

Quality of services and citizen profiling in e-Government

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Abstract: This research, still in progress, aims at increasing e-government services (e-Gov services) appropriation through recommendations for design of adaptive interface for e-Gov services.

In order to reach this goal, we propose to focus our research on e-Gov services quality, considering the fact quality is one of the most critical dimension which influences website usage. This is particularly true when website addresses e-government services, where confidentiality, quality and information authenticity are crucial. The e-Gov services quality measure is then a major stake for public administrations if they want to promote e-Gov services use to citizens.

The paper proposes a methodology in several steps. At the end, we must be able to propose a quality model for e-government which will be derived into several set of perceived quality models, trust models and acceptance models, corresponding to different user's profiles. Moreover, we propose to identify interaction way that is the most suitable for user regarding their profile. To do that, we will define some interaction characteristics that have to be taken into account, such as interface form, dialogue structure, manipulation preferences, errors treatment... and then propose interaction typologies depending on user's typology model.

In the mid-term, our objectives are to provide tools and methodologies to support European eGovernment. This research could help designers and developers in producing better quality services regarding the e-governance objectives and to benefit from recommendations closer to reality.

Keywords: quality, e-services, e-Government, user profile, appropriation, adaptive interface, interaction

1. Introduction

Deploying online administrative services, already begun in the early 2000 in several countries, is actually a main stake for all governments (Lu, Bai & Zhang 2007). E-Government goals are huged and a number of individual, social as well as political perspectives is often mentioned (Jaeger & Thompson 2003).

Since a few years, it is possible for numerous administrative procedures to be performed remotely over the Internet. The benefits can be considerable for governments that want to increase their process efficiency as well as for citizens that can interact with public administrations more easily and comfortably. For example, e-Gov services enable people with disabilities and people living in rural areas to improve their living conditions by enhancing access to information and services. Based on the use of information and technological communication increase, the Commission of European Communities (CCE) proposed in 2006 (Commission of The European Communities 2006), a E-government action plan putting forward 5 main goals for 2010:

- carry on efforts regarding e-Government, in order to allow everyone, including socially disadvantaged groups, having access to online services;
- increase users' satisfaction regarding public services, and reduce significantly administrative tasks for businesses as well as for individuals;
- give the opportunity to any public administration in Europe to spend 100% of their procurement electronically;
- give the opportunity to any businesses and individuals, in Europe to benefit from electronic means, secure and convenient, in order to be able to identify themselves to public services in their own country or in any other member state;
- reinforce the participation and the democratic process in Europe through electronic voting.

Today, in 2011, results seem to be positive, even if all objectives have not been reached. This is particularly shown through a study conducted by the "Caisse des dépôts et de l'Association de l'Economie Numérique" (l'Acse), published in 2010. According to this study, 60% of French internet users are using online service to do their tax return and 46% of them consult their social security account online. Moreover, 96% declare that they trust e-government services, which represent a higher score than for online bank services (69%) or e-commerce (only 51%). However, this study also

show that these results are mainly positive for certain users' profile, and that other profile are on the contrary more reticent, and that specific studies have to be conducted in their direction, in order to promote e-Gov services use.

Therefore, since both governments and citizens have a shared interest in e-Gov services, it is important to ensure that services provided meet citizens' needs with maximum efficiency and satisfaction. In other words, the issue of e-Gov services appropriation seems fundamental. By appropriation, we mean "the process by which people incorporate advanced technologies into their (work) practices" (DeSanctis & Poole 1994).

