FACTORS AFFECTING THE USAGE OF T-GOVERNMENT SERVICES
An Exploratory Study

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Abstract: Developing humanly acceptable information and interactive systems is a complex process where testing from the outset, the setting of operational criteria for efficiency, effectiveness and satisfaction, the development of prototyping etc., has to be considered as the central activity of a field implementation. Design and operative alternatives can be effectively selected and long-term targets can be seen to be attainable. However, sometimes it happens, especially in the domain of information system implementation, that obtained datasets can be effectively utilised to reach more tailored purposes. The case of interactive T-government services at the Municipality of Parma is analysed aiming to redesign the analysis model about the factors affecting the usage. To this respect one of the most recognized ICT predicting models in the literature is utilized. Final results show the success of the methodology and encourage further developments and applications in contiguous areas of ICT designed for residential population.

1 INTRODUCTION

The following study has been designed to be an exploratory study into aspects of T-government services usage among residential users. It aims to generate new groups of variables from a pre-existing dataset which can address the analysts towards different and reasonably more tailored purposes. The method and the first results here presented are part of a larger work still in progress, moreover having the objective to investigate the usability and economic factors affecting adoption and usage of T-government services.

With reference to the emerging ICT usage, it may happen, especially in the domain of information system implementation, that achieved datasets, even rich and widely aimed to support the design of technologies compatible with users' abilities and needs, cannot be applicable to more complex and different kinds of analyses. Reasons can have different justifications, nevertheless it is usual that different theoretical positions do not all share the same views even in the same research domain.

Hence there can be different orientations, even with respect to a similar target of an investigation, which can carry to a wide range of final resultant datasets, i.e. different for study typology, for structure, for procedures to submit/collect data, for user profile, for task design, for boundary conditions, and so on.

T-government stands for a wide set of services addressed to citizens (e.g. about health, education, tourism, bills payment), delivered by a Public Administration and accessible by Digital Television.

The piloting research program on DTT (Digital Terrestrial Television) in Italy has been developed through a number of initiatives (Section 2.1), some of them issued to explore the potential impact on population of the new digital services associated with the broadcasted TV channels. In that field of investigation, T-government interactive services were introduced to be early tested with a real sample of residential private adopters of the digital TV decoder. A large amount of data were processed to investigate how residential end-users reacted to the usage of T-government services and they perceived their added value. Specifically, the results pointed

out how, in some cases, the usage of the services was to some extent low assessed. A significant difference in the usage was also found between informative and interactive services.

These findings have been the input for the current investigation about the factors affecting the usage. The study was carried out by comparing the UTAUT model (Unified Theory of Acceptance and Use of Technology, Venkatesh et al. 2003) with the real data of the basic questionnaire, the one applied to the Italian T-government project named "Parma Municipality Services" (Section 2.2), in order to redesign the analysis model.

The UTAUT model (Section 3) is a proved, reliable representation from social psychology, concerned with the determinants of acceptance and usage behaviour of new adopters of emerging information technology. It was applied as reference to cluster and re-code the relevant variables from the pre-existing dataset into new groups of indicators (Section 3.1). The indicators thus generated, were those of T-government, concerning respectively interactive services and informative contents. At last they were tested both for significance and construct power to check if they effectively meet the reference model basic requirements (Section 4), so verifying that structural differences may be sometimes overcome to start more complex analyses.

2 T-GOVERNMENT SERVICES

T-government services are herewith categorised as "informative services" (e.g. provision of general information) and "interactive services" (e.g. searching for specific information, e-mail, chat, form filling and form sending, payments).

Most of T-government services that have been so far developed are informative services.

One of the opportunity given by T-government is to promote the use of ICT-based public services by large groups of people (e.g. the elderly), who have no Internet access or the required skills of using. For those people, the past experience with TV and remote control may be a key qualification to become effective users of the above services.

