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Ge-Government: A Geographic Information Based E-Government Adoption Framework

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Abstract

The aim of this research is to assess the influential role of Geographic Information -as the location information concept- over citizens E-government adoption model citizens to adopt e-government and to introduce a full GI-based e-government citizens' adoption framework entitled GE-government. A thorough literature review was executed in order to examine how GI is relevant to e-government services and to identify the aspects of GI that may affect e-government adoption by citizens. This paper proposes a factor that could affect e-government adoption modelling, which has not been identified in the literature, so far. The paper concludes with a proposed GE-government citizens' adoption framework and outlines future research that will examine its validity.

Keywords: Geographic Information, Geographic Information System, Digital Government, E-government, E-services, Adoption

1 Introduction

E-government, as per The World Bank Group (2004), encompasses the use of e-government services that transform relations with citizens, businesses, and other arms of government. The e-government services can serve a variety of different ends: better delivery of government services to citizens, improved interactions with business and industry, citizen empowerment through access to information, or more efficient government management. E-government employment may lead to less corruption, increased transparency, greater convenience, revenue growth, and/or cost reductions. Studies on the subject have been conducted in different contexts, including developed countries (O'Reilly, 2005; Siau, & Long 2005; Frank, 2004; Siau & Tian, 2004; Davidrajuh, 2003) as well as in developing countries (Kurunananda & Weerakkody, 2006; Heeks 2002).

A recurring theme in many studies is the development and examination of adoption models for e-government initiatives, which are based on adoption theories (Rogers, 1995; Venkatesh et al., 2003; Davis 1989). As substantiated by the extensive literature review we have conducted, proposed e-government adoption models that study the impact on users' adoption for the government e-services have not taken into consideration the influence of geographic information (GI), defined by Goodchild (1997, 2010) as the location or information linked to a place or property on or near Earth, and the knowledge about the location of something and its description at a specific time or time interval. The GI is characterized by its two components: the Geographical Information System (GIS), which provides the geographic information with "the infrastructure, tools and methods for tackling real world problems within acceptable timeframes" (Maguire, 2010), and the Geographic Information Science (GIScience), which allows us to consider the philosophical, epistemological and ontological contexts of geographic information" (Maguire, 2010).

Recently, GI has been used widely in advanced information systems and e-services, like E-land Administration System, E-tourism System, Disaster Management System, and many others, to provide potential users with advanced usability, flexibility, usefulness, and information accuracy, while at the same time being less complex. Therefore, GI, coupled with relevant tools and applications, is expected to influence interactions among different stakeholders in various societal settings (Goodchild & Palladino, 1995).

In this paper, we examine the main influential factors as identified in the literature and also whether there is evidence to suggest that the GI factor exercises influence on e-government adoption, and, if so, what aspects of it could be proposed for a new GI based e-government citizens' adoption framework.

The rest of this paper is structured as follows. Section Two introduces a brief literature review section about e-government, the GI related components that are relevant, as well as GI aspects that relate to e-government services adoption. Section Three introduces a conceptual model for the GI based e-government adoption framework, with a brief on the identified influential factors. Section Four outlines the main research findings, and Section Five concludes with recommendations for future research.

2 Literature Review: E-government, Technology Adoption, Geographic Information and Their Interrelation

2.1 E-government

The e-government dimensions, as described by Bonham et al. (2001), Fang (2002), Yildiz (2003), Reddick (2004), Ramaswamy & Selian (2007), Turban et al. (2008), ITU (2009), Chavan & Rathod (2009), Ashaye & Irani (2014), are the following:

- Government to Government – G2G
- Government to Businesses – G2B
- Government to Citizens – G2C
- Government-to-Nonprofit – G2N
- Government-to-Employee – G2E
- Government-to-Civil Societal Organizations – G2CS
- Citizen-to-Citizen – C2C

The World Bank Group's (2004) definition covers multiple perspectives, including Information Technology, Reforming Public Sector, Relationship with partners, Benefits, Dimensions, Political Reasons and Citizens Focus. This definition is aligned with the research objective of studying e-government citizens' adoption models and the importance of using the Geospatial Technology to enhance the citizens' adoption of e-government services and fortify the G2C (Government to Citizen) dimension relation.