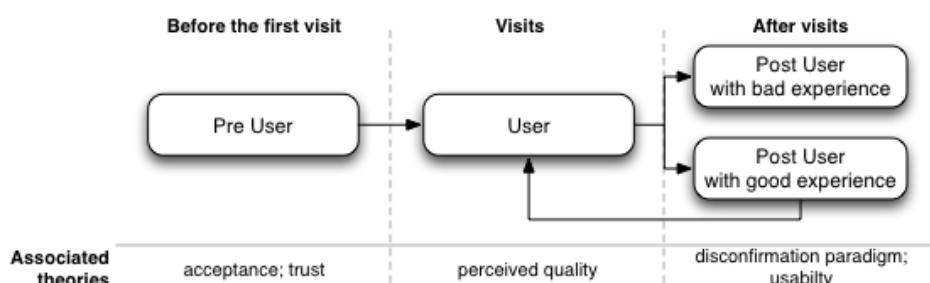
In order to answer to this question (e-Gov services appropriation for the largest number of citizens), and based on a previous literature review (Gronier & Lambert 2010), we propose to consider the quality of e-Gov Services as a starting point. In the proposed approach we will target the e-Government websites adaptation to different users' classes, through citizens profiling. Sometimes called e-Profile, user profiles can improve e-Gov services with the delivery of trusted and personalized services (Pettenati, Pirri & Giuli 2010).

2. E-Governement Service Quality

Satisfaction and loyalty to a website are in response to a number of criteria for the individual. While visiting a site, it is possible to distinguish several stages which the individual passes through before deciding whether or not he/she will return to this site. At each moment during navigation, different cognitive processes will sequentially occur in the individual, which will lead him (or her) to decide at the end of the visit if the site has or has not met his/her expectations.

The concepts such as acceptance, trust, usability of the site or perceived quality are all variables that will be involved in assessing the online service.

Figure 1 illustrates these different points of navigation and the main cognitive mechanisms involved by the user. The review of literature that we are presenting therefore aims at showing how they can improve the adoption, use and appropriation of e-Government services.



2.1 Acceptance and e-trust as factors in the use and adoption of e-Government services

System acceptability is often considered a key factor in the success or failure of a development project for a new technology, and more specifically for an e-Government service (Hamner & Qazi 2009). In fact, technology is external to humans, and it is necessary to accept it in order to use it.

Acceptance refers to the attitude and intention that will decide whether or not to implement an usage behaviour for a technology. The first to have modelled this concept are (Davis, Bagozzi & Warshaw 1989), with the TAM, "Technology Acceptance Model". The TAM predicts the individual acceptability of new information systems by future users, and diagnoses problems that may hinder the system being adopted.

The authors started with the premise that the perceived usefulness and ease of use of technology were influencing our attitudes, which themselves were influencing our usage intentions, and are therefore a prediction of our actual use. Fishbein and Ajzen's (1975) theory of reasoned action laid the foundation for this model.

However, according to (Legris 2003), many criticisms are raised regarding this model, such as the fact that it only takes into account the subjective aspects while omitting the importance of usability, or that it is too deterministic and not social enough. These flawed aspects have fostered other models.

Thereby, the P3 model "Power, Perception and Performance" (Dillon & Morris 1996) aims to meet the same objectives as the TAM, but takes into account both subjective and objective aspects, such as users' perception of the actual usefulness and usability of technology. At present, according to (Brangier, Hammes-Adelé & J.-M. C. Bastien 2010), the model that combines the most of other

models, and best explains the usage intention of a technology, is the UTAUT - "Unified Theory of Acceptance and Use of Technology" (Venkatesh 2000).

Trust in the online service, often called "e-trust" or "digital trust", is also a factor influencing the use and adoption of a site. According to (Bélanger & Carter 2008), we define trust as "an expectancy that the promise of an individual or group can be relied upon". The authors add that trust in e-Government is therefore composed of the traditional view of trust in a specific entity (trust of the government) as well as trust in the reliability of the enabling technology (trust of the Internet). (McKnight, Choudhury & Kacmar 2002) demonstrated that consumer trust in electronic services influenced their transaction intentions. Trust depends on a combination of factors, such as the level of use, the use of standards, reputation, and past user experience with e-services.

2.2. Quality as a factor in the adoption and use of e-Government services

Service quality is a fundamental marketing element to understand customer satisfaction. Specifically, individuals will evaluate the perceived quality, which can be defined as a subjective assessment, in the same way that a consumer will make about the superiority of a product.