On the other hand some studies (Damodaran, 2002) make evident the gap of knowledge about the human aspects of T-government services: usage and usability, user satisfaction, the capability of services to reach all citizens and the capability to include them in the benefits of information society.

On these topics some field investigations have been developed in Italy in the framework of the T-

government projects promoted by Centro Nazionale per l'Informatica nella Pubblica Amministrazione (CNIPA) and Fondazione Ugo Bordoni (FUB).

2.1 T-government Field Investigations Developed in Italy

2.1.1 CNIPA Projects

In Italy, in 2004 CNIPA allocated 7 million euro in order to co-fund T-government projects based on DTT and addressed to the general public. As in the case of the advanced applications co-funded by FUB (3 million euro), such a competitive call came from a joint initiative of the Minister for Communications and the Minister for Innovation and Technology.

The experimentation carried out by CNIPA is mainly oriented to transfer on the DTT platform existing e-government services. Twenty-nine informative applications were selected and co-funded, with a total amount of investments exceeding 32.5 million euros. Correspondingly, 13 regions, 25 provinces, 164 municipalities and 15 mountain communities along with 40 local and national broadcasting corporations were involved. These funded projects aimed at the experimental implementation of several services for the citizens.

The services considered within projects can be grouped into five classes:

- social services: health care, social assistance and disability, third age, jobs and occupations;
- environment and tourism: environment, tourism, traffic congestion and cultural events;
- education: nursery schools, kindergartens, schools and universities;
- relationships with Public Administration: institutional activities;
- "Agorà": citizens and elections.

Within several projects, interactive services exploiting back channel (reverse/return channel) and smart cards have been experimented.

As to the users involved, particular attention has been devoted to people having limited opportunities of accessing the Internet, users with disabilities, old people and people looking for their first job.

2.1.2 FUB Projects

One of the objectives of the six T-government projects co-funded by Fondazione Ugo Bordoni (FUB) was to experiment high interactivity T-government services, realised by Digital Terrestrial Television (DTT), involving real users.

The high interactivity T-government services provide the user with some of the following features:

- remote interactivity using the return channel;
- high performance return channel (e.g. broadband or wireless);
- user authentication using a smart card (e.g. electronic identity card, services regional card or other kind of smart cards);
- on line payments.

The experimented services belong to different application areas: demographics, utilities and fines, education, T-health, T-learning, employment, T-commerce, T-banking.

In order to investigate usage, usability and socio-economical aspects of T-government services, an explorative field investigation was developed in each of the six projects.

The field investigations were realised using a common framework referring to human factors discipline (Papa & Spedaletti, 2001). The following main usability aspects related to interactive services were identified (Papa & Spedaletti, 2004): perceived usefulness, perceived ease of use and attractiveness, training and user support (human support, user manual, support provided by DTT, call center), user perception of technical disturbances and troubles (due to television signal, set top box, return channel), security and privacy perception (confidentiality of personal data, security of payments), impact of the equipment in the house, users' satisfaction about the service including the comparison of different channels to perform the same task (e.g. DTT versus Internet, DTT versus traditional office desk).

Service usage is related to whether a given service is used or not and to the service utilisation level. Service usage is evaluated collecting subjective data provided by the user. The adopted indicators for service utilisation level are (Davis, 1993): frequency of use, time duration of the session, kind of use (shallow or intensive). Socio-economical aspects included: user profile (including income and social network information), TV and Internet usage (including other entertainment technologies), and scenarios (including interest levels, willingness to pay for equipment and services, decision factors).