2.2 Technology Adoption

According to Rogers' (2003) definition, Adoption is the decision of "full use of an innovation as the best course of action available". A detailed literature review on technology adoption theories has been conducted, derived from the need for a thorough understanding of the adoption theories' origins and an overview of some key adoption theories used in the technology, business, and many other sectors to assess the success of any concept implementation. Many technology adoption theories were accepted and validated over the last four decades to understand the user's acceptance of technology (Venkatesh et al., 2003; Hu et al., 1999) where a user can be an individual, household, organization or community. The three main technology adoption theories and models include Technology Acceptance Model – TAM

(Davis, 1989), Diffusion of Innovation theory – DOI (Rogers, 1995) and Unified Theory of Acceptance and Use of Technology – UTAUT (Venkatesh et al., 2003).

Based on those technology adoption theories, many researchers have developed and introduced many e-government adoption models to identify and study the e-government influential factors. The factors influencing the citizens and overall society to adopt e-government technology have been studied by Carter & Bélanger (2005) and Warkentin et al. (2002), including the "intention" and "willingness" of the citizens to use e-government services (Gilbert et al., 2004), and many adoption models have been proposed and tested between 2005 (Web 2.0 official launching (O'Reilly, 2005)) and 2017 in developing and developed countries (countries categorization according to the World Bank, 2016). during our literature review, we have identified sixteen e-government adoption models between 2005 and 2017 where we could identify the common influential factors that have an impact on citizens' intention to adopt e-government. We have identified that most of the identified models used TAM, described by Venkatesh and Davis (2000) as the most "well-established, well-tested, powerful, robust and parsimonious model for predicting user acceptance of technology". As the TAM is testing the adoption of technology at the individual level (Chong et al., 2009), and since we are assessing the citizens' technology adoption, the upcoming conceptual G-government Citizen's Adoption model will be based on the TAM (Davis, 1989), which is considered as one of the more mature technology adoption models and has been widely used and tested over the last two decades in various information systems including E-services.

The TAM has been illustrated extensively in the literature where we have described the evolution of the TAM model from the original TAM, developed by Davis in 1986, until the final one presented in 1996 by Venkatesh and Davis, and extended later on by Venkatesh and Davis (2000) and by Venkatesh (2000) with two extended TAM models which introduced multiple influential factors over the Perceived Ease of Use and Perceived Usefulness. Accordingly, the essential TAM models' independent factors are Perceived Ease of Use and Perceived Usefulness, having impact over the Behavioural Intention to use dependent factor.

The identification of two main factors from the TAM model, perceived ease of use and perceived usefulness, was followed by an identification of additional factors categorized by various researchers under the "social" category, including word of mouth – WOM (Alomari, 2014, Kim and Prabhakar, 2004), favoritism – FA (Alghamdi and Beloff, 2016; Alomari, 2014; Al Awadhi and Morris, 2009), digital divide – DD (Alomari, 2014; Alateyah, 2013), website design – WD (Alghamdi and Beloff, 2016; Alomari, 2014; Akkaya, 2013), internet & computer skills confidence – ICSC (Alghamdi and Beloff, 2016; Alomari, 2014; Al Hujran et al., 2013, Alateyah, 2013), fear of job loss belief – FJLB (Alomari, 2014; Vassilakis et al., 2005), religious belief – RB (Alomari, 2014; Hofheinz, 2005; Evans and Yen, 2005; Dimitrova and Beilock, 2005), attitude – AT (Williams et al., 2016; Alomari, 2014; Al Hujran et al., 2013; Susanto, 2013), resistance to change – RC (Schwester, 2009; Kamal and Themistocleous, 2006), trust in internet – TI (Gupta et al., 2016; Alomari, 2014; Al Hujran et al., 2013; Alateyah, 2013) and trust in government – TG (Bwalya, 2017; Gupta et al., 2016; Alomari, 2014; Al Hujran et al., 2013; Alateyah 2013). Those social factors were also considered to be potential influential factors in citizens' adoption of e-government, and it was tested in almost all the e-government citizens' adoption models. Accordingly, the "Social", representing the grouping of the social factors, will be inserted in the conceptual GE-government Citizen's Adoption model and tested in order to extract the significant influential social factors over the e-government citizens' adoption.

Moreover, some demographic factors, including gender – GE (Williams et al., 2016; Alateyah, 2013; Voutinioti, 2013), age – AG (Williams et al., 2016; Alomari, 2014; Alateyah, 2013; Voutinioti, 2013), level of income – LI (Alomari, 2014; Abu Nadi, 2008) and level of education – LE (Alomari, 2014; Susanto, 2013; Alateyah, 2013, Voutinioti, 2013) were also considered as potential influential factors in the e-government citizens' adoption and were tested in various e-government citizens' adoption models. Accordingly, "Demographics", representing the grouping of the demographic factors, will be inserted in the conceptual G-government Citizen's Adoption model and tested in order to extract the significant influential demographic factors over e-government citizens' adoption.

