eChallenges e-2012 Conference Proceedings
Paul Cunningham and Miriam Cunningham (Eds)
IIMC International Information Management Corporation, 2012
ISBN: 978-1-905824-35-9

User Toolkits for Citizen-centric Mobile Service Innovation

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Abstract: Around the world, there is an ongoing shift from en economy focusing on product development to an economy with focus on digital service development. An ongoing initiative in Europe to support this shift is the Internet of Services (IoS) which strives for a situation where everything that is needed to use a software is available as a service. The aim of this paper is to present a toolkit that non-programmers can use develop their own innovative mobile services. This environment strives to put forth a situation where technologies are made available as components that easily can be composed into a mobile services by just about anyone. This has tremendous impact on the feasibility of citizen-centric services where citizens create apps based on their current needs in their contemporary situation.

Keywords. Toolkits, Citizen involvement, Service Innovation, Visual Programming, Internet of Services, Inclusion

1. Introduction

All around the world, there has been a huge shift from a product-based economy to an economy based on services, especially digital services [1]. This is a result of the diffusion of computers and the pervasive Internet, which in combination provides a digital infrastructure that facilitates new and different ways of developing and distributing digital services to a wide range of potential users. One ongoing vision to support service innovation throughout Europe is Internet of Services (IoS). Internet of Services means that everything that is needed to use specific software applications should be available as a service. This includes the software itself; the tools needed to develop the software, as well as the platform to run the service. By this anybody who wants to develop applications can access necessary resources by the Internet of Services paradigm to develop and distribute

those applications. This approach to service innovation has benefits since it for instance, lowers the investment costs for companies and it also makes it possible to develop an innovation based on other people´s efforts. When Internet of Services is fully developed and implemented it offers great opportunities for developing services that citizens need and want to use.

In the process of developing innovative services for citizens it is important that the service offers an added value to its users [2]. As a way to understand what creates value for the citizens it is important to involve them as early as possible in the process. In this paper we will report on a project striving to take one additional step towards Internet of Services by offering a tool for service development in which citizens can develop their own mobile services.

The value of involving users in the development process has been recognized by several researchers. Von Hippel [3, 4], for instances, has reported that users developed 80 % of the most important scientific instrument innovations. The value of user-involvement has also been acknowledged by Shah [5] who found that the most commercially important equipment innovations, in four sporting fields, tended to be developed by users. These examples indicate the importance of involving users and taking user-experiences and expressions seriously in innovation processes. To stimulate and facilitate this co-production user toolkits for innovation have been developed. Toolkits are defined as a set of user-friendly design tools that makes it easier for the user to design a product or service through a trial and error process [6, 7]. There are user design toolkits which operate in diverse markets such as semiconductors and integrated circuits [7], computers [8], computer games [9]; online travel systems [10], skiis [6], watches [11], and custom food [7].

The aim of this paper is to present a new type of toolkit for service innovation that makes it possible for users without coding skills to develop their own innovations in the form of mobile services. The toolkit has been developed within an EU Structural Fund project called SATIN II (www.satinproject.eu).

The remainder of this paper will start with a section on service innovation and the significance of this area. The paper will continue with a discussion of user involvement and toolkits that supports innovation processes. Thereafter, a presentation of the SATIN II project and the platform developed in the project is given. Finally, a discussion of the lessons learned from this project is presented.

2. Service Innovation

Within the area of service innovation the drivers are changing from production of hardware to production of services. Service thinking is one of the fastest growing areas and the end-user spending on IT services was expected to have a 6.4 percent annual growth rate through 2010 and reach $855.6 billion [12]. Thus, the economic future can be expected to rest on services. According to Aas and Pedersen [13], the service industry accounts for more than 70% of the GNP and employment in most developed countries and researchers agree that service innovation is critical for both service and manufacturing firms´ success, both in the short and long [e.g.14, 15, 16].

For companies' survival in a long-term perspective, it is important to turn to innovation in services, which can mean to wrap a service around a product, or re-imaging a product as a service, as software-as-a-service firms have done and by that shift their innovation focus from products to services [17]. At this stage, services are the only thing that can sustain differentiation in a competitive environment that commoditizes products almost as fast as they emerge.

There are several reasons why the service area will continue to grow. Rai and Sambamurthy [18] state that in the highly competitive market where globalization, rapid product and service innovation leadership, operational excellence, and customer intimacy

are important drivers of competitive performance, firms are discovering that they have significant structural barriers to agility and competitive performance [18]. The growth in services is also fueled by firms using it as a defense against the standardization of products and as a strategy for productivity, growth, and retention. A critical enabler of this growth is the convergence of different kinds of IT [19].

