Transforming Government: People, Process and Policy

Prioritization of citizens' preferences for using mobile government services: the analytic hierarchy process (AHP) approach

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Abstract

Purpose: The identification of key criteria that influence citizens' preferences for using m-government services, prioritization of these criteria, and making them consistent with the development of m-government services can improve the relationship of the government with citizens and vice versa. To increase the usage number of m-government services users, the study investigated and prioritized the criteria that influence the usage of m-government services in the United Arab Emirates (UAE) using the technology acceptance model (TAM) and diffusion of innovation (DOI) theory, along with external variables of perceived security and perceived privacy.

Design/methodology/approach: A quantitative approach has been applied using a questionnaire with a nine-point scale for collecting data. The analytic hierarchy process (AHP) approach has been deployed to structure and prioritize citizen's preferences as well as select users of the Ministry of Interior (MOI) application.

Findings: The results of the data analysis showed that the first criteria, which refer to intention to use m-government services, were ease of use and perceived security and were given the highest priority, and the criterion of observability was given the lowest priority.

Originality/value: This study integrates DOI theory and TAM theory with other external variables such as perceived security and perceived privacy to develop a conceptual framework. AHP has been used to structure and prioritize the main criteria and sub criteria of m-government services. The results can assist the m-government decision-makers and software developers in focusing on the criteria that should be considered for the development of m-government services.

Keywords: *Mobile Government, Diffusion of Innovation (DOI), Technology Acceptance Model (TAM), United Arab Emirates (UAE), Analytic Hierarchy Process (AHP)*

Introduction

Information and communication technology (ICT) improves collaboration between citizens, the government, and service providers through the expansion of technology in providing services and fastening the communication (Alotaibi&Roussinov, 2015; Mengistu& Rho, 2009; Sharma, 2015). One of the emergent technologies is electronic government (e-government), which is a technological innovation developed by governmental initiatives that improves and provides equitable access to government services for citizens through wired connection (Alomari, Sandhu& Woods, 2014). Despite the number of e-government initiatives, e-government failed to consider the high penetration of mobile users through wireless technology when providing its public services to the citizens through mobile devices (Abu-Shanab & Haider, 2015). In order to overcome the limitations of e-government, mobile government (m-government) can be considered the next inevitable direction of the evolution of e-government initiatives (Amailef & Lu, 2011).

M-government enables the government to provide public services through mobile devices depending on the availability of wireless technology in order to improve the level of

interaction with its citizens and to provide high-quality services (Abaza &Saif, 2015; Abdelghaffar & Magdy, 2012). One of the greatest advantages of m-government services is the opportunity to provide public services for citizens from any place and at any time (Abu-Shanab & Haider, 2015), along with other advantages, such as accessibility, user proximity, real-time information exchange, and immediacy of messages (Vincent & Harris, 2008).

As a completely alternative way of providing public services through mobile devices, m-government has been accepted in several countries around the world to deliver services to the citizenry with impressive efficiency and effectiveness (Shareef, Dwivedi, Stamati& Williams, 2014). As an area of particular focus in the Gulf Cooperation Council (GCC) countries, the UAE was ranked number one by the United Nation's (UN's) e-smart services index in 2016—the index used to evaluate the performance of e-government and m-government services around the world—amongst all the GCC states for providing the most e-government and m-government services to citizens (Innovation and tech, 2016). Thus, the UAE offered 89.13% of its government services through electronic and mobile portals, followed by Bahrain with 82.61%, Kingdom of Saudi Arabia (KSA) and Qatar with 67.39%, Kuwait with 65.22%, and Oman with 59.42%. Even with the success of implementing m-government services on mobile platforms, m-government will not achieve long-term success and constancy of use until it meets citizens' requirements (Carroll, 2005). Alssbaiheen and Love (2015) and Ishmatova (2007) argued that the citizens' potential preferences depend on the critical factors for the success of m-government.

The current understanding of what preferable factors drive citizens to use m-government services is limited (Abaza & Saif, 2015). In order to develop citizen-centered m-government services that provide citizens with immediate accessibility, relevant information, and high-quality services, m-government developers should understand the citizens' preference factors for using m-government services (Shareef, Archer &Dwivedi, 2012). Therefore, it is important to investigate the key factors that influence the use of m-government services. Thus, this study is designed to measure the key factors that influence the use of m-government by answering the following questions:

(a) What are the key factors that influence citizens' use of m-government services in the UAE?
(b) Which of these factors that influence the use of m-government services in the UAE are most or least preferred by citizens?