2.3 Geographic Information

The interrelation between e-government adoption and geographical information has not been formally studied. Yet in our literature review, we have identified e-services that incorporate GI technologies and are used widely by citizens. Thirteen E-government applications and services that are GI enabled have been identified in our literature review. A few indicative examples follow.

There is a wide range of Disaster Management Systems (DMS) that are geo-enabled, Crowd-sourced Emergency Services, which are currently used to improve a government's response to an incident, critical event or disaster. Through such systems, citizens collaborate dynamically, employ geospatial e-government services, and ultimately support the governmental disaster/emergency agencies through a variety of means. It is worth noting that situational awareness is improved by the assimilation of accurate real-time geo-information via the DMS's interactive map, which extends incidents' locations with all relevant and supportive spatial and non-spatial information so to enhance the on-event decision making, improve the future analysis of the government's response to disasters and incidents, and support the proper development of a preventive disaster management plan (Bott & Young, 2012; Grant et al., 2012). Another interesting GI-based e-service is the Complaints Management System, which increased the response efficiency of the local government. A case study that demonstrates such potential is the adoption of a Complaints Management System in Amsterdam in 2007, in which citizens' complaints were addressed within two working days for 80% of the reported incidents. The improved throughout was attributed to the accurate pinpointing of the relevant location of the incident or complaint that significantly affected the operational response process (Hickel & Blankenbach, 2012; Hassan, 2010; Stachowicz, 2004). The e-participation application is another web GI based e-government application that is usually launched by local governments and municipalities to offer their citizens expected capabilities; for example, citizens have the ability to visualize the urban planning of any new development, submit their feedback and reactions to what is proposed, chat and communicate with local government decision makers and thus improving the citizens' participation in all governments' future policy making and service delivery (Ijeh, 2014; Moody, 2007; Stachowicz, 2004; OECD, 2001).

A variety of GI-based e-tourism applications exist, and some are included in e-governmental platforms dedicated to tourism. These services include advanced querying capabilities, like search for the nearest facilities, search by address, identify the shortest route between two points of interest, and plan a tour with multiple scenarios (html5). Very recently, those applications support 3D display of the touristic sites in order to offer more attractions to tourists as well as to increase their familiarity with the sites to be visited. To enhance users' experience, those applications support the insertion of blogs or reviews on each visited site as a wasy of sharing the travellers' experiences (Marson et al., 2015; Shah & Wani, 2015; Pandagale et al., 2014; Yan & Wang, 2012). Lately, many countries started the adoption of the GI-based E-elections Management Application, a geospatial based e-government application that offers services for the pre-election period, as well as after the electoral process is finished. Some indicative pre-election services include the online voter registration, retrieval of information about the election process or procedure such as voters' (citizens') locations, the polling station, the shortest path to the polling station with directions, location of the voters' assemblies, location of the buses, taxis or any available transportation system with schedules and routes, etc. Situation analysis is also supported, and the results may be visualised in maps, plots and reports in real time. Such visual representation enhances citizens' capability of sharing their observations and opinions about the overall election procedure and execution directly on the application or through the integration with the social media apps (Aphane, 2015; Gupta et al., 2014; Everton et al., 2013; International IDEA, 2013).

Based on the literature review, we could identify the GI impact on a set of factors influencing citizens' adoption of e-government, including website design (WD), perceived ease of use (PEOU) and perceived usefulness (PU). Through the cases mentioned above, it is evident that the impact of GI on citizens' adoption should be examined in more detail, especially with the identification of the influential role GI plays in these factors. Thus GI has been considered to have direct influence over e-government adoption and over the three factors (WD, PEOU and PU), which is also totally aligned with the extended TAM models that mentioned the existence of independent factors affecting the PEOU and the PU. Therefore, those evidences indicate the need to exercise the impact of the GI over the adoption of e-government services among citizens, and accordingly it is interesting to develop a framework for examining such adoption influences more thoroughly.

3 GE-government: E-Governments Citizens' Adoption Framework Encompassing Geographic Information

The influential citizens' adoption factors, as identified in the literature, include the TAM adoption theory factors, perceived ease of use and perceived usefulness social factors, as well as demographics, were identified through the literature as the common factors between the majority of the identified e-government citizens' adoption models. We considered the GI factor as an independent potential direct and moderate influential factor over the independent TAM factors and the website design social factor, and a direct influential factor over the e-government citizens' adoption dependent factor. Figure 1 illustrates the different elements of the GE-government Citizens' Adoption conceptual framework. The proposed framework was tested with regards to the significance of the GI factor's role in enhancing e-government adoption, and the research findings are summarized in the next section.

