

# Validating the user-centred design process within a developing context

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## ABSTRACT

South Africa is a developing country with diverse multi-cultural communities, eleven official languages and various infrastructure challenges. Enabling e-government is therefore considered a unique problem. A critical approach in developing a solution entails applying human computer interaction principles to cultural dimensions in South Africa. This paper illustrates how the user-centred process can be validated within a developing context. A paper-based government service was transformed into an e-government service by carefully applying the model of ISO 13407, *Human-centred design processes for interactive systems*. The usability thereof was evaluated through heuristic testing.

## Keywords

e-government, user-centred design, human-computer interaction, heuristic evaluation, cultural dimensions, telephony interface

## INTRODUCTION

Governments worldwide are under extreme pressure to reduce spending on civil service provision. In addition, citizens are demanding that the same governments not only improve, but also expand existing services.

A principle way to solve this problem cost-

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effectively is by innovative use of information and communication technologies (ICT). We believe that governments have no other alternative but to transform themselves into citizen-centric e-government entities.

The successful establishment of e-government is divided into the following four stages [4]:

- *Stage One* involves the government disseminating service information to citizens via the web.
- *Stage Two* involves setting up an ICT-based two-way communication through which citizens can provide less sensitive information (changing of addresses, filling in applications, etc) to the government.
- *Stage Three* involves expanding the communication channels of Stage Two by enhancing security and privacy on the information exchanged.
- *Stage Four* involves integrating several services into entities based on needs and functions, and not on departmental structures.

The South African government has arguably completed Stage One: information has been disseminated through the media and most (if not all) government ministries, departments and related organizations have well-established websites. The government is therefore ready to be taken into Stage Two. This paper discusses the implementation of a process that established a two-way communication for information exchange with citizens via telephony interfaces.

## PROBLEMS IN SOUTH AFRICA

South Africa is a developing country, with multicultural communities [6]. Rural communities and communities in informal settlements are under-served by most government departments. There exists a need for efficient e-government service delivery. While some services (e.g. pension collections) are provided in local community centres, there are still many more important services that are not as accessible. Two workshops were held exploring unique South African needs with respect to e-government. One explored cultural implications and the other usability requirements.

## CRAW AND HCI WORKSHOPS

Delegates from universities, technikons, rural educational centres and national libraries, with expertise in both sociology and computer science, participated in the cultural rendering aspects workshop (CRAW). This workshop identified the local requirements for successful e-government implementation and the cultural issues to be considered when designing user interfaces. The key factors highlighted include: gender, age, environment and geographic location, functional literacy, accessibility, trust and community buy-in[2].

A second workshop on human-computer interaction (HCI) revealed the importance of usability to address the discovered cultural constraints. This workshop engaged usability expertise in identifying usability goals, user experience goals and user pragmatic goals important to telephony interfaces. Deliberations centred on effectiveness, efficiency and satisfaction, and how they can be measured on telephony interfaces when being used by South African citizens in under-served areas.

## FACTORS AFFECTING SERVICE DELIVERY

To understand fully the implications culture has on government service delivery, the concept of culture must first be defined: “*culture is the shared patterns of behaviours and interactions, cognitive constructs, behavioural norms, expectations and affective understanding that are learned through a process of socialization. These shared patterns identify the members of a culture*

*group while also distinguishing those of another group*” [3].

Consider Hofstede’s Dimension of Culture [8], [5]. In his theory, Hofstede identified dimensions of cultures that can be applied to user interfaces:

- Power-distance
- Collectivism vs. Individualism
- Femininity vs. Masculinity
- Uncertainty avoidance
- Quantity vs. quality of life

In spite of the very complex power struggles in many sectors, including political, social and organizational, South Africa has a relative *power hierarchy* because of the high disparities between the poor and the rich. With the social changes taking place in the country, South Africans in urban environments tend towards *individualism*, where individuals are inclined to heed only their own and their immediate families’ needs. People in the rural areas however, are still surrounded by the culture of *collectivism* because in most cases they reside according to their kinship. If a family struggles economically for basic necessities, the neighbours or relatives would provide some form of assistance to the family.