Measuring the quality of online services has been the subject of many models. The SERVQUAL model (Iwaarden van 2004) is perhaps one of the most widely used to measure the quality of online public services. Based on a dichotomy between the service offered by a client and the service perceived by the user-consumer, SERVQUAL has been applied to many industries and has undergone some modifications (Li, Tan & Xie 2002).

Other models have also been proposed to evaluate commercial sites (Webqual, Sitequal, E-Qual, E-tailQ, ES-Qual, etc.). However, the criteria that define the quality of services offered by these models seem too generic, and do not sufficiently take into account, for example, the interface quality or elements that promote interaction. Furthermore, no scale of the perceived quality of e-services has specifically been developed for e-Government services. However, (Liu, Du & Tsai 2009) emphasize that a model developed for one type of service is not necessarily applicable to another type. Also, e-Government services have several characteristics of their own:

- they respond to a social demand (United Nations 2008) and therefore must be particularly attentive to peoples' expectations;
- they are the extension of an existing physical service. Therefore, people are still able to choose whether to use the physical service or online service;
- in addition to the efficiency principle, e-Government services incorporate the equity principle by remaining accessible to all citizens, consequently, the public sector cannot exclude any category of the population;
- the physical government service cannot be abolished. This comes from the fairness principle. The e-Government service should therefore be considered as related to the physical service;
- e-Government services have no competition. Therefore users cannot compare the quality of several e-Government services (Wang & Liao 2008);
- users of e-Government services would be more heterogeneous in terms of socio-demographic characteristics than users of commercial websites.

Consequently, e-Government services differ from other types of e-services by the nature of the service offered, their intrinsic characteristics and the characteristics of their users.

2.3. The concept of usability and satisfaction as a factor in the long term use and adoption of e-Government services

Although often underestimated, usability plays a major role in the adoption and use of e-services (Corradini, Polzonetti, Re & Tesei 2008). Usability (Norm ISO 9241-11) is defined as: "the degree to which a product can be used, by specified users, to achieve defined goals with effectiveness, efficiency and satisfaction in a specified context of use". Ease of learning and memory were subsequently incorporated into that definition by (Scapin & J. M. C. Bastien 1997).

Literature thereby puts forward the following observation: the ease of using a human-machine interface or a website influences the use of this technology (Brangier, Hammes-Adelé & J.-M. C. Bastien 2010). Usability problems that may be encountered could influence his/her use.

Usability is therefore a key element, which promotes individual performance, error reduction, technology acceptance and user satisfaction (Corradini, Polzonetti, Re & Tesei 2008). When applied to government services online, usability is described as "an assessment of the relative "ease with which a novice user interacts with a public agency website to accomplish the user's goal(s)" (Baker 2009). According to (Corradini, Polzonetti, Re & Tesei 2008), the quality of e-Gov sites is largely a

product of usability and the effectiveness and efficiency provided by the site.

3. Adaptive interfaces

In the previous part, we have proposed a literature review on quality models definition in order to be able to better take into account users' needs. However, as the research proposed here intends to have an impact on the development of adaptive interfaces; we have to complete our state of the art, by a study of existing researches in this domain.

3.1. General approach to personalisation, adaptive interface and profiling

Applications or services personalisation proposes a user adaptation, targeting his preferences, interests and needs, as well as his own characteristics. Any personalisation process first needs a profiling stage, i.e. a user model and its instantiation to each specific user representing then its profile. In a second step, the adaptation itself consists in providing the user with relevant information at the right time and in an adapted format. This adaptation stage is generally separated into two main classes: information filtering and application modification. Current systems are more specifically developed for general public, and mainly concern recommending systems, or information retrieval (on the internet or for training courses (Mitchell, Caruana, Freitag, McDermott & Zabowski 1994).

Concerning the profiling approach, researches mainly focus on the way to identify user profile during the interaction. This profiling could be either explicit, i.e. edited by the user, either implicit, i.e. determined by behaviour and interaction analysis (Teevan, Dumais & Horvitz 2005). An explicit profiling can be obtained through electronic questionnaires or interviews, while implicit profiling requires logging user activity, analyzing it and deduct useful behavioural patterns, interests or preferences.