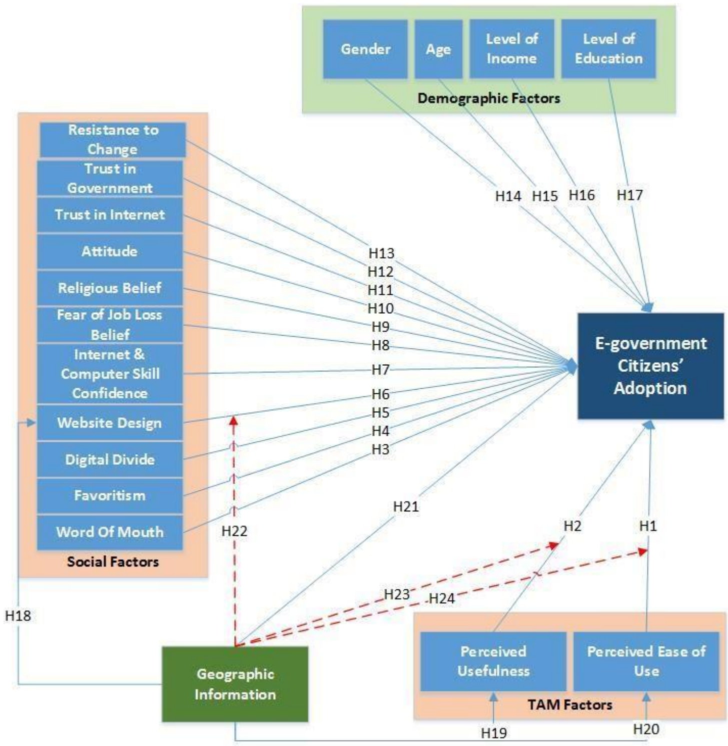

Figure 1: GE-government (GI based E-government) Citizens' Adoption conceptual framework

Proposed hypotheses as well as the relevant independent and dependent factors are summarized in Table 1.

HN	Research Hypothesis	Ind. Factor	Dep. Factor
H1	High level of perceived ease of use has positive influence on citizens' e-government adoption	PEOU	EGovAdop
H2	High level of perceived usefulness has positive influence on citizens' e-government adoption	PU	EGovAdop
H3	High level of positive word of mouth has positive influence on citizens' e-government adoption	WOM	EGovAdop
H4	Low level of favouritism has positive influence on citizens' e-government adoption	FA	EGovAdop
H5	Digital divide has influence on citizens' e-government citizens' adoption	DD	EGovAdop
H6	High level of website design has positive influence on e-government citizens' adoption	WD	EGovAdop
H7	High level of internet & computer skills confidence has positive influence on citizens'e-government adoption	ICSC	EGovAdop
H8	Low level of fear of job loss belief has positive influence on citizens' e-government adoption	FJLB	EGovAdop
H9	Low level of religious belief has positive influence on citizens' e-government citizens' adoption	RB	EGovAdop
H10	High level of positive attitude has positive influence on citizens' e-government adoption	AT	EGovAdop
H11	High level of trust in internet has positive influence on citizens' e-government adoption	TI	EGovAdop
H12	High level of trust in government has positive influence on citizens' e-government adoption	TG	EGovAdop
H13	Low level of resistance to change has positive influence on citizens' e-government adoption	RTC	EGovAdop
H14	Males is more likely to be e-government adopters than females	GE	EGovAdop
H15	Younger and middle age citizens are more likely to be e-government adopters than older age citizens	AG	EGovAdop
H16	Higher level of income groups are more likely to be e-government adopters than lower level of income groups	LI	EGovAdop
H17	Higher level of education groups are more likely to be e-government adopters than lower level of education groups	LE	EGovAdop
H18	GI has influence on the website design of e-government applications	GI	WD
H19	GI has influence on the perceived usefulness of e-government applications	GI	PU
H20	The GI has influence on the perceived ease of use of e-government applications	GI	PEOU
H21	GI has positive influence on citizens' e-government adoption	GI	EGovAdop
H22	GI increases the level of positive influence of website design on citizens' e-government adoption	GI& WD	EGovAdop
H23	GI increases the level of positive influence of the perceived usefulness on citizens' e-government adoption	GI & PU	EGovAdop
H24	GI increases the level of positive influence of the perceived ease of use on citizens' e-government adoption	GI & PEOU	EGovAdop