The study seeks to prioritize the factors that affect the use of m-government services. These factors were derived using the diffusion of innovation (DOI) theory, which is one of the earliest theories used to test the adoption of information systems (Rogers, 2003), as well as the technology acceptance model (TAM), which was used to determine the acceptance of innovative technology use (Rehman & Esichaikul, 2011). Both focus on individual perceptions in the adoption and use of innovative technology (Kamal, Bigdeli, Themistocleous&Morabito, 2015) along with external variables of perceived security and perceived privacy. To prioritize the factors, the analytic hierarchy process (AHP) approach was adopted. AHP is a useful tool designed to solve complex multi-criteria decision-making problems (Ahmad & Hussain, 2016; Saaty, 2008). AHP provides a means of prioritizing the various elements in the hierarchy, thereby assisting the government and software developers in focusing on the most important issues (Zhao & Khan, 2013).

The study makes its major contributions by satisfying the two research questions. First, the integration of DOI theory and TAM theory along with external variables, i.e. perceived security and perceived privacy, helps to build a conceptual framework for citizens' preferences for m-government services. Second, unlike previous studies, this study tests a comprehensive hierarchical model that examines the criteria underlying citizens' preferences and analyses the relationships that exist among several important higher preferences factors of m-government services using the AHP approach. Third, the study provides empirical support for the integration of the DOI, TAM and external variables with the use of a hierarchical model to conceptualize, measures and prioritizes the citizens' preference of m-government services. Finally, the results of the study will benefit the decision makers and software developers of m-government services to consider the citizen's preferences in developing m-government services in order to promote the wider use of m-government services.

Following the introduction, I offer a brief critical review of m-government from other literature reviews in the context of the UAE. Also, it presents the theoretical framework of DOI and TAM theory—the two theories used in the study. This is followed by a research method section that presents an overview of AHP and its structure. Furthermore, it presents the results and analysis of the collected data using AHP. Finally, the study closes with a discussion of the results, implications, limitations of the study, and the conclusion.

Literature Review

Emergence of Mobile Government (M-Government) Services

Many governments around the world are introducing e-government by exploiting the existence of ICT to develop and improve the delivery of services to citizens (Abaza &Saif, 2015). E-government entails the use of ICT to deliver government services through an application of Internet-based technologies in an interactive manner that attracts citizens using Internet wired technology (Sharma, 2015). It can be considered a way to connect the citizens in an effective and efficient approach through the e-government service initiatives by accessing the government's portal (Zhao, Scavarda & Waxin, 2012). Although e-government improves the interaction between the government and the citizens, developers failed to consider the high level of mobile user penetration through wireless technology when providing public services to the citizens through mobile devices (Abu-Shanab & Haider, 2015). To recover from the limitations of e-government initiatives, mobile government initiatives can be considered a solution for addressing the e-government gap (Amailef & Lu, 2011).

M-government is an extension of or complementary technology to e-government services, with features that enable access to these services through mobile devices (Abu-Shanab & Haider, 2015; Kushchu & Kuscu, 2003; Litan, 2015; Shareef et al., 2012). The main purpose of m-government services is to provide citizens with accessibility anytime and anywhere, user proximity, real-time information exchange, immediacy of messages, and high-quality services (Abu-Shanab & Haider, 2015). Although m-government is considered an extension of e-government, it is challenging for the developers of m-government services to encapsulate and capture the citizens' preference factors in order to improve m-government services (Shareef et al., 2012) due to lack of interaction between the government and the citizens in investigating citizens' preferences to increase the use m-government services (Amailef& Lu, 2011). However, there are important issues that must be considered and that have gained great attention, which include the increased usage of m-government services by citizens (Abaza &Saif, 2015). In order to increase citizens' usage, m-government developers

should focus on the factors that influence their usage and identify the services that are most useful for them, and then focus on providing these services in the way they require (Abaza &Saif, 2015).

M-Government Services in the United Arab Emirates (UAE)

M-government initiatives were launched by His Highness Sheikh Mohammad Bin Rashid Al Maktoum on May 22, 2013. He advised providing services for citizens around-the-clock via a single login that can be used wherever they are (Cherrayil, 2014). The Telecommunication Regulatory Authority (TRA)—which is responsible for the telecommunication and technology industries in the UAE—was established to provide the guidelines and the roadmap for the delivery of m-government services through smart devices. This was successfully accomplished by the end of June 2015. One of the most important objectives of the UAE's m-government is to provide citizens with the best services at a lower cost and to increase overall efficiency and accessibility (Cherrayil, 2014). However, the major track of the UAE roadmap is to meet the desire of citizens by verifying their preferential criteria for using m-government services (TRA, 2014a).