The main results of the field investigations realised in the FUB projects can be summarised as follows:

- The role of the information and communication campaign is very important in ensuring a high adhesion to the field experiment by the users of the panels and, in some projects, in increasing the service usage.
- In general, the usage of T-government services has been quite low. A relevant difference in usage was found between informative services and interactive services. A possible explanation could be related also to the fact that some services with "high interactivity" are mainly referring to periodical or occasional activities (e.g. bill payment for phone etc, payment of fines, change of family doctor) which cannot justify a continuous use in the short time period of the field experiments (two-three months on average). However, the reasons of low usage should be investigated in depth.
- In general, technical problems were not producing relevant perception of disturbances and troubles and the users easily handled the provided equipment. Overall the users were quite satisfied with T-government services in comparison to different channels to perform the same task as the Internet and the traditional office desk. However, in some projects, technical problems produced relevant perception of disturbances and troubles mainly due to the lack of the digital television signal and to the interruption of the connection with the return channel. Other problems were connected with current input devices of the digital television, for instance user difficulties in the input of alphanumeric data by the remote control or by the virtual keyboard.
- Services developed in three of the six projects are still "on air" after the end of the project. These services have the common feature of being provided in the context of a public administration (municipality, regional administration, public schools).
- One of the initial objectives of the projects was to promote the use of Public Administration services by groups of people who have not the needed skills to use a computer and the Internet but are familiar with television and with the remote control. To this respect this objective was only partially reached since the investigation has shown that the most intensive users of T-government services were people using a PC and the Internet at home.

As mentioned before, the reasons of the low utilisation of interactive services need to be investigated more in depth. In particular, the identification of factors affecting usage of interactive T-government services could provide useful elements to increase their usage in the future.

2.1.3 The Field Investigation Developed in the Municipality of Parma

FUB provided the six projects with a common framework and some general tools:

- guidelines to evaluate usability of T-government services with high interactivity;

- a first questionnaire for the users, about usability and usage aspects;
- a second questionnaire for the users, concerning socio-economical aspects.

Each question or group of questions had the aim to evaluate indicators related to usability aspects, socio-economical aspects and usage. Within the above common framework, each project utilised different tools and techniques for data collection, adapting the above general tools to the particular context of the project. Each project was also responsible for data collection. In the following, the field experiment carried out in the Project "Parma Municipality Services" is described.

T-government Services Implemented. The project has developed both informative and interactive services. The former provide information about: Parma Municipality organisation; services offered to the citizens by the Municipality; cultural initiatives in progress in the city.

The interactive services allow the user (after authentication through Electronic Identity Card):
- to pay fines using a credit card;
- to visualise the state of a demographic dossier (e.g. for changing place of abode);
- to visualise the state of a request for education services provided by the municipality (e.g. nursery school).

A screen shot is presented in Figure 1.

Figure 1: Data input to select a demographic dossier.

During the field experiment a call center was available to the users for any information and help in the utilisation of the services.

The Users Panel. A sample of 200 people was selected from a group of 4.000 citizens of Parma Municipality. The selection followed two main criteria:

- demographic characteristics to reflect the main features of citizens in the Municipality of Parma (in terms of age, gender, and city district);
- potential interest toward the interactive services under experimentation (holders of driving licence and electronic identity card).

It was decided to choose the sample age ranging from 20 to 45 years, people in general skilled in the use of new information technology. The 200 citizens were randomly selected in this age range. Finally, 181 citizens (88 males and 93 females) took part at the experiment for the all planned period of two months and a half.

Procedure. In the first phase, the T-government applications were implemented and broadcasted in the territory of Parma Municipality.

In the second phase a randomly chosen users panel of 200 citizens was selected with the above mentioned criteria. The recruitment officially started when the municipality sent a letter to the users' panel explaining objectives and modalities of the trial. The users were then invited to contact the call center to choose between self-installation and personnel assisted installation of the decoder.

In case of self-installation, users were asked to pick up by themselves the Set-Top-Box (STB) at the Municipality offices. A user guide was also released to aid home installation and services use. In case of assisted installation, a technician brought the STB to the people residence and there trained the users.

Tools and Techniques for Data Collection. Data were collected mainly using a paper-based questionnaire filled in by the users. The questionnaire was both delivered and collected by Municipality of Parma personnel.