The concept of services as such has been defined in many different fields such as marketing, economics and information technology [18]. In this paper we focus on digital services the following defintion: a digital service is obtained and/or arranged through a digital transaction (information, software modules, or consumer goods) over Internet Protocol (IP) [1]. The difference between "normal" services and digital services include [1]:

- Being digital, at least for a portion of the interaction
- A different sense of tangible vs. intangible
- Often the digital service is a coordination or arrangement of something physical
- The idea of ownership is subtler including digital rights for a certain purpose vs. outright ownership.

3. Users as Actors or Factors

The idea of what actually is the "user" of a service has a strong influence in the services to be designed. Different interpretations of the term have occurred over time and within different communities. Thus it may be useful to take a closer look at the evolution of the idea of the user. Until the latter parts of 1990s the users were mainly seen as users of a system needed for work-related activities. This has now changed rapidly which means that the perspective of the user needs to change. Today the user needs to be viewed, not only as a person with rationality and reason, but also as a human being with emotions and needs for pleasure and self-expression. A user do not use a service for the sake of the service, they use it as a means to fulfill an important goal. A user has a set of values, goals and beliefs about life and work, hence, viewing users as actors emphasize their role as an autonomous agent with the capacity to regulate and coordinate their own behavior [20].

Involving citizens into the service innovation process is a promising strategy for companies as they strive to develop services that answer to the citizens ever-changing needs and requirements. Research studies show that citizens are remarkably creative and innovative [21], some have even challenged the traditional R&D departments when it comes to the strategic success of developed products [22, 23]. This process of citizen involvement often results in a process of co-design or co-production for the purpose of attaining added value [24]. When designing citizen-centric services, different involvement strategies and perspectives could be applied depending on the purpose of the citizen centricity.

Kaulio has identified three different types of customer involvement: design *for* customer, design *with* customer and design *by* customer [25]. Here, we choose to replace the word customer with the term citizen since the toolkit explored in this paper is directed towards citizens in general and it is not a company behind the toolkit earning money.

Design *for* citizens means that products and services are designed on behalf of the citizens. To understand the citizens and their needs, general data, models, and theories of citizens and their behavior are collected and used as input to the design. Specific citizen data and/or requirements are elicited through interviews, focus groups, and observation. Citizens are consulted, but do not actively participate in the decision making process. The citizens play a relatively passive role; the designers elicit information from them in order to produce a relevant requirement specification and obtain feedback regarding produced items.

Following the Design *with* users approach products and services are co-designed by designers and citizens. The sharp distinction between citizens and designers has lost its

edge but usually there are still noticeable differences in their roles and responsibilities. The designers still have the more active and controlling role, especially in relation to initiating, staging, and running the process. But, when it comes to the control over form and content and to some degree the solution space, the citizens have a strong to equal voice.

When it comes to Design *by* users products and services are designed by citizens with support from designers. Here, the citzens become the innovators and to some extent the designers while the designers become facilitators with the role of enhancing the citizens' possibilities of developing a service that meets their expectations and fulfils their needs.

4. User Toolkits for Citizen-centric Service Design

Within the area of citizen involvement it is now possible to discern a trend moving from designing for citizens towards starting to develop processes and tools for designing by citizens where they are given toolkits to design their own desirable solutions [41, 42]. With this shift in perspective, it is becoming progressively easier for many citizens to get precisely what they want by designing it for themselves. In this approach it is important to give innovative citizens ways to combine and leverage their efforts since innovation by citizens tends to be distributed rather than concentrated among a few innovative persons. One way for users to achieve this is by engaging in different forms of cooperation.

To stimulate and facilitate this co-production user toolkits for innovation have been developed within different areas, such as computers [8], computer games [9] or watches [11]. One important dimension differentiating these toolkits is their scope. The scope of a toolkit describe the citizens innovation possibilities [26].

Initially toolkits were developed as a way to decrease costs related to sticky information when it comes to understanding users needs [27]. User toolkits aim to assist users in designing their own custom service [28]. Despite the variety of available toolkits, existing research suggests that there are a number of common objectives or features that all toolkits should aim to have [7, 10]. They should build on a customized design language that does not require much additional training for the user; they should offer users a "solution space" that encompass the innovations they want to create; they should contain libraries of commonly used modules that the user can incorporate into his or her custom design; they should enable users to carry out complete cycles of trial-and-error learning; and they should ensure that custom products and services designed by users are easily manufactured or implemented by the hosting organization.