The UAE has achieved remarkable success with m-government by achieving objectives such as improving readiness, making environmental improvements, and achieving user happiness in delivering m-government services (Emirates247, 2015). According to the evaluation by the UN's e-smart services index in 2016, UAE is ranked eighth globally, third in Asia, and first in Gulf Arab countries and Western Asia in implementing its government services in the form of electronic services (e-services) and mobile services (m-services) successfully (Innovationandtech, 2016), which puts the UAE in a competitive position to develop its services around the globe.

Three hundred and thirty-seven services considered paramount by the UAE government were implemented during a smart transition to m-services as m-government services (Emirates247, 2015). The online booking service "The Record" is one such service launched by the Ministry of Health (Gulf News, 2016), which provides easy access to health data for patients who want to check their health status, book appointments, and check medical records such as medical reports, prescription drugs, and laboratory tests. The Ministry of Education (MOE) launched a mobile application called "Abnaai" ("My Children") that provides an interactive environment for parents, their children, and schools (Krol, 2014). The Ministry of the Interior (MOI) launched an application called "MOI UAE" that integrates multiple services such as traffic services, civil defense services, and more (AD Police, 2016). The UAE Ministry of Environment and Water (MOEAW) implemented a mobile application called "M-Environment Self Service" (MOCCAE, 2014), which uses a smart service through Twitter enabling customers to receive automated responses within 15 seconds – the first time such a system has been used in the Middle East and Arab region. The application also provides other services such as guidance initiation, request status, service inquiries, and more.

Following the m-government initiative, the UAE government implemented an application that enables citizens to access services offered by governments across the seven emirates (Abu Dhabi, Dubai, Sharjah, Ajman, Fujairah, RasAlkaimah, and Um Al-Qewain) through a single portal to citizens. The Abu Dhabi government has 26 applications, Dubai has 56 applications, Sharjah has 12, Ajman has 5, Fujairah has 5, RasAlkaimah has 6, and Um Al-Qewain has 1 application. In addition, there are three learning institute applications and nine media institute applications (UAE m-government, 2016). In 2015, the UAE m-government launched an m-government magazine that raises awareness among citizens about m-government initiatives, informs citizens about the most important applications, and provides

other services related to coverage quality (Zawya, 2015). Although the UAE government entities mandated improvement of the services to increase the usage of m-government services (TRA, 2016), the indicator of the proportion of use of electronic/mobile government services is less than the target that has been set by the government. According to the detailed report of smart enabler's government indicators that has been issued by TRA, the usage number of m-government services in 2014 was 21% where the target was 60% and was 41.6% out of the target 65% in 2015 (TRA, 2014b; TRA, 2015). Thus, m-government service developers should interact with citizens in parallel to measure the citizens' preference factors in order to increase the usage of m-government services (Abaza &Saif, 2015).

Theoretical Background: Citizens' Preferences for Using M-Government Services

Various models have been developed in order to investigate and predict users' use of and response to innovation technology. The most widely used theories are the theory of reasoned action (TRA), the diffusion of innovations (DOI) theory, the theory of planned behavior (TPB), the technology acceptance model (TAM), the technology acceptance model 2 (TAM2), and the unified theory of acceptance and use of technology (UTAUT).

The Theory of Reasoned Action (TRA), which was developed by Ajzen & Fishbein in 1975, states that the beliefs in one's mind impact on one's intentions and that intentions influence one's actions (Abaza & Saif, 2015). TRA theory measures the impact of cognitive components, such as intentions, social norms and attitude on the user's behaviors (Guo et al., 2007). In addition, a user's performance of a specified behavior is determined by user's attitude toward the behavior and the social pressure put on the user to perform (Malhotra &Galletta, 1999). In general, TRA is designed to explain virtually the relationship between attitude and behavior within a user's action (Ajzen & Fishbein, 1980). Thus, many researchers have suggested and used TRA as a foundation for investigating a user's technology behavior (Hsu & Lin, 2008; Chang, 2013; Rehman et al., 2007).

The Theory of Planned Behavior (TPB) was developed by Ajzen in 1985 and defined as a dominate model used for predicting and understanding users' behavioral intention (Ajzen, 1985, 1991). Research has indicated that TPB is a well-defined model for exploring a user's acceptance behavior to an information system (IS) (Bhattacherjee, 2000; Hung et al., 2009; Taylor & Todd, 1995). TPB stated that acceptance behavior of IS can be measure by behavioral intention, whereas the behavioral intentions are antecedents including perceived behavioral, attitude and subjective norms (Rana, Dwivedi& Williams, 2013). Riffai, Grant and Edgar (2012) found that TPB provides deep and specific information about a group of users who resist the use of the system, although it is slower, complex and its implementation is more expensive. Hung, Chang and Kuo (2013) have shown that TPB in the context of the m-government can work effectively along with other external factors.