Results. The first results of the field investigation can be summarised in the following points:
- The usage of interactive services has been quite low. In particular only 20% of the users answering to the questionnaire completely used the interactive services. 35% used the interactive services in a shallow way. A possible explanation could be related to the fact that the services are referring to occasional activities (e.g. payment of fines).
- Technical problems were not producing relevant perception of disturbances and troubles and the users easily handled complex equipment. Overall the users were quite satisfied with T-government services in comparison to different channels to perform the same task, as the Internet and traditional office desk. However, the sample involved in the field study was composed by a

large part of young people using ICTs. Of course it is not possible to generalise such indications to the whole Parma population and, even less, to the whole Italian population.

3 THE FACTORS OF USAGE

Since many years the study/assessment of usage of emerging ICTs requires to be carried out through the analysis of more and more reliable models (Taylor & Todd, 1995).

3.1 Theoretical Background

In this paper we assume that the main forecasting feature of the most recognized models in the literature, i.e. the "Technology Acceptance Models" (TAM) (Malhotra & Galletta, 1999) and UTAUT (Venkatesh et al., 2003) in particular, could be applied to analyse other experimental datasets, built up by different criteria other than, of course, to be suitable with ICT contexts of use. This hypothesis, whether verified, should expand the possibilities to analyse the usage constructs of the original sets of variables and as well as to come to more satisfying results. In fact, it is very difficult to attain data due to the high complexity and variability especially about socio-technical systems (Dillon, 2000) and/or when technology is being oversold (Cornacchia, 2003). The relevant literature on this topic describes the development of several models of technology acceptance by the users and many extensions to the basic constructs (Malhotra & Galletta, 1999; Venkatesh & Davis, 2000), mostly built with the behavioural elements (Ajzen, 1996) of who is forming an intention to act (Bandura, 1986) and the inclusion of some kinds of constraints (limited ability, learning and usage (Bagozzi et al, 1992), time, environmental, organisational, unconscious habits, and so on) which influence the individuals' actions (Compeau et al, 1999; Pierro et al, 2003).

This study thus aims to give a methodological answer in measuring the effects of re-coding the experimental T-government variables dataset, the one described in the previous paragraph. The procedure is carried out by matching the T-government simple sets of variables with/into new ones of the usage and technology acceptance of TAM and UTAUT.

Actually the TAM and UTAUT both apply to the adoption and use processes of emerging ICT in order to understand the human choices and technology acceptance. The models suggest that when users are presented with new technological devices, a number of factors influence their decision about how and when they will use them, notably two main key sets of constructs: Perceived Usefulness and Perceived Ease of Use (Davis, 1989).

Perceived Usefulness is defined as the user's "subjective probability that using a specific application system will increase his/her job performance within an organisational context". Perceived Ease of Use refers to "the degree to which the users expects the target system to be free of efforts". Both complex constructs predict the attitude toward using the system, in that order defined as "the users desirability of using the system".

There can be also strong behavioural elements with which the models assume that when someone is forming an intention to act, then he/she is free to act without limitations. UTAUT extends TAM by introducing the terms of social influence and cognitive instrumental processes and, above all, it ultimately unifies the main competing user acceptance models, namely eight theoretical approaches sharing the same basic concepts. As shown in Figure2, the key dependent variable is the intention and/or the use of technology, thus the final purpose of the model is that of understanding and providing explanation of the phenomenon "use of information technology", taken as dependent variable. The role of intention, as an antecedent of behaviour (i.e. of use), is the actual critical factor of the model and was analysed and proved in literature.
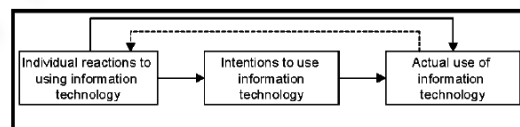

Figure 2: Basic concept underlying user acceptance models.

In the formulation of the unified model four constructs were identified which may play a significant role as direct determinants of the user acceptance and usage behaviour: Performance Expectancy, Effort Expectancy, Social Influence and Facilitating Conditions. In addition, Age, Gender, Experience and Voluntariness of Use were the moderators of the model.