One part of succeeding in designing a citizen-centric toolkit in order to attract a broader group of citizens, is to find ways to support inclusion, related to gender as well as diversity. We need to challenge ingrained gender roles and avoid preserving stereotypes throughout the design process. Phases where these aspects are to be considered are while recruiting test subjects, when communicating with them, in the examples and environments tested, realities referred to, and evidently in the actual design regarding terminology as well as features that support both male and female strategies when they use citizen-centric toolkits.

In a number of studies, debugging and mashup programming behavior and strategies have been studied, focusing on gender differences in particular [29, 30, 31]. Some of the results point in the direction that females benefit from taking a comprehensive view, while males are more likely to take an opportunistic approach choosing the most salient feature in an interface. Another difference observed is that males tend to appreciate and use dataflow strategies, while females are more appreciative of code inspection strategies [31].

If we expect e.g. an ordinary female to try out a citizen-centric toolkit, the aspects mentioned above has to be considered in an attempt to adjust the toolkit and adopt an inclusive approach.

5. The SATIN II Project

In October 2009 the project SATIN II started. The aim of this project is to create a tool for non-programmers to create applications using modern web-tools, which are to be consumed in a mobile setting. The SATIN II project provides a good example of a user-centric environment for building mobile applications using a visual interface. This three years long Swedish project is funded by the EU structural funds, the County administrative board of Norrbotten, the Norrbotten County Council and the City of Luleå. In this project, SMEs, academia, and citizens are interactively collaborating. The aim of the project will be met by developing tools, business models, and new architecture for mobile service creation. Special care and measures will be taken to increase the share of women engaged in the regions IT-industry. The project focuses on three areas: - Technical platform, - Business aspects - User participation.

5.1 Mobile Application Development - Background and Trends

How are applications developed for mobile consumption? First of all, what is a phone? A clear trend is that we will get a number of new high-end devices during 2010-2011 and onwards that are a hybrid between phones and laptops, e.g. the Apple iPad as well as the several Android based devices with 5-12 inch touch screens. This will allow users to use the same applications on both their day to day-to-day phone (typically iPhone or Android based phone) as well as on other types of devices. We here assume that the mobile application future lies in modern phones with high capacity (a lot of RAM and storage, GPS, WIFI, Camera, various types sensors etc.) and thus the project will not support "older" types of phones even if they are produced and sold.[1]

Secondly, we have to take a look at how successful mobile application vendors develop their applications. One observation here is that most of the development is done fast and swift. Develop an application and release it in several steps, i.e. release early, release often. By doing it that way feedback from early users can be incorporated into the final application and this method is the proposed way of working in the SATIN II project.

Currently, many applications developed for a modern mobile setting are developed as downloadable applications distributed via various online markets (e.g. Apple App Store or Android Market). The reason for this is not purely technical as in many cases the same functionality could just as easily be created using modern HTML5 features. It is important to note that much work is currently being done on extending the HTML5 standard with support for many typical native functions that earlier only were available in native applications (geo-info, background processing, advanced graphics handling, data storage etc.). This division between native applications and pure HTML5 applications is something that is addressed within the SATIN II[2] project, but we foresee that initially only purely web-based applications will be supported.

Finally, an additional clear trend is towards the real-time web where data is delivered to readers as soon as it is published. This is already seen for social applications where updates are distributed directly, and this is something that will move into more 'advanced' applications in the future. An example can e.g. be that changes in collaboratively authored documents are shared in real-time with all interested parties. How this is applied in the mobile field is a very interesting problem and this challenge is something that needs to be addressed within the SATIN II project.

One very interesting idea to make application development more open and social is that one developer might release an early draft of an application (fully running and working)

[1] E.g. Symbian is still the operating system in a large number of phones being sold today.
[2] www.satinproject.eu

and others might change and contribute to the application after it has been released. Compare this to collaborative web page development, or a social media application (e.g. Google Buzz or Facebook) where different users collaborate and generate the 'final' content together. An extension of this is to allow running applications collaboratively and making all SATIN II applications shared and collaborative by default.

5.2 Technical Building Blocks

The SATIN II architecture is divided into 6 primary building blocks, as described below.