The Technology Acceptance Model 2 (TAM 2) was developed by Venkatesh and Davis in 2000 (Venkatesh & Davis, 2000). Two processes within the TAM 2 model are considered to be crucial to the study of users' acceptance of technology. This involves a) the social influence process, including the following variables: image, subjective norm, voluntariness; and b) the cognitive instrumental process, including the following variables: perceived usefulness, output quality, result demonstrability and job relevance (Wu et al., 2008). Venkatesh and Davis, (2000) identified that TAM has some limitation in explaining the reasons of the way of measuring how users would perceive a given technology's usefulness. To adjust for this, they added the two processes for the TAM variable (perceived usefulness).

Wu et al., (2008) have argued that by using TAM 2 the researcher would be able to provide a detailed explanation for the reasons users considered a giving technology to be useful.

Unified theory of Acceptance and Use of Technology (UTAUT) has been developed by Venkatesh et al. (2003) to overcome the limitation of the TAM model (Riffai, Grant & Edgar, 2012; Abdelghaffar & Magdy, 2012; Abaza &Saif, 2015; Abu-Shanab & Haider, 2015). However, UTAUT is a theory that explains users' intention to use technology and their subsequent behaviors which fulfill the gap in TAM (Venkatesh et al. (2003)). UTAUT is based on different theoretical models, including: TRA, TAM, the theory of TPB, a model combining the TAM and TPB, Model of Personal Computer Utilization (MPCU) - developed by Thompson et. al. (1991) - and deal with workers who use personal computers (pc) by their own choice in an organization that does not mandate the use of pc's-, the social cognitive theory – developed by Bandura, (1986). Moreover, it focuses on the concept of self-efficiency, which is a motivational model developed by Davis et al. (1992) for the study of information technology adoption and use, and DOI (Abaza &Saif, 2015). UTAUT has been implemented in a wide range of Information System (IS) adoption processes and most of IS adoption studies use this theory because it maps all the theories of IS adoption (Rana, Dwivedi& Williams, 2013). UTAUT consists of several factors, namely: performance expectancy, effort expectancy, social influence and facilitating conditions (Abdelghaffar & Magdy, 2012).

Table 1 provides brief comparative information concerning the above theories by presenting the theory developer, the use of that theory, origin of the applied area and remarks about each theory. However, in recent years, despite the increased number of studies that have used these theories, little remains known about users' preferential criteria for using mobile communication technologies and the criteria that influence decisions to use mobile technologies (Al-Hadidi, 2010; Kushchu, 2007). Thus, Al-Hadidi (2010) argued that the combination of both TAM and DOI is the most effective method to test users' preferences for using m-government services. In addition, many studies have suggested the integration of TAM with other theories, such as DOI, in order to overcome rapid changes in technology and improve specificity and explanatory power (Al-Hadidi, 2010; Carter &Bélanger, 2005; Legris, Ingham &Collerette, 2003).

Table 1:
Technology/Innovation Theories

Theory	Use/Stages	Originating area	Remarks
Theory of Reasoned Action (TRA; Ajzen&Fishbein, 1980)	TRA is used to determine the user attitude and behavior. Two main intention factor determinants: 1.Attitude toward behavior (ATB) 2.Subjective norm (SN; social pressure or decision making to perform behavior)	Social psychology	TRA is designed to explain virtually the relationship between attitude and behavior within a user's action (Ajzen&Fishbein, 1980). TRA focuses on users' behavior related to technology. Thus, TAM is the replacement of TRA's attitude since TAM is considered the most influential extension of

			TRA (Conrad, 2009; Shareef et al., 2012).
Diffusion of Innovation (DOI; Rogers, 1962, 1983, 1995, and 2003)	DOI is used to investigate how, why, and at what rate an innovation spreads through cultures. Innovation-decision process can be defined in five stages: 1.Knowledge of an innovation 2.Persuasion toward the innovation 3.Decision to adopt or reject an innovation 4.Implementation of the new idea 5.Confirmation of this decision	Education/Economics/Anthropology/ Marketing and Management/Sociology/Communication/Geography/Technology Adoption	Rogers is considered the only innovation scholar focusing on diffusion theories, both at the individual and organizational level (Conrad, 2009).
Theory of Planned Behavior (TPB; Ajzen, 1985)	TPB was proposed as an extension of the TRA applied to behaviors that are under a lack of control. There are three kinds of belief: 1.Behavioral beliefs 2.Normative beliefs 3.Control beliefs	Social psychology	Riffai, Grant, & Edgar (2012) found that TPB provides deep and specific information about a group of users who resist the use of the system, although it is slower, more complex, and its implementation is more expensive.
Technology Acceptance Model (TAM; Davis, 1989)	TAM influences the extension of the TRA theory, which determines how users come to accept new innovations. The attitude is determined by: 1.Perceived ease of use (PEOU) 2.Perceived usefulness (PU)	Information Systems/Technology Adoption	TAM has been found to have a significant impact on technology/innovation usage behavior. It is considered the strongest theory in terms of acting freely in using technology/innovation without limitation (Barclay, Higgins & Thompson, 1995; Moore & Benbasat, 1991).
Technology Acceptance Model 2 (TAM 2; Venkatesh & Davis, 2000)	TAM 2 is a new version of TAM in which subjective norms are added to measure the intention to use. The attitude is determined by:	Information Systems/Technology Adoption	TAM 2 focuses on a detailed explanation for the reasons users find a given technology to be useful (Wu, Chou, Weng & Huang, 2008) more than the users' preferences.