3.2 Recoding T-government Variables

In the current exploratory study all direct determinants of UTAUT constructs were considered in the application with experimental T-government dataset. To this extent, the questionnaire items were

recoded into aspects dealing with usage of "STB", "informative contents", "interactive contents" and others. During the matching and re-coding process, the following four step scheme was applied:

1. set up the reference sets of complex constructs from UTAUT;
2. search for simple items in the questionnaire that can replicate the causal structure of the unified model UTAUT, according to its requirements and basic conditions;
3. re-code by grouping them into new sets;
4. test statistically both for significance and meaningfulness of the new constructs of variables.

Following steps 2 and 3 in the above mentioned scheme, factors of UTAUT model were replicated using the indicators adequately selected from the T-government questionnaire. The result of such recoding process is herewith summarised.

Use Behaviour
- Use of Parma municipality services
- Use of DTV services
- Frequency of use
- Time duration of each session
- Type of use (intensive/shallow)
- Comparison with alternative channels
- Weekly interactions

Behavioural intention
- Willingness to pay for equipment
- Willingness to pay for services
- Interest levels toward DTV services

Performance expectancy
- Perceived service usefulness
- User satisfaction
- Comparison with alternative channels
- Factors influencing adoption
- Privacy and security

Effort expectancy
- Perceived ease of use
- Attractiveness
- Perception of technical problems
  - Loss of television signal
  - Too much time for application loading
  - Loss of connection by the return channel
  - Problems in establishing the connection
  - Too much time to reach the objective
  - Technical troubles in using equipment
- Interaction with equipment
- Service functions
- Impact of equipment in the house

Social influence
- Social network

Facilitating conditions
- Decoder installation
- User support provided by DTT
- User manual for STB install

- Manual for service use
- Information on the cost of connection
- Call center and contact center

Moderators
- Gender
- Age
- Income and education
- Experience (skills in using TV, Internet and entertainment appliances)

Arranged by the above recoded factors, since this was an exploratory study, dependent variables considered in testing the significance of the new causal constructs (step 4 of the procedure) were:
- *cont_utente_servizi* (STB Use)
- *cont_interattivi* (Interactive Service Use)
- *cont_informativi* (Informative Service Use).

Besides, in carrying out assessment, following independent variables constructs were applied:
- *Performance expectancy*
- *Effort expectancy*
- *Social influence*
- *Facilitating conditions*

The other constructs left over, i.e. *Behavioural Intention* and *Moderators*, were not taken into consideration at this preliminary stage of the study. Finally, ahead of computing each predictor of the novel UTAUT model, the three dependent variables were standardised in order to make them comparable each other.

4 RESULTS

In order to better understand the active relations among the new generated set of variables, either for the general or for the information or for the interactive usage of T-government services, a regression analysis was applied according with the UTAUT reference model. This choice was suitable given the low variability affecting the new dependent variables. To this regard, it was pointed out how people didn't use many of the several available on-line facilities, but they typically used no more than one at time.

4.1 Predictors Estimation

Regression analysis allowed to estimate the different weights of the UTAUT model factors applied to the novel T-government usage structure, that is the influence each of them may have in controlling the weight of a single predictor.

Three models were thus arranged and tested, using as criteria the assessment respectively of STB

Use, of Interactive Service Use, and of Informative Service Use. As shown in Table 1, set *cont_utente_servizi* (STB Use) as dependent variable, all coefficients with the exception of *Facilitating conditions* were significant (overall model: Adjusted R Square=.13; p<.000). Hence, it can be said, the more subjects perceived high values of these three *predictors* in adopting the STB the more positive was the evaluation of this dependent variable (Beta=.279, .311; .236; overall p<.001).

Table 1: Dependent variable: general *STB Use*.