Table 1: Summary of proposed Hypotheses

A survey has been conducted, where the convenient sampling method has been applied for the questionnaire distribution since the survey's participants were selected from public and private organizations and agencies that we have access to. The developed questionnaire was partially based on previous research as identified in the literature, with close ended questions following the Five-point Likert scale for all non-demographic questions. Content validity has been employed to examine the validity of the research instrument through face-to-face interviews with three experts in the relevant fields. Following that, a pilot test with ten respondents was conducted. A cover letter was attached with the questionnaire to clarify the purpose of conducting this research survey.

A multivariate statistical approach, Exploratory Factor Analysis (EFA), was used because it offers the advanced statistical tools that help the researcher in measuring (a) the independent variables' influence (Social except digital divide, TAM and GI factors) over the corresponding measured dependent variable (e-government adoption), (b) the strength & correlation between the independent variables and the corresponding measured dependent variable, and (c) the depth, breadth and validity of the measurement scales (Malhotra et al., 2013; Williams et al., 2010; DeCoster, 1998). This statistical technique is widely used by many e-government researchers, including but not limited to: Alomari (2014), Harfouche (2010), Al-Shafi and Weerakkody (2009). The EFA also will help in identifying the factors having a factor loading of above (0.4), defined as the minimum preferable in IS research (Carter et al., 2008; Dwivedi et al., 2006; Straub et al., 2004) to be considered in the next stage of the model testing and therefore eliminating the factors that have no significant role in our study.

A Binary Logistic Regression Modelling Analysis (BLRMA), also employed by Harfouche (2010) and in Al-Shafi and Weerakkody (2009) for analysing the relationship between one dependent variable (binary variable) and multiple independent variables (Malhotra et al., 2013), has been followed in order to analyse the relation between citizens' e-government adoption dependent variable (binary variable) and the independent variables (Social except digital divide, TAM and GI) identified in the conceptual framework.

The data analysis process continued by using the Pearson Chi-square statistical tool that tests the relationship between two categorical variables, whether they are binary (two categories) or more than two categories (Malhotra et al., 2013). Accordingly, the Pearson Chi-square was first used to analyse the relation between the GI independent variables and the other three independent variables (website design, perceived usefulness and perceived ease of use) within the conceptual framework. The study of those relationships helps in getting clear response to the proposed research questions. Then, the Pearson Chi-square was used to explore the impact of the demographic and digital divide variables (independent categorical variables) on e-government adoption (binary variable).

During the data analysis process, a third validity technique, the construct validity, was used to measure and rate of the participants' responses of (i) each factor's degree of influence on the proposed framework for citizens' e-government adoption, (ii) the degree of influence of the GI factor on the proposed framework for citizens' e-government adoption, (iii) the degree of influence or moderation of GI over other factors.

Finally, the data representation process followed by developing charts, graphs, tables and statistics in order to give figures and numbers for further interpretation.

Therefore, citizens' g-government adoption conceptual framework has been developed based on the TAM model, and the Literature Review has identified the factors that are influential factors to citizens' adoption of e-government, and a list of hypotheses has been proposed for testing and interpretation. Hence, we have (i) selected a large and representative sample of the targeted population for later generalization purposes, (ii) collected their responses on the formal close ended questions already deducted in the majority from previous researchers' questions, (iii) analysed the feedback and (iv) interpreted the final results that should highlight the accepted and rejected hypotheses. Therefore, this study of the proposed conceptual framework (a) relied on a large amount of collected data that is heavily expressed in numerical forms and (b) required complex statistical analysis to study each measurable variable or influence factor over the citizens, including the GI factor, as well as the correlation between those factors.

4 Research Findings

Five hundred survey questionnaires were distributed, while 446 were collected with completed questions, between October and November 2016, which represents a successful questionnaire collection rate of 89.2%. From the collected questionnaires, only 409 were actually used for the analysis, representing 91.7% of the collected questionnaires, since the remaining (8.3%) belonged to participants who responded that they were unaware of any e-government services (2.5%) or were unaware of any geographic information or mapping services (2.5%), or both (3.3%).

From the (409) participants who are aware of e-government and geographic information, 83.4% of them used e-government services previously, whereas the rest (16.6%) did not. Furthermore, 88% of our survey participants had used Geographic Information services before and 12% did not.