	1.Perceived ease of use (PEOU) 2.Perceived usefulness (PU) 3.Subjective norms		
Unified Theory of Acceptance and Use of Technology (UTAUT; Venkatesh,Morris, Davis & Davis, 2003)	UTAUT is used to determine the intention and behavior of the users over time. The construct of usage behavior and usage intention: 1.Performance expectance 2.Effort expectancy 3.Social influence 4.Facilitating conditions	Information Systems/Technology Adoption	Rana, Dwivedi and Williams (2013), found that the UTAUT is not a sufficient theory that can be used to test the users' preferences for e-government services, which means it cannot be applied to m-government services.

Technology Acceptance Model (TAM)

TAM is considered one of the most widely used theories in information technology for measuring the influence and predicting the response to use of innovative technologies (Abaza &Saif, 2015; Abdelghaffar & Magdy, 2012; Conrad, Michalisin & Karau, 2012; Liu, Kostakos, Goncalves, Hosio & Hu, 2014; Rana, Dwivedi & Williams, 2013). TAM is an extension of Ajzen and Fishbein's (1980) theory of reasoned action (TRA), which states that once someone has a belief in mind, it will influence his or her intention, and his or her intention will influence his or her action (Abdelghaffar & Magdy, 2012). However, Conrad (2009) argued that the TAM is a replacement model of TRA attitudes that measures the acceptance to use of the technology because TRA measures the user's behavior in connection with the use of the technology. This model consists of two factors that determine people's acceptance to technology based on their intention of usage: perceived usefulness (PU) and perceived ease of use (PEOU; Abaza &Saif, 2015).

PU is defined as the degree to which the individual is able to use a particular system and whether this system can enhance his or her job performance (Liu et al., 2014), which can be achieved by providing certain m-government services (Abdelghaffar & Magdy, 2012). PEOU, on the other hand, is defined as the degree to which a user of a particular system believes that using it will be free of effort (Abaza &Saif, 2015). Shareef, Archer, and Dwivedi (2012) mentioned that "ease of use" refers to the nearest of the mobile devices that citizens can use to apply for government services. "Ease of use" can be more rigidly defined as how clear the application is, whether it is user friendly, whether it is easy to learn how to use it, and whether it is free of effort compared with the previous method used. Liu, Kostakos, Goncalves, Hosio and Hu (2014) supposed that the criterion for using m-government services was a product of these two factors.

Abu-Shanab and Haider (2015) explored the factors influencing the adoption of m-government services in Jordan. The study used TAM theory and discovered that both PEOU and PU were major motivating factors for the use of m-government services. Moreover, Liu et al. (2014) investigated the factors driving the adoption of the use of m-government services in rural China. The study used TAM theory and found that PEOU and PU were important

attributes of technology. Furthermore, Zhao and Khan (2013) used TAM theory to investigate the factors influencing e-government adoption in the UAE and found PU to be significant factor for the adoption of e-government services. Despite the fact that the TAM theory was developed to study users' acceptance of innovative technology and to predict the factors influencing the use of the innovative technology (Kushchu, 2007), Al-Hadidi (2010) argued that the TAM theory does not fully cover specific influence and usage context factors regarding the use of m-government services. Therefore, this study utilized DOI theory to investigate the criteria and citizens' preferences for the use of m-government services.