The explicit approach is intrusive and suffers from the bias of the evaluation doubts. The implicit approach is more effective than an explicit profiling and does not need human intervention (at least only a little). However, this approach suffers from "the cold start" problem and needs a large amount of data in order to converge towards an effective user profiling.

Several approaches are proposed in the literature concerning data collection and analysis regarding users' profiling. Mainly (Gauch, Speretta, Chandramouli & Micarelli 2007) propose an interesting state of the art on recent approaches as well as an overview of classical profile formalisation modalities.

A good compromise can be achieved by using both explicit and implicit approaches. Additionally, an interesting solution can be found in the use of stereotypes (Rich 1979). Stereotyping allows to group users by broad categories of similar profiles. As a consequence, regarding computer implementation, two approaches are possible:

- Create these stereotypes by grouping similar users' profile after an implicit profiling;
- Determine a priori stereotypes, and then use them as an initialisation of the implicit profiling process, overcoming then the "cold start" problem.

These two approaches can also be combined in a loopback, the initialization being based on a priori stereotypes, refined through a posteriori stereotypes grouping. In addition, a posterior stereotypes grouping can also be performed through methodologies used in collaborative filtering, such as clustering, neural networks or evolutionary approaches (Adomavicius & Tuzhilin 2005).

In the project, the profiling stage will be conducted focusing on the evaluation of parameters defined by the perceived quality model through priori stereotypes, as well as by the definition of interaction typologies, explicitly and implicitly as we will now describe in the following paragraphs.

3.2. Personalisation and interaction

Nowadays, Human-Computer Interactions are part of our everyday life, from computers to mobile phones, and in the near future, they will be practically in every artifact. There is a proliferation of devices, acting in more and more different contexts and interacting with more and more users, thanks to the ever-going technical breakthroughs. This propagation of electronic devices tends to complicate interaction paradigms and leads to lose users' attention.

In order to make the user focus on his task among a set of devices, new interaction paradigms came as a response, such as the "pervasive computing" (a.k.a. "ubiquitous computing" abbreviated "ubicomp"). Introduced for the first time by (Weiser 1995), this interaction paradigm describes seamless interactions between the user and his surrounding electronic devices to an extent that the devices' presence is omitted by the user. While "pervasive" and "ubiquitous" literally means "manifesting throughout everything", by speaking of pervasiveness or ubiquity, Weiser is also referring

to the seamless aspect of interactions.

3.2.1 User Interface Adaptation

Interfaces adaptability is not a new subject. During the last years, a lot of studies have been carried out on the subject, but they were mostly oriented on Adaptive Hypermedia Systems (AHS). (Brusilovsky 2001) works focused on what can be adapted (content and navigation) and on adaptation methods and techniques. Since, these works have evolved and multiplied (especially applied to web sites). Besides the generic context, interface adaptation can be executed at different levels, namely at the user and device ones. According to our research, we will focus only on the user.

3.2.2 Interface adaptation according to the user profile

One important source of interface adaptation perspectives consists in the study and modeling of the user profiles. It includes his identity information, his preferences and interests as well as his capacities. The user profile can also be useful to define user disability, as an example a visual interface will be adapted into an audio interface for a blind; or some set of colors will be never used for a color-blind. Adaptation work will focus on the different interaction channels now available on mobile devices (e.g. entry: keyboard or tactile screen, vocal command, body movements).

Adaptation to user profile implies modeling the user and profiling it, explicitly by asking for his personal data or preferences, or implicitly. As it relies on an analysis of the user behavior, implicit profiling is more efficient in the sense it is not biased by the inherent uncertainties of human assumptions.

3.3 E-Government problematic

However, we can notice that these researches focus mainly on the software architecture and algorithms (Calvary et al. 2002). (Thevenin & Coutaz 2002) have proposed taxonomy related to Human Computer Interface adaptation, where notions such as « interaction », « presentation » « dialogue controller » are mentioned. However, these aspects are only put forward in a software architecture perspective.