The participants were 55.3% male and 44.7% female, with a majority of respondents between 20 and 50 years old (91.6%). The majority of the respondents had an income level between USD 500 (Lebanese minimum threshold salary determined by the Lebanese government for the public and private sectors) and USD 2,500 (79.7%). In addition, the majority of the respondents were well educated with at least a college degree (90.9%), where (57.1%) participants had higher education degrees. The participants were Muslim (66.7%) or Christians (26.5%), although 6.8% decided not to disclose their religion. Respondents working in the private sector represented 55.5% of the total, and around 15.9% selected "Other", corresponding to an "Employee in Public or Private Sector" participant who is an owner of a small business. The majority of respondents (69.9%) lived in cities or urban areas, and 30.1% live in villages or rural areas. Almost all the respondents had internet access where they live (98.8%). The survey shows that 44.4% of the respondents preferred to use the Internet at home, 16.4% preferred to us it at work, and 39.6% did not express any preference. In addition, 55.6% of the respondents preferred to execute their e-government transactions at home, 20% at work and 24.4% did not have any preference. Finally, we can realize that the majority of respondents (76.8%) preferred to use the tools that offer mobility, such as mobile, tablet and laptop, 11.5% preferred to use the desktop PC and 11.7% had no preference.

4.1 Framework Testing

The research questionnaire reliability was tested using the reliability analysis test in SPSS, which calculates Cronbach's alpha values for the overall questionnaire and the research framework's factors. According to Field (2005) and Hinton et al. (2004), Cronbach's alpha measures the reliability and examines the inter-consistency of the data collected. Moreover, Hinton et al. (2004) proposed four reliability categories based on a value range: excellent (above 0.9), high (0.7–0.9), high moderate (0.5–0.7) and low (below 0.50). The overall questionnaire's Cronbach's alpha value, based on 20 standardized items/questions, is 0.846, which is considered to have high reliability value.

To identify the factors' potential grouping according to their correlation, exploratory factor analysis (EFA) was executed using the principal component analysis (PCA) extraction method with the varimax rotation with Kaiser normalization. The EFA will help in identifying the factors that can be grouped together in common components, having relationships between each other, in order to be analysed separately using the Binary Logistic Regression Analysis. The EFA performed on the 16 independent variables or 5-Likert scale items that were proposed as potential influential factors over the dependent variable EGovAdop in the Literature Review shows a KMO (Kaiser-Meyer-Olkin) of 0.812, which is considered high and acceptable, since it exceeds the (0.5) minimum value required for the PCA factor analysis results to be accepted, and a Bartlett's Test of Sphericity with high significance (0.000).

The EFA results discovered the existence of 16 components where only four components have eigenvalues exceeding 1, which are considered important components for analysis according to Hair et al. (1998). Table 2 shows the initial eigenvalues and the total variance of the four extracted components.

Comp.	Initial Eigenvalues			Extraction Sums of Sq. Loadings			Rotation Sums of Sq. Loadings		
	Total	% of Var.	Cum. %	Total	% of Var.	Cum. %	Total	% of Var.	Cum. %
1	4.687	29.296	29.296	4.687	29.296	29.296	2.536	15.853	15.853
2	1.545	9.658	38.954	1.545	9.658	38.954	2.358	14.736	30.589
3	1.387	8.669	47.623	1.387	8.669	47.623	2.298	14.361	44.950
4	1.072	6.697	54.320	1.072	6.697	54.320	1.499	9.370	54.320

Table 2: Initial Eigenvalues & Total Variance with 16 items

Table 3 shows the distribution of the 16 factors across the four extracted components that have a factor loading above 0.4, which is defined as the minimum preferable in the IS research (Carter et al., 2008; Dwivedi et al., 2006; Straub et al., 2004), except for the ICSC factor (0.388) and with no cross-loading of the variables where none exceeds the (0.4) in the other components.

Factors		PEOU	PU	WOM	FA	WD	ICSC	FJLB	RB	AT	TI	TG	RC	GI& WD	GI& PU	GI&P EOU	GI
Components	1	0.723	0.769	0.609	0.595	0.490											
	2													0.515	0.716	0.836	0.761
	3						0.388			0.692	0.548	0.666	0.677				
	4							0.839	0.794								

Table 3: EFA Factors loading with 16 items

The internet & computer skills confidence (ICSC) independent variable, having a factor loading less than (0.4), has been removed and thus the relevant hypothesis (H7) was automatically rejected.