While South Africa can be viewed as having a *masculine* culture, it must be noted however that the definition of masculine and feminine roles differ depending on community definitions. To a certain extent, some of these definitions are breaking down more rapidly in urban city communities.

Arguably, South Africa has *moderate uncertainty avoidance* as highlighted by Lebogang Mashile, a Sociologist at the University of South Africa. There are those people who are afraid of taking a risk and those who are prepared to take a calculated risk. For those who avoid taking a risk, they fear the unknown and so feel safe in their comfort zones. The level of community buy-in strongly affects this dimension; winning a community’s trust, their co-operation and participation can prove to be a difficult hurdle to overcome.

*Quantity versus quality of life* would have a similar argument to that of individualism versus collectivism in the South African context. Hofstede views both dimensions as representing a dichotomy. In South Africa, urban people value quantity of life because for them being assertive, acquiring money and material things is important for their lifestyle. While people in the rural areas put emphasis on the quality of life because they value relationships and show sensitivity and concern for the welfare of those around them.

Studies carried out by CPSI [1] concerning access to government services have shown that individuals from rural and previously under-served areas prefer interacting with a human intermediary rather than a computer. Individuals are more accepting of a system that is simple, user friendly and not technologically intimidating. What is preferable is presenting services using an interface with which users are familiar.

The geographic location of government offices provides another hurdle to service delivery. People living in rural communities have to take long journeys to access services, costing them considerable amounts.

Functional literacy has been defined as the ability to use reading, writing, and computational skills at a level adequate to meet the needs of everyday situations [10]. Many South Africans, while being able to identify letters in the alphabet, are unable to read or write well enough to apply this knowledge in a useful manner. Considering that most government services are currently paper based, being functionally illiterate poses a complex problem.

The above cultural dimensions, technology accessibility and acceptance potential were studied to find an optimal solution for service delivery.

### **TELEPHONY INTERFACES**

Stage Two of the e-government establishment can be carried out using a number of interfaces, such as Internet-based, mini-ATMs or telephony interfaces. Telephony and Internet-based interfaces require considerable cost and effort on the part of the government, however they will be

using already existing infrastructure. The mini-ATMs will require a huge amount of infrastructure installations, additional user training, and most probably, additional staff. The targeted users have more access to telephones than to computers in South Africa: in 2001, there were about 365 mobile and fixed telephones per 1000 people, in comparison to about 70 personal computers for every 1000 people [10]. There are also more public phones than public computers at various places. Therefore telephony interfaces are more accessible than the Internet and that is why the telephony interfaces were chosen.

A telephony interface, or computer telephony interface (CTI), is the means by which users access services from a computer system through a standard telephone [12]. This interface is easy to use, it supports multi-modal input, it caters for multilingual and multicultural issues and it requires minimal user training. There are mainly two modes of input into the telephony interface, Dual Tone Multi Frequency (DTMF) and Speech Recognition (SR).

DTMF mode, or Touchtone as it is widely known, transmits user input from the standard telephone handset (numbers 0-9, A-D, # and \*) using a set of frequencies. Every input is represented as a combination of a low frequency (697, 770, 852 or 941Hz) and a high frequency (1209, 1336, 1477 or 1633Hz). This mode is limited to 16 characters, requires literacy and does not support personalized call flows. Nevertheless, it performs well under background noise and it offers a higher degree of privacy and accuracy with respect to user input. In addition, some financial institutions are already making use of these interfaces, resulting in some targeted users already being familiar with them.

With the speech recognition mode, the user provides input in the form of speech through a standard telephone headset. This input is then captured, filtered and digitised for use by the computer system. Speech recognition offers speaker dependant, continuous speech, barge-ins, automatic adaptation and multilingual interactions [12]. Furthermore, it supports natural and personalized interactions. But it is vulnerable to background noise and sound attenuation over

telephone lines [11]. It must be noted that speech recognition technology has not reached absolute accuracy. Speech recognition is part of the wider area of speech technology, which also includes speech synthesis and speaker verification.