For their part, (Hariri, Lepreux, Tabary & Kolski 2009) mentioned the concept of « database design patterns », fundamental to any adaptation process. As shown through these studies, having interaction model is then a base for adaptive algorithm. The underlying question is then: on which bases these concepts of “interaction, presentation, dialogue controller,” as well as “design patterns” should rely on? Indeed, before constituting these databases, we must still identify the data that would be stored in.

In order to answer to this problematic, it seems essential to identify the interaction types corresponding to users' needs. This means, that we should be able to link user' profile to interaction profile, and then identify underlying characteristics that should be present for e-Gov services and more specifically in our case for e-Gov services.

The study proposed in the present project eProfiler, will mainly be based on such an approach; drawing interaction typologies adapted to e-Gov services which could then be used as inputs for the adaptive interfaces domain. Our study will be based here on literature references in the interaction domain and which mainly concern:

- dialog mechanisms (menus, natural command languages, question/answer, direct manipulations, forms, etc.) (Sears & Shneiderman 1994);
- way to manage the dialog (information filtering, information flow management, interaction objects management, environment management, etc.);
- information presentation (visual characteristics – size, position, colours – notation conventions, data format);
- help functions: Out of error (comprehension help, feedback, online help, navigation, warning) or in case of error (When, why, task performed percentage, task backup, cancellation, etc.);
- tasks type (selection, positioning, orientation, path, quantification, text acquisition, images acquisition);
- metaphor use (Carroll, Mack & Kellogg 1988). This domain is not new, and establishes Human Computer Interaction bases since a long time and is always subject to actual studies, which will need to be carefully analysed.

4. Methodology proposed

In order to improve the quality of e-Gov services, we propose a methodology based largely on the user, in this case, the citizen. The main objective is to understand the factors that determine the appropriation of e-Gov sites and to ultimately be able to increase the appropriation and use of online government services, through adaptive interfaces.

We describe below each step of our methodology, which will be applied to Belgian and Luxembourgish e-Gov services.

4.1 Identify user's profiles and classes

The first step of our methodology consists of a preliminary study that will identify different profiles of potential users of e-Gov sites. The data needed to characterize user profiles will be collected through an online questionnaire, which will gather the following data:

- demographics (age, gender, socio-professional status, etc.);
- data on frequency of use;
- data on their experience of Internet use in general, and e-Gov sites in particular;
- statistical analysis (Hierarchical) with SPSS software.

Three classes of potential users may be identified *a priori*:

- regular users of e-Gov sites;
- infrequent users, for instance those who have visited an e-gov site at least once but who did not return, following, for example, a bad experience or low satisfaction;
- individuals who have never visited a government website.

4.2 Understand use and not-use of e-Gov services

The second stage is to collect qualitative data in order to understand what may or may not influence the use and acceptance of e-Gov services. These interviews will be conducted by taking into account previously identified user types and the reasons that motivate or do not motivate them to use these online services:

- semi-structured interviews;
- flanagan's critical incident technique following interviews. This technique (1954) in its original context can detect incidents that operators have deemed critical to a stage of their work. This methodology will include potential bad experiences with e-Gov services;
- focus groups.

4.3 Model of e-Gov services quality

The third step is to substantiate questionnaires from the existing models (models for perceived quality, usability, acceptance, trust, etc.). In order to do this, the methodology aims to:

- review literature and select 10 scales from different models;
- identify an e-Gov site;
- administer online questionnaires, relating to an identified e-Gov site;
- statistical analysis (linear regression).

4.4. Perceived quality and interaction typologies validation

This step will propose some recommendations for the adaptive interaction domain declined for e-Gov services. However, we think that such recommendations should at least be validated through concrete experiments. Since some years now, the Wizard of Oz paradigm has been used with success in complex natural-language systems study and more recently in spoken dialog systems (Winterboer, Tietze, Wolters & Moore 2010). This technique can be viewed as a rapid prototyping technique where the system answers are implemented but simulated by human actors.

This technique consist to propose to the user a system which answers are simulated by a human (the wizard), but, in order to study real situation, to let the user think that he is interacting with a real system.