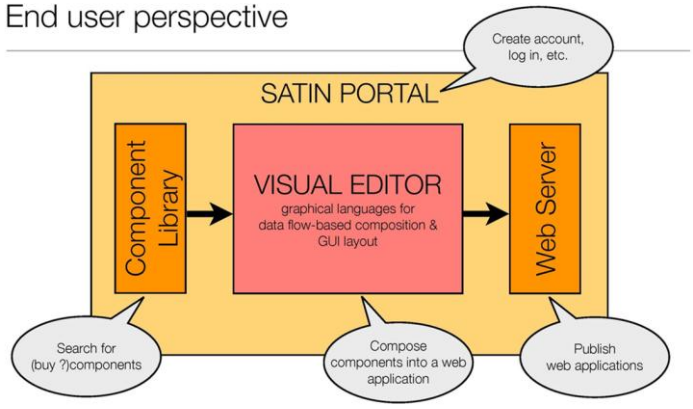

Figure 1: SATIN User-toolkit Architecture

5.2.1 The Services Components

The SATIN II environment will include a number of service components that can be used in the application editor to create new applications. The service components will be added to the SATIN II environment initially by members of the project itself and later by allowing service providers to add new services using a web interface.

Open technical and research questions include:

- How to specify the components, i.e. name, functionality, icon, financial constraints etc. An interesting metaphor is the usage of Intents in the Android environment where separate applications be integrated into a richer user experience as well as extended with new functionality even after the application has been deployed on mobile devices.
- How to specify the service level of the component. What will happen if the component relies on some external source and that source is no longer available? How quickly will the component be fixed?
- How to handle financial constraints where the usage of the component will incur a monetary cost.
- How should the service component be certified? Should a developer just be able to upload a new service and then based on feedback be graded as good or bad? This method is used successfully by the Android Market, with the benefit that components can be published and updated without any delay. Another alternative is to follow the Apple App Store model where each application is pre-certified via testing by humans. This creates a delay in publishing and also puts a bigger financial burden on the SATIN II environment provider as human resources are needed.

5.2.2 The Application Editor

This is the most important and critical part of the whole SATIN II environment for the project to be successful. It has to be very easy for the user to create new applications by combining service components. We need to allow users to simply drag-and-drop

components and very easily combine them into something "useful"[3]. For example, it has to be easy to understand what a service component does by just looking at the icon and very easily be able to get more information about the service. It is also important not to overwhelm the user with a lot of boxes and popups, and instead let the user focus the current operation at hand. Various wizards can be beneficial at initially to help the user get going. The SATIN environment needs to be not only easy to use but also attractive to a broader group of users. How to design for diversity and inclusion are important aspects and therefore, special actions are taken to integrate gender equality and diversity perspectives in the design work.

Something to keep in mind, is that not all users will have an understanding (initially) of sequential programming as well as typical logical programming and the editor should also cater to this group of non-technical users. What this implies in practice should be further researched.

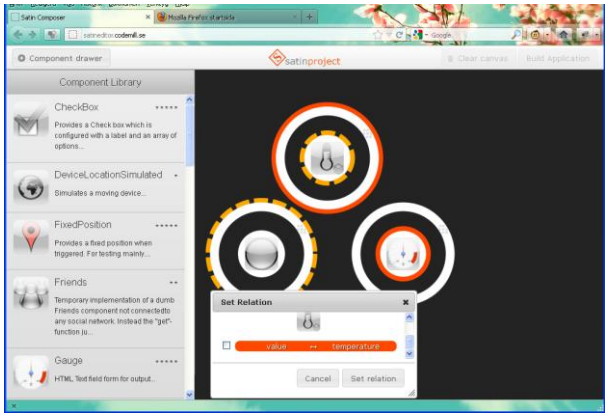

Figure 2: SATIN Application Editor

5.2.3 The Execution Environment

Some services will require backend support and in some cases this will be provided directly by the service component provider (i.e. the running component will communicate directly with the service providers servers). Other components might require the application to be run in an execution environment provided by the SATIN II project. An open question here is if the project should provide such an environment or if it should rely on some external execution engine, e.g Google App Engine to which the SATIN II environment could automatically upload applications using the Publisher building block (see below) or the service provider could be encouraged to use that kind of external execution environment directly.

5.2.4 The Publisher

After the new application in built using the SATIN II editor, the application has to be published to be available to end-users. Depending on the type of application that the editor generates, various paths are needed. For instance if a native application is generated it is natural to provide a means for the application to be automatically published on the Apple App Store and/or the Android Market. Integrating towards these environments is rather straight forward, especially the Android Market which has an open API for publishing.

Another view of the publisher is to provide a package that can be deployed on the execution platform described above. Exactly how this should be handled depends on the execution environment itself and is left for further discussion.

[3] The term ‘useful' is very subjective and individual to every user of the SATIN II application.