Diffusion of Innovation (DOI)

DOI is another theory purporting to explain users' preferential criteria for using new technology (Abdelghaffar & Magdy, 2012; Conrad et al., 2012; Rana, Dwivedi& Williams, 2013; Sharma, 2015). This theory is seen to be a good fit for measuring users' usage and can be considered the only proven theory that scholars use to measure the diffusion between the government and the citizens' level (Abaza & Saif, 2015; Abdelghaffar & Magdy, 2012; Conrad, 2009). The theory was developed by Rogers in 1995. The theory model consists of five factors that influence users' decision to use a new technology on organizational levels, which are relative advantage, compatibility, complexity, trialability, and observability (Conrad et al., 2012; Rogers, 2003; Sharma, 2015). Relative advantage refers to the degree to which individuals can receive the idea in a better way than is expected (Rogers, 1995). Robinson (2009) found that the greater the perceived relative advantage of innovation, the more rapid its usage rate is likely to be because social prestige will be created to match the users' requirements, increasing productivity and efficiency as well as saving users time. Compatibility is the degree to which innovation can be compatible with the existing users' needs and values, as well as the users' past experiences (Abaza &Saif, 2015; Abdelghaffar & Magdy, 2012). Carter and Bélanger (2005) and Conrad, Michalisin and Karau (2012) found that compatibility is a significant indicator for predicting citizens' criteria for using e-government services. Seen from this perspective, compatibility must fit citizens' style and needs and not conflict with previously implemented ideas (Rogers, 2003).

Complexity is defined as the degree to which innovation or technology is relatively difficult to use or understand by the user (Rogers, 2003). Moore and Benbasat (1991) assert that the more complex the technology is, the more maintenance it needs, the less user friendly it is, the more complex it is to operate the service, the more effort required on the user's part, and therefore it is less likely to be used. Trialability is the degree to which innovation is tested or experimented with by the user, which means that if the citizens get the chance to use the trial version within a certain period of time and in an effective way that is noticed by the government effort, then the citizens will easily accept long-term use of the e-government service (Conrad et al., 2012). Moore and Benbasat (1991) mentioned that the user must have access to the technology and service before applying for them. Observability is the degree of the innovation's visibility to users and how easily the benefit can be shared with others (Rogers, 1995). Observability is a significant variable that can be used to measure the user's criteria for using the innovative technology by determining how accessible it is to the user and how frequently it is used by others (Carter & Bélanger, 2005). Conrad et al. (2012) mentioned that there is a similarity between the factors in DOI and TAM that have been proven by other studies. These factors comprise a relative advantage that is similar to PU and complexity, which are the opposite of ease of use (Conrad et al., 2012).

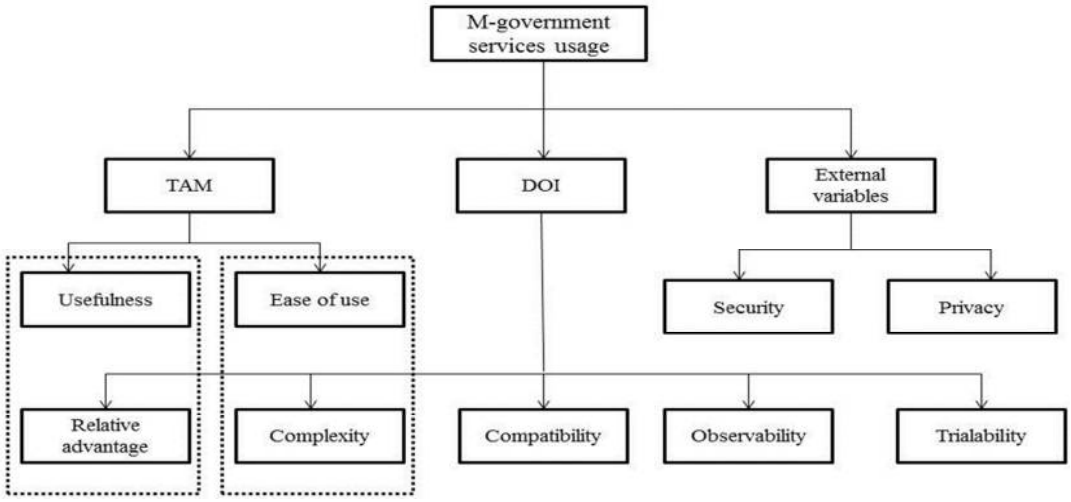
Briefly, the study used both TAM and DOI theories because both are important in testing the understanding of acceptance, rejection, and usage criteria for new technology (Al-Hadidi,

2010; Davis, 1989; Davis, Bagozzi&Warshaw, 1992; Venkatesh et al., 2003; Ziamou, 2002). In addition, both theories were used to research the usage, acceptance, and innovation process of both the individual and organization (Gallivan, 2001). Furthermore, these theories have strong methodological support, which makes them popular and widely accepted by scholars (Venkatesh et al., 2003). Thus, this study investigates citizens' preferences and prioritizes them using the combination of TAM and DOI criteria, along with the external variables of perceived security and perceived privacy, ensuring that the results obtained herein are methodologically sound.

