain. Based on this experience we have started some generalizations towards a plasticity space for multi-target user interface for the e-government domain. Future work will include refinements on criteria for helping administrations to better chose communication channels for e-government services. Additional work will be done to explore the user interface adaptation on promising communication channels (not exploited here) such as the interactive TV.

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