



Citizens as consumers: Profiling e-government services' users in Egypt via data mining techniques



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ARTICLE INFO

Article history:

Available online 10 May 2013

Keywords:

e-Government services

Consumer profiling

Neural networks

Data mining

Egypt

ABSTRACT

This study uses data mining techniques to examine the effect of various demographic, cognitive and psychographic factors on Egyptian citizens' use of e-government services. Data mining uses a broad family of computationally intensive methods that include decision trees, neural networks, rule induction, machine learning and graphic visualization. Three artificial neural network models (multi-layer perceptron neural network [MLP], probabilistic neural network [PNN] and self-organizing maps neural network [SOM]) and three machine learning techniques (classification and regression trees [CART], multivariate adaptive regression splines [MARS], and support vector machines [SVM]) are compared to a standard statistical method (linear discriminant analysis [LDA]). The variable sets considered are sex, age, educational level, e-government services perceived usefulness, ease of use, compatibility, subjective norms, trust, civic mindedness, and attitudes. The study shows how it is possible to identify various dimensions of e-government services usage behavior by uncovering complex patterns in the dataset, and also shows the classification abilities of data mining techniques.

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1. Introduction

One of the most intractable problems for anyone dealing with government is the sheer complexity of its organizational structure. For example, it has been estimated that the average government has between 50 and 70 different departments, agencies and regulatory bodies (Silcock, 2001). A number of government's different agencies may be involved in simple matters such as registering the birth of a child. Fortunately, advances in technology, particularly the advent of the Internet, has made it possible for local governments to deliver their services to citizens via a single portal known as e-government. e-Government has been regarded as a 'paradigm shift' or a catalyst for government administrative reform resulting in improved quality of service, cost savings, wider political participation and more effective policies and programs (Helbig, Gil-Grcia, & Ferro, 2009). e-Government has also been proposed as a solution for increasing citizen communication with government agencies and, ultimately, political trust (Chadwick & May, 2003).

In several countries there has been a growing pressure for governments to move online. In the Arab world, Dubai pioneered e-voting in elections for half the members of the United Arab Emirates' consultative assembly (The Economist, 2008). In Bahrain the

e-government authority of Bahrain (E-GA) has recently launched the Enterprise Architecture Project (EAP) initiative, which is considered to be the first of its kind in the Arab world. The initiative aims at streamlining government procedures by unifying the standards and procedures among all government entities in all matters related to information communication technology (Bahrain Tribune, 2009). Finally, in Egypt e-government currently provides 85 services to citizens including government forms, public policy information and tax filing (Hamed, 2008). Two main reasons are behind governments' decision to move online. First, a more enlightened view has begun in the ranks of government to treat the citizen like a consumer where transaction satisfaction is important. Second, pressures for governments to do more with less will force governments to provide services in a more efficient way. In fact, e-government offers substantial performance gains over the traditional model of government. For example, based on the analysis of 49 empirical studies, Danziger and Andersen (2002) concluded that there were positive e-government impacts on data access and efficiency and productivity of government performance in both internal operations and external service functions. In fact it has been argued that a significant portion of the benefits created by e-government services are obtained by the government itself in terms of efficiency gains (Tung & Rieck, 2005). For example, the U.S. government generates around US\$ 3 billion on its Web site (Clark, 2003).

While several terms are synonymous with e-government such as digital government, e-governance and e-democracy, authors

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generally use a broad conceptualization for e-government to encompass all government roles and activities shaped by information and communication technologies (Brown, 2005). There are three relationships in the e-government interactive processes: government to government (G2G), government to business (G2B) and government to citizen (G2C). For the purpose of this study, only G2C relationship will be discussed. e-Government progress has also been divided into three phases: the first phase is to *publish*, in which e-government has only limited digital presence through limited published information. The second phase is to *interact*, where citizens can interact with government via electronic media such as emails and chat rooms. The third stage is to *transact*, where citizens participate in government services via the government's digital portal (Lau, Aboulhoson, Lin, & Atkin, 2008).