5.2.5 The Shopping Window

Independently of where the application is published there will be a need for the user of the SATIN II environment to promote her application, either to a small selected group (friends or family) or to the whole world. We foresee the need for such a Shopping Window in the SATIN II project where added-value might be that the user can aggregate information about her applications independently of where they are published (various online markets) and also might want to aggregate several applications into one published package.

Just like a real physical shopping window, it is important to allow for the user's SATIN II shopping window to be customizable to allow for creating a specific look and feel. This is an area where a lot of effort can be invested and can be rather costly for the project.

5.2.6 The Application Management Area

From the users (application developers) point of view it is important to be able to organize finished applications or applications that are under development. The environment should for example, make it easy to separate between applications under development, published applications and off the market applications. We also foresee a need for evaluation support and collaboration during the development process, e.g. by social media.

5.2.7 The Integration Part

It is important to remember that for the SATIN II project to be successful, it cannot live in an isolated world and it has to allow for integration with other environments on various levels.

There will be a number of similar application environments out there and instead of competing with these, the SATIN II environment should instead try to be open and allow for integration with these the environments. We should strive for an openness where e.g. SATIN II service components could be published in other similar environments, or applications developed using other editors should be importable into the SATIN II environment.

6. Discussion

This paper presents one way to accomplish citizen involvement in service innovation processes by means of toolkits. Firstly, involving citizens in innovation processes has proved to contribute to innovation processes by providing both more knowledge and more innovative ideas that can radically transform the end result. Secondly, using toolkits that support innovation processes also contributes to creating more innovations. Thirdly, giving the right users the opportunity to develop services they need themselves and thereafter having the opportunity to distribute this service to others, offers great opportunities for service innovation. This type of solution may also attract a diversity of citizen groups with different interests such as interests in providing service components, interests in developing their own services, or interests to buy and use what others have developed. Hence, the usage of toolkits for service innovation offers great opportunities to an increase of innovative services being produced as well as consumed by citizens on a broad scale.

The SATIN II environment can be seen as an example of what is being made available within a couple of years, where technologies are made available as components that easily can be composed into mobile services by just about anyone. This has tremendous impact on the feasibility of citizen-centric services where citizens create apps based on their current needs. It also shows that co-creation is technically feasible and that a market for components and configurable apps can be made available on both private and commercial terms.

7. Further Work

Since this environment is under development there are many aspects that need to be researched further to contribute to its success. For instance, it is important to look into possible business models for this type of environments, where possible ownership is an important aspect since it has to be maintained and promoted on a broad scale to create success. It is also important to study how gender equality and diversity perspectives benefit this type of environment and make it more attractive for both men and women.

The SATIN II environment provides normal users the means to create mobile services, which fuel the capacity for innovation in an area where traditionally professionals have been required. At the same time the challenges for managing the increasing amount of devices (the Internet of Things) will need to be faced, driven by individual needs. The emergence of open government data, directed towards citizens in general, also puts forward interesting future scenarios where the digital data can be made available to a larger group of citizens for use in the development of new digital services. All this needs to be studied further, beginning with understanding how services based on sensors and actuators change peoples' daily life and then how not only mobile services but also smart (pervasive) environments can be created by using the SATIN II editor.

Related to gender differences, we suggest that a comprehensive view in the SATIN II editor might be accomplished by displaying only the most vital features. Also organizing the features in a logical way can be fruitful. Familiar features from other interactive systems with similar functionality could also contribute to a comprehensive view. Besides the editor, peripheral functionality such as forums, chats, and introductory tutorials might support vicarious experiences for novice users, in order to strengthen their self-esteem. Tinkering, which is a well-known behavior for learning, can be supported by easiness to undo and redo, start over, and look at other people's results. Finally to motivate users to actually investigate in the effort needed for reaching a finalized product, we must find ways to support the feeling that the effort is not too hard, and that the products developed are worth the while.

From an initial study of the Satin II editor, it was obvious that one of the great challenges for the users was to understand how to connect components. Users wanted to put them close together, on top of each other, or connecting them with some kind of string. None of this was supported in the editor, instead one had to click a certain area of the component to initiate at dialogue dealing with connections. This problem remains to be studied, both conceptually and technically, in order to come up with a design that supports a comprehensive view, and a tinkering style of interaction.

Another design challenge is to support understanding the whole process from how to start and finish the development, and then downloading the application to a Smartphone.

The last obvious challenge was how to present components, how to describe them in a way so that novice users could grasp their functionality, and how to use them in a composition of several components. Crucial in the description of components is also the highlight demands to be met in order to connect one component to another, something that needs to be obvious and easy to understand.

All these features and design choices remain to further investigate.

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