Perceived Security and Perceived Privacy

Many other studies have considered different variables that affect the use of a new technology (Abdelghaffar & Magdy, 2012; Carter & Bélanger, 2005; Zhao et al., 2012). Most of the factors are related to subjective norms and perceived behavior controls that influence use of new technology (Hung, Chang & Kuo, 2013). By considering other studies, Carter and Bélanger (2005) integrated constructs from TAM and DOI models, along with the Web trust (privacy and security) model, in order to create a model of factors that impact citizens' adoption of e-government initiatives. The findings indicate that trustworthiness, compatibility, and PEOU are significant predictors of citizens' criteria for using an e-government service. Kumar and Sinha (2007), Chang, Kannan, and Fellow (2003), and Alhujran and AlMigdadi (2013) mentioned that perceived security and perceived privacy play a vital role in the usage of an innovative technology. Security and privacy have been established as the primary issues with mobile technology, given that users will not use the technology without trusting it (Suo, Liu, Wan & Zhou, 2013). Kumar and Sinha (2007) considered the perceived security of innovative technology as the hallmark of a successful technology because it provides comfortability in use, provides more financial security, and increases the safeguard level and trustworthiness. Perceived privacy can be accomplished when the citizens accept that the government uses their personal information and trust that their information is fully protected and when they know their rights (Suo et al., 2013). Shareef et al. (2012) examined the behavior regarding adoption of m-government services and found that perceived security is a significant factor that affects the adoption of the use of the services. Furthermore, Shrama (2015) explored the adoption of e-government services in Oman and found that perceived security is one of the most important predictors of the willingness to use e-government services. To sum up, this study extends TAM theory and DOI theory, including the external variables of perceived privacy and perceived security, to investigate users' preferences for using m-government services in the UAE. Figure 1 below presents the conceptual framework of the variables affecting the use of m-government services.

Figure 1:
Conceptual Framework



Methodology

An AHP approach is used in this study in order to prioritize the factors affecting the use of m-government services which will outline the strategic plan for the decision-maker and software developer to develop mobile services according to citizens' preferences. AHP was developed by Thomas Saaty in 1970 and used for understanding complex system issues in order to structure managerial decision-making in a hierarchical way (Saaty, 2008). In other words, AHP is a theory used to measure a pairwise comparison that relies on expert judgment and provides a priority scale among a set of alternatives (Sipahi& Timor, 2010). AHP consists of two fundamental approaches to solving problems: the deductive approach that focuses on the parts and the system approach that focuses on the entire system.

Recent studies that have recorded impressive success in using AHP, have validated the theory as an emerging solution for decision making, especially when one is faced with a mix of quantitative, qualitative, and sometimes conflicting factors (Ahmad & Hussain, 2016; Forman and Gass, 2001; Ishizaka, Nemery & Pearman, 2012; Kumar & Aidya, 2006; Liberatore&Nydick, 2008; Sipahi& Timor 2010; Vargas, 1990). For example, Ahmad and Hussain (2016) applied the AHP method in the international education sector; Kurttila et al (2000) and Masozera et al (2006) in environmental management; Lee and Kwak (1999) and Kwak and Lee (2002) in health care management; Ngai and Chan (2005) and Grimaldi and Rippa (2011) in knowledge management; Seffah, Gulliksen and Desmarais (2005) and Seffah and Metzker (2008) in software engineering; Radasch and Kwak (1998) and Kwak, Lee and Kim (2005) in marketing discipline; and Chen and Zuo (2006) in mobile access services.

AHP was very effective for making complex, often irreversible decisions. The initial stage before the implementation of the mobile service system is to perform a detailed analysis of

the system, often referred to as an IT system selection. It is essential to analyze the domain of interest to be able to establish all the procedures that the new system will support. This analysis should cover the entire spectrum of user categories. This step is followed by a description of the requirements of the system to be implemented (Lai, Wong & Cheung, 2002). This should cover both the functional tasks that provide a description of the specific tasks to be performed by the system and the non-functional requirements that generate the criteria and goals of the system other than the specific attributes.