Accordingly, the above analysis indicates the following:

- Component 1 groups the technology adoption model (TAM) factors PEOU & PU with WOM, FA and WD social factors.
- Component 2 groups the GI based factors, GIWDEGov, GIPUEGov, GIPEOUEGov and GIEGovAdop, related directly to the dependent EGovAdop.
- Component 3 groups the trustworthiness social factors TI & TG with AT and RTC social factors, and the ICSC will be removed from the Component 3 factors as having a factor loading less than (0.4).
- Component 4 groups only the belief social factors FJLB and RB together.
- All the components except Component 2 are totally or partially social factors.
- All the factors with factor loading exceeding 0.4 and no cross-load across the other components are valid and thus the data collected and the results can be considered reliable and valid.

Based on the EFA results, we started the test of the E-government Citizens' Adoption Framework through various testing method on the framework's influential factors:

- The four components extracted from the EFA – PCA were tested using the Binary Logistic Regression.
- The Pearson Chi-square was performed to check the correlation between the GI independent factor and the other three independent factors (WD, PU and PEOU).
- The Pearson Chi-square was applied in order to examine the relation between the Demographics' factors and the EGovAdop dependent factor.
- All the tested factors were analysed according to their relevant proposed hypotheses in Chapter 4 – Conceptual Framework.

The overall E-government Citizens' Adoption Framework was tested with a df (number of factors tested) equal to 15, representing the independent factors defined as potential influential factors over the e-government adoption (EGovAdop) dependent factor. The model significance (Sig.) was equal to **0.000** with a Chi-square value of **113.639**, the model -2 log likelihood was equal to **174.008**, the Cox-Snell R^2 was equal to **0.243**, adjusted by Nagelkerke R^2, having a value of **0.480**. All the aforementioned results show that the model fits well with the research data.

The Sig. value, calculated for the overall model and for the components based on the omnibus tests of model coefficient, represents the P value that should be less than 0.05 to consider the factor, component or model significant. The -2 log likelihood, which should be a small value close to 0, reflects how much the model or the component fits. The Cox-Snell R^2, ranging from 0 to 1, measures how well the independent factors predict the dependent factor and should be bigger than 0, in addition to the Nagelkerke R^2, ranging from 0 to 1, which is considered as "an adjusted version of the Cox-Snell R^2 that adjusts the scale of the statistic to cover the full range from 0 to 1" (IBM, 2017).

The results of the binary logistic regression are summarized in Table 4:

HN	Factors	Coef. (B)	SE	Sig. (P)	Odd Ratio (Exp. B)	Confidence (95%) Interval	
						Lower	Upper
H1	PEOU	-0.095	0.238	0.688	0.909	0.570	1.449
H2	PU	**0.553**	0.259	**0.033**	1.738	1.045	2.888
H3	WOM	**0.631**	0.202	**0.002**	1.879	1.265	2.791
H4	FA	0.301	0.168	0.074	1.352	0.972	1.880
H6	WD	0.281	0.220	0.202	1.324	0.860	2.040
H21	GI	**1.202**	0.275	**0.000**	3.328	1.941	5.704
H22	GI & WD	**0.673**	0.219	**0.002**	1.960	1.277	3.010
H23	GI & PU	-0.185	0.269	0.491	0.831	0.490	1.407
H24	GI & PEOU	-0.063	0.270	0.816	0.939	0.553	1.595
H10	AT	**0.525**	0.208	**0.011**	1.690	1.127	2.535

H11	TI	-0.332	0.243	0.172	0.718	0.446	1.156
H12	TG	**0.882**	0.246	**0.000**	2.415	1.490	3.914
H13	RTC	**0.556**	0.220	**0.010**	1.744	1.141	2.666
H8	FJLB	**-0.475**	0.163	**0.003**	0.622	0.452	0.855
H9	RB	**-0.320**	0.149	**0.032**	0.726	0.542	0.972

Table 4: Binary Logistic Regression Extracts

The results of the Pearson Chi-Square results are summarized in Table 5:

Factor1	**Factor2**	**Asymp. Sig. 2 sided (P)**	**Pearson Chi-Square Value**	**Contingency Coefficient**	
				Approx. Sig.	**Value**
GI	PEOU	**0.000**	**125.254**	**0.000**	**0.484**
GI	PU	**0.007**	**33.089**	**0.007**	**0.274**
GI	WD	**0.000**	**205.506**	**0.000**	**0.578**
EGov Adop	Gender	0.079	3.087	-	-
EGov Adop	Age	**0.000**	**31.947**	**0.000**	**0.482**
EGov Adop	LI	0.536	3.135	-	-
EGov Adop	LE	**0.000**	**47.325**	**0.000**	**0.322**

Table 5: Pearson Chi-Square extracts

In this study, we have tested and identified, through various analysis tools, such as exploratory factor analysis – PCA, binary logistic regression and Pearson Chi-Square, the factors that have significant influence on e-government adoption. Table 6 shows the proposed hypotheses along with the test result, which classify every hypothesis as accepted or rejected.