2. Research objectives

Profiling e-government services users is very important because the first step in planning the target marketing strategy is to segment the market and develop profiles of the resulting market segments. In fact, the usefulness of market segmentation hinges upon accurate profiling. Relatively low accuracy in forecasting segment membership will result in ineffective marketing programs and potential negative impact due to targeting unintended segment members. Despite the importance of profiling e-government services users, researchers have largely ignored specific circumstances under which citizens adopt e-government services. From a public policy standpoint, it is important to know what motivates individuals to use e-government services if a pro-digital government change policy is to be successfully implemented. Using intelligent modeling techniques, this research aims at profiling e-government services users versus non-users. More specifically, the aim of this study is two-fold: (1) to investigate the influence of various demographic, cognitive and attitudinal factors on e-government services usage behavior in Egypt; and (2) to compare the classification performance of data mining techniques against the more traditional techniques such as LDA within the context of e-government services usage behavior.

3. Literature review and hypotheses development

Drawing on research from North America, Europe and Australasia there is a wealth of evidence that suggest that a wide variety of factors influence e-government services usage behavior. These can be characterized as perceived usefulness, perceived ease of use, compatibility, subjective norms, trust, civic mindedness and attitudes.

3.1. Perceived usefulness

Perceived usefulness has consistently been a strong determination of the intention to use a technology. In the technology acceptance model (TAM), Davis (1989) used the term "perceived usefulness" to refer to the prospective user's subjective probability that using a specific application system, in this case e-government services, will increase his or her performance within an organization. Perceived benefits from e-government services occur when the new system is perceived as more beneficial than the paper-based system it supersedes. In their empirical exploration of e-government service adoption, Bretschneider et al. (2003) found that perceived benefit is the major factor in using e-government services. The perceived benefit factor is closely related to perceived usefulness in the TAM theoretical model. Raman and Leckenby (1998) used the concept of utilitarianism to explain online behavior. They found a positive link between utilitarianism and duration

of visit of web ads. This construct, too, seems to be closely related to perceived usefulness identified in TAM. Rogers (1995), in his diffusion of innovation paradigm, also posits that the perceived benefit or relative advantage of innovation positively influences adoption rate. In a meta-analysis in the innovation research literature, Tornatzky and Klein (1982) concluded that relative advantage was positively related to adoption. In a similar vein, King and He (2006), in a meta-analysis of the TAM, found a strong positive link between perceived usefulness and behavioral intention ($\beta = 0.505$). It follows that

H1. Perceived usefulness of e-government services positively influences users' intention to use these services.

3.2. Perceived ease of use

Perceived ease of use refers to the degree to which a prospective user expects the target system to be free of effort (Davis, 1989). TAM further suggests that perceived ease of use is instrumental in explaining the variance in perceived usefulness. This dimension is similar to the complexity or the perceived ease of adoption in the diffusion of innovation paradigm. Perceived ease of adoption can affect adoption behavior since an innovation that is easy to use can considerably reduce the time and effort required by the user and, thus, increase the likelihood of adopting the technology (Wang & Qualls, 2007). Most studies on technology acceptance showed that perceived ease of use directly influenced attitude toward use (e.g., Ahn, Ryu, & Han, 2004; Bruner & Kumar, 2005; Chen, Gillensen, & Sherrell, 2002). King and He (2006), in a meta-analysis of the TAM, found a strong positive link between perceived ease of use and behavioral intention ($\beta = 0.186$). In a study of technology adoption in government agencies, Hamner and Qazi (2009) found a statistically significant association between perceived ease of use and attitude, indicating the important role of the ease of use in the formation of users' attitudes. It follows that

H2. Perceived ease of use of e-government services positively influences users' intention to use these services.

3.3. Compatibility

Compatibility was originally one of the factors determining the diffusion of innovation rate in the diffusion of innovation paradigm. It refers to the degree to which the use of the new technology is perceived to be consistent with the potential users' existing values, previous experience and needs (Nan, Xun-hua, & Guo-qing, 2007). Prior studies indicated that compatibility had strong direct impact on behavioral intention in areas such as using group support systems (Van Slyke, Lou, & Day, 2002), adopting new methodology for software development (Hardgeave, Davis, & Riemenschneider, 2003) and using university smart card systems (Lee & Cheng, 2003). In a recent study of e-payment adoption in China, He, Duan, Fu, and Li (2006) found that only compatibility has a significant effect on respondents' intention to adopt the system. Compatibility may also influence behavioral intention through performance expectancy and effort expectancy (Schaper & Pervan, 2007). For example, Chau and Hu (2002) showed that compatibility of telemedicine technology exerted a significant effect on perceived usefulness. It follows that

H3. Perceived compatibility of e-government services positively influences users' intention to use these services.

3.4. Subjective norms

Subjective norm (also called social norm) refers to users' perception of whether other important people perceive they should

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