4.5 Recommendations for adapting e-services interfaces

The main objective of our project is to improve quality of e-Gov services, through several recommendations for adapting e-services interfaces. Using the previous steps, we will have two essential types of information in order to improve e-services: on one hand, user's profiles and on the other hand, different types of interfaces in accordance with profiles. Thus, it will be possible to provide exact information about what information and how to propose them to a particular type of user. In other words, we can provide recommendations for adapted interfaces, and to a longer-term for adaptive interfaces.

For example, these recommendations will take the form: "if the user is a male over 45 years, with little Internet experience, the interface must include elements which increases his trust with the e-service, and must be reduced to only essential information needed to service for which he is connected". Of course, this example is not based on any experience and is given as illustration. These

recommendations will take the form of guidelines, which will be freely available to e-Gov services.

5. Expected results and conclusion

The research aims at facilitating e-Gov services and to improve their appropriation. The appropriation concept is here proposed as the cognitive, organisational and social mechanisms that lead a user to integrate a technology (e-Gov services in our case) in his practices, through spontaneous answer. The main idea is to provide citizens with online services that better meet their expectations in terms of quality. Three main results can be put forward:

- the first result aims at establishing a citizens' classification in relation to e-Gov services quality. Many ergonomics recommendations addresses Web interfaces, works on this subject are consistent and many heuristics and criteria have been defined (Scapin & J. M. C. Bastien 1997). However these recommendations, like quality models, are formulated for the benefit of all internet users, independently from their profiles. We propose to cover this gap, by identifying citizens' profiles, in order to develop a set of quality models as well as recommendations for designers.
- the second result will lay the foundation for the design of a dynamic interface dedicated to e-Gov services. As shown in the state of the art, the problematic of adaptive interface is mainly concerned by software architecture considerations but less is mentioned about interaction model underlying this question. The underlying objective is to propose an interaction model as well as interaction typologies adapted to e-Gov services which would be used as inputs for adaptive interfaces;
- the third result concerns the improvement of perceived quality and appropriation of egovernment websites and online e-government services, through a new model of e_gov services quality included trust, acceptance and usability aspects. In fact, very little research to date focuses on the concerns of public administration and in particular on increasing the use of e-Gov services. New elements of understanding relating to the reluctance towards or adoption of government sites will be identified from the user-centred approach that will be adopted. Moreover in recent years the concept of acceptation, trust, perceived quality have not been rehabilitated or reworked.

The following table shows an example of what could be our result. We will identify the quality criteria of their respective e-Gov service and the interaction will be adjusted according to these criteria. In this case, we illustrate the example of post-users. The table will be completed and is in progress.

		Profile 1	Profile 2	Profile 3	Profile 4	Profile n...
Pre user	Quality criteria	<i>i.e : usability,</i>	<i>i.e : trust in e-gov</i>	<i>i.e: perceived usefulness, usability</i>	<i>i.e : perceived quality</i>	<i>i.e: availability of information</i>
	Interaction element	<i>i.e : limit the amount of information on screen</i>	<i>i.e: strengthen the perception of safety data</i>	<i>i.e: highlight the services available</i>	<i>i.e : citizen efficiency, usability, design of the web site</i>	<i>i.e: citizen support, availability of system</i>
Post user with good experience	Quality criteria	<i>in progress</i>	<i>in progress</i>	<i>in progress</i>	<i>in progress</i>	<i>in progress</i>
	Interaction element	<i>in progress</i>	<i>in progress</i>	<i>in progress</i>	<i>in progress</i>	<i>in progress</i>
Post user with bad experience	Quality criteria	<i>in progress</i>	<i>in progress</i>	<i>in progress</i>	<i>in progress</i>	<i>in progress</i>
	Interaction element	<i>in progress</i>	<i>in progress</i>	<i>in progress</i>	<i>in progress</i>	<i>in progress</i>

The objectives are numerous; nevertheless the main goal is to provide tools and elements for assessing and improving the appropriation of e-Government services. To finish, the interest of this research is that results may be extended to other sectors that also have this type of organisation (e-commerce, e-services, etc.).

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