Predictors	Beta	t	Sig.
Performance expectancy	.279	3.406	.001
Effort expectancy	.311	3.793	.000
Social influence	.236	3.368	.001
Facilitating conditions	.046	.648	.518

In the second model of Table 2, the evaluation of Interactive Service Use, set *cont_interattivi* as dependant variable, gave nearly the same results than the previous one (overall model: Adjusted R Square=.14; p<.000). Therefore, still excluding *Facilitating conditions*, the more subjects perceived high values of the three *predictors* in using the Interactive Service the more positive was the evaluation of this dependent variable (Beta=.315, .285; .264; overall p<.001).

Table 2: Dependent variable: *Interactive Service Use*.

Predictors	Beta	t	Sig.
Performance expectancy	.315	3.900	.000
Effort expectancy	.285	3.528	.001
Social influence	.264	3.811	.000
Facilitating conditions	.032	.456	.649

Finally, as shown in Table 3., the evaluation of Informative Service Use, set *cont_informativi* as dependent variable, found that no one predictor turned out to be effective (overall model: Adjusted R Square=.003; p=n.s.); (Beta=.107, .153; .081; .024; overall p>.05).

Table 3: Dependent variable: *Informative Service Use*.

Predictors	Beta	t	Sig.
Performance expectancy	.107	1.222	.223
Effort expectancy	.153	1.749	.082
Social influence	.081	1.086	.279
Facilitating conditions	.024	.315	.753

According to this last model, Use of Informative Services is not a variable depending on the given

UTAUT factors. Whether a predictor should be taken for a supplementary analysis, the best rank is *Effort Expectancy*.

4.2 The Final Model

By means of regression analysis it was demonstrated *if* and *how much* the values taken by the dependent variables, as well arranged from the T-government dataset, either depended on or were determined by the correspondent values taken by the independent variables, in our case the main determinants of UTAUT. Figure 3 summarises the results of the positive dependences found in the analysis.
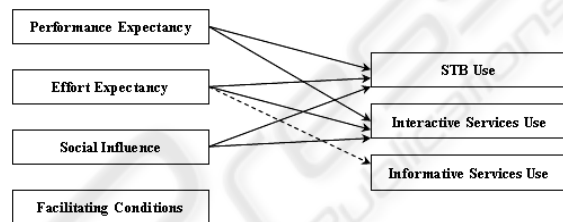

Figure 3: T-government factors usage: final model.

The figure also shows that *Facilitating Conditions* hasn't effective links to the hypothesised usage constructs.

5 CONCLUSIONS

In this paper the main feature of a forecasting model has been applied in order to give a further representation of a field research dataset about ICT information and interactive services proposed for residential users. Specifically, data coming from an Italian T-government field experience at the Municipality of Parma were re-processed to bring to more significant results towards new purposes, i.e. the identification of most relevant factors affecting usage. In such a way, the low usage of interactive services scored at Parma, and as well as of informative services and decoder adoption, was explained in terms of "use of information technology" key dependant variable, in UTAUT mentioned as direct determinant of user acceptance and usage behaviour. The determinants Performance Expectancy, Effort Expectancy, Social Influence and Facilitating Conditions were reformulated by means of T-government data to assess *if* and *how much* the information system was humanly acceptable developed. Results demonstrate that the procedural scheme can be successfully applied to recode most basic questionnaire items into new constructs

referable to UTAUT. The resultant model achieved is statistically significant for the first three constructs above mentioned, while it reveals to be partially adequate for the last construct. Results encourage also to go ahead in further developments on some important issues.

At this stage of the study about the usage of T-government services, the UTAUT key moderators (i.e. age, gender, experience, voluntariness) were not included in the process. However, a further analysis has been planned to aim at finding whether it is possible to incorporate in the model the variables "income" and "education", either as new moderators or as new determinants.

This study is antecedent to a development also in the area of forecasting the T-government services diffusion processes for residential users. Actually, re-modulated datasets and UTAUT constructs can effectively feed a microsimulation model (Turk et al, 2008), where different policy measures (such as subsidisation or inclusion of different services) could be tested from different aspects, for instance their cost, time and relevance.

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