HN	**Hypothesis Accepted**	**HN**	**Hypothesis Accepted**
H1	**NO**	**H13**	**YES**
H2	**YES**	**H14**	**NO**
H3	**YES**	**H15**	**YES**
H4	**NO**	**H16**	**NO**
H5	**YES**	**H17**	**YES**
H6	**NO**	**H18**	**YES**
H7	**NO**	**H19**	**YES**
H8	**YES**	**H20**	**YES**

H9	**YES**	**H21**	**YES**
H10	**YES**	**H22**	**YES**
H11	**NO**	**H23**	**NO**
H12	**YES**	**H24**	**NO**

Table 6: Summary of Tested Hypotheses

Based on Table 6 findings, the GI based E-government (GE-Government) Citizens' Adoption conceptual framework was adjusted and the final GI based E-government (GE-government) Citizens' Adoption framework is illustrated in the Figure 3.

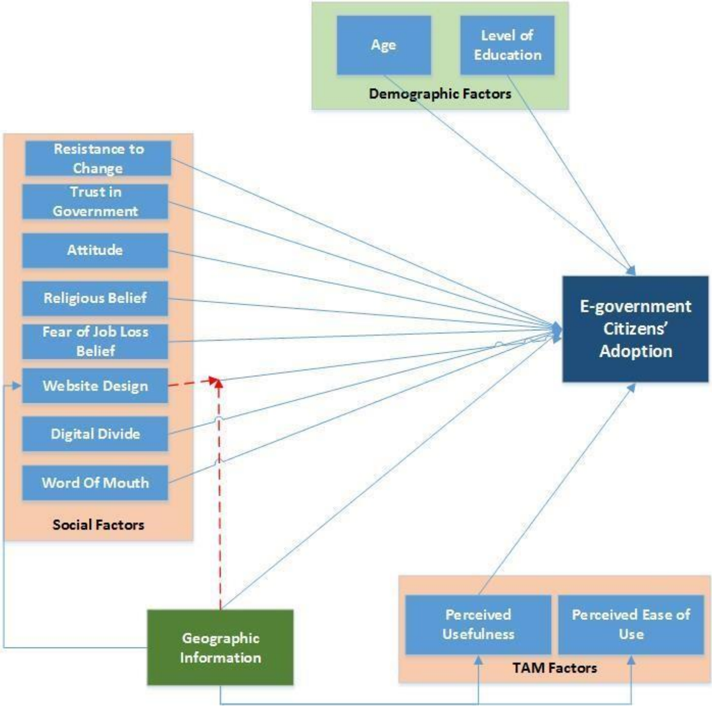

Figure 3: Final GE-government Citizens' Adoption framework

5 Conclusions

The main aim of this research was to assess the role of the geographic information (GI) in citizens' adoption of e-government. The research findings confirm the relation between geographic information and e-government adoption by identifying a new factor, geographic information (GI), as being influential over citizens' adoption of government e-services. Also, it proposes that the GE-government adoption framework is considered a new framework in e-government adoption. This needs to be examined further in the future. We could identify various direct and moderate influential roles of the GI factor over the e-government adoption. The GI factor shows a strong direct influence on e-government adoption, strong direct influence on website design, perceived ease of use and less over perceived usefulness. Finally GI has a strong moderate indirect role in website design, which has been considered non-influential as a standalone factor, but which turned out to be an influential factor when associated with GI. Therefore, GI should be considered in any future studies, and included as a potentially influential factor in any new proposed conceptual frameworks of e-government to assess and examine its influential role in e-government adoption in both developed and developing countries, as it showed a strong significant, direct and moderate role in various factors in the current research setting.

Moreover, some limitations were identified in this research and should be taken into consideration in any future related study, starting from (i) the necessity to test this model in other countries (developed or developing) for further model validation, (ii) the need to diversify the sample population to cover not only employees, considered to be the most likely users of e-government services, and finally (iii) to test the influence on real adoption, as the model is more oriented toward the intention to adopt, especially if we consider the use of TAM model as the basis of our GE-government model.

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