With the two interfaces, the user is presented with choices. The DTMF mode will be a good choice for submitting sensitive and private data and for situations where there is a substantial amount of background noise. Speech recognition will most likely be chosen in cases of less private input, less background noise environment, text-input oriented interactions and for use by visually impaired users.

### THE IMPLEMENTATION PROCESS

Different government services were considered and the Unemployment Insurance Fund (UIF) service was chosen as a pilot. The choice was based on the fact that the UIF service has been widely publicized over the past eight months, the information exchanged during the service does not require the highest degree of privacy and security and the service is applicable to a wide range of citizens. Furthermore the UIF registration and claim processes are familiar to most South Africans.

A successful implementation of e-government specifically in South Africa, taking into account its challenges, is only possible with a user-centred approach. For this reason the ISO 13407 *Human-Centered Design Processes for Interactive Systems* was carefully studied and applied. It is worth noting that ISO 13407 can be applied to both waterfall and iterative type of development process [7]. In this instance it was applied to an iterative and incremental process where *heuristic evaluation* and actual *user testing* served as the measuring yardstick to usability.

Budgetary, human resource and other necessary planning actively allowed the process to be carried out. As a validation measure, the implemented system must be able to offer *at least* all components of the current UIF service *but* at less cost, reaching more clients and making it available over longer periods.

The project stakeholders (representative users, developers, project manager, psychologists, and

usability expert) were then invited to attend the CRAW. The intended context of use was discussed and agreed upon. Specifying the context of use specifically to a multicultural, multilingual nation proved to be both challenging and educational. Since a telephony application is language and voice driven, the eleven official languages were used as one dimension for identifying user groups. Universal life style measures (LSM) descriptors were also used as a dimension [9]. Factors such as age, education, geographical locations and others identified in the cultural rendering aspects workshop were further divided into more specific groups. In total, one hundred and ten groups were defined as the user population.

In specifying the user requirements, the existing government procedures were studied and were then mapped to processes and flow diagrams. These flow diagrams were simplified to fit within an ideal service delivery world, which illustrates the user goals when using the system. By limiting the problem domain (i.e. addressing only one government process and a subset of the user groups defined in the context of use), HCI and task qualities as well as effective task performances were the areas of focus. These usability goals are key to developing a system to achieve the user pragmatic goals (i.e. trust, feeling good, being effective etc.), thus it is very important to define these goals with care and considerations especially with regard to a multicultural audience.

A paper-based design was developed. A carefully selected panel of people, with various backgrounds, then evaluated this version heuristically. The results and comments of this heuristic evaluation were then documented for incorporation into the next iteration. That marked the end of the first iterative cycle. Valuable comments and suggestions were received from the heuristic evaluation reviewers who evaluated the system against various usability criteria specifically aimed at telephony interfaces. A general consensus among the evaluators was that the overall usability of the system was very good. Specifically one area that did receive a lot of criticism was error messages and error prevention.

Other areas that might need more attention were the natural flow of the system and the user's control and freedom when interacting with the system. With results and comments from the first iteration, updates are made to the context of use as well as to the user and organizational requirements. Thereafter, a functional prototype will be developed and heuristic evaluations will be executed again, before the third iteration can commence.

### CONCLUSIONS

The state of e-government in South Africa is ready for an ICT-based two-way communication through which citizens can provide less sensitive information to the government. Critical consideration of cultural aspects and HCI factors is key to setting up this communication. The disparities between rich and poor, urban and rural offer a dichotomous view of cultural dimensions and how they relate to issues of access, the issues driving the success of e-government service delivery in South Africa. Moreover, the interpretation of the cultural dimension considered inter-links with HCI. It affects the usability of telephony interfaces, DTMF and SR, in the South African context. However, a user-centred design approach is useful in positioning e-government service delivery in South Africa.

### NEXT STEPS

This design approach will be carried through further iterations on the interfaces under development. The extent to which culture and HCI can impact e-government will be uncovered through further refinements implemented in future iterations. Once satisfied with the system and the result of our research, the system will be demonstrated to various governmental departments and other stakeholder. Thereafter a process of extending the demonstrator to a fully functional system, which will be accessible to all South Africans, will be initiated.

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