The last two steps are performed correspondingly. The first one regards the selection of alternatives, while the last one is the determination of comparison criteria. In the development of a new system, there are more subcategorized alternatives when compared to an existing system. The various criteria used for comparison of the alternatives should also be included in every aspect of the system's implementation, usage, and functionality (Millet & Schoner, 2005; Wei, Chien & Wang, 2005). The criteria include:

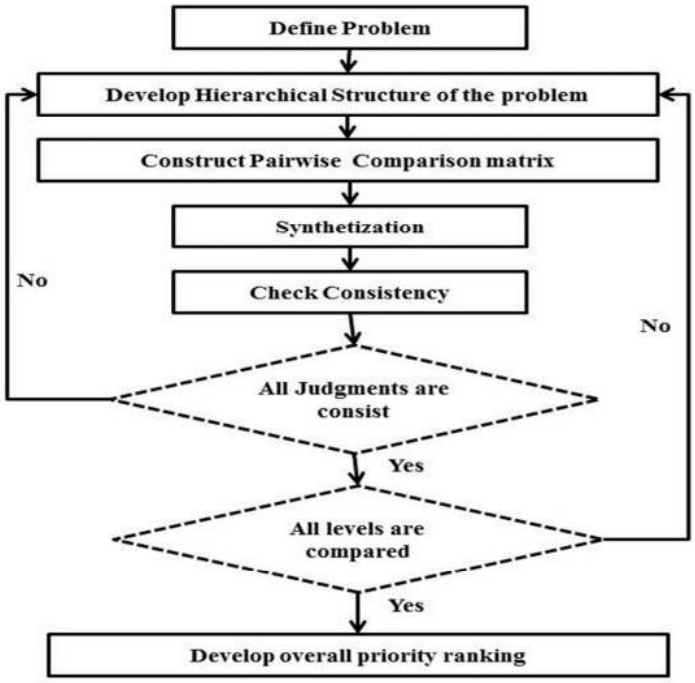
(a) Managerial—mostly related to the cost and required time of implementing the new IT system.
(b) User-related—refers to the capabilities of the system with regard to satisfaction of the requirements (functional and non-functional), ease of use, success of the system regarding the former.
(c) Technology-related— refers to the expertise or skills necessary to use the system (in terms of both hardware and software).
(d) Vendor-related—refers to the vendor's expertise, stability, and reputation.

Why AHP?

The study illustrates the citizen's preference factors to successfully increase the usage of m-government services based on DOI and TAM theories with other additional construct. In order to structure and prioritize the citizen's preference factors (main criteria) and the sub factors (sub criteria), the AHP method is employed in this study. AHP has proven to be a very useful technique when the decision-maker of any organization must deal with complex, unstructured, and multi-criteria problems in order to make the overall best decision (Ahmad & Hussain, 2016). The strength of AHP lies in its ability to recognize users' judgments about the importance they attach to different influential factors and to structure a complex and multi-criteria system matrix (Ahmad & Hussain, 2016). By applying AHP, the decision-maker can identify several criteria, and measure their relative importance in order to determine priorities among them (Saaty, 1994). Therefore, this study uses AHP to measure the conceptual model by assessing relative importance and to determine the priority weights of the criteria and sub-criteria according to the citizens' preferences and judgments that lead to an increase in the use of m-government services.

Abaza and Saif (2015) assert that to predict citizens' preferences for using m-government services, the government should focus on and prioritize the factors affecting the use of m-government services through highlighting and prioritizing the criteria affecting m-government. The criteria are ranked depending on how they meet the requirements. The organization can decompose a decision by generating priorities for making the decision by following the AHP analytic hierarchy phases (Saaty, 2008), as shown in Figure 2.

Figure 2:
The AHP Process



Source: Saaty, (2008)

Analytical Hierarchy Framework

This study can be considered pioneering in that it uses AHP to refine the current theories with the attributes of using a new technology in order to define the key factors that compel a user to use m-government services and to prioritize these factors. Thus, the study has composed a multi-criteria decision-making hierarchy of this prioritization process. To deal with the complexity of the multi-criteria decision-making process, AHP has been applied using the four phases mentioned above.

Applying AHP

To answer the central questions of this study, a quantitative approach has been used via AHP. The first phase is to formulate an AHP hierarchy of the citizens' preferences for using m-government services in the UAE, which could be easily applied by m-government developers. This research is aimed at establishing the key factors that increase the usage of m-government services in the UAE. Therefore, this research is segmented into a hierarchal process, and the AHP has been applied to investigate this complex hierarchal system. This hierarchy is classified into several levels. In the highest level, the goal of this paper has been specified as the citizens' preferences for using m-government services in the UAE. That is followed by an intermediate level that mentions the main criteria of this research, which were derived from extensive literature reviews. The main criteria of this study include relative

advantage, compatibility, trialability, ease of use, observability, privacy, and security. Following the main criteria, there are sub-criteria for each separate criterion. At the lowest level, the alternative decision has been measured, which is the Ministry of Interior (MOI) application's user. Figure 3 presents the hierarchy of the AHP for measuring the citizens' preferences for using m-government services. Table 2 shows the main criteria and sub-criteria that have been adopted from other research and modified to fit the concept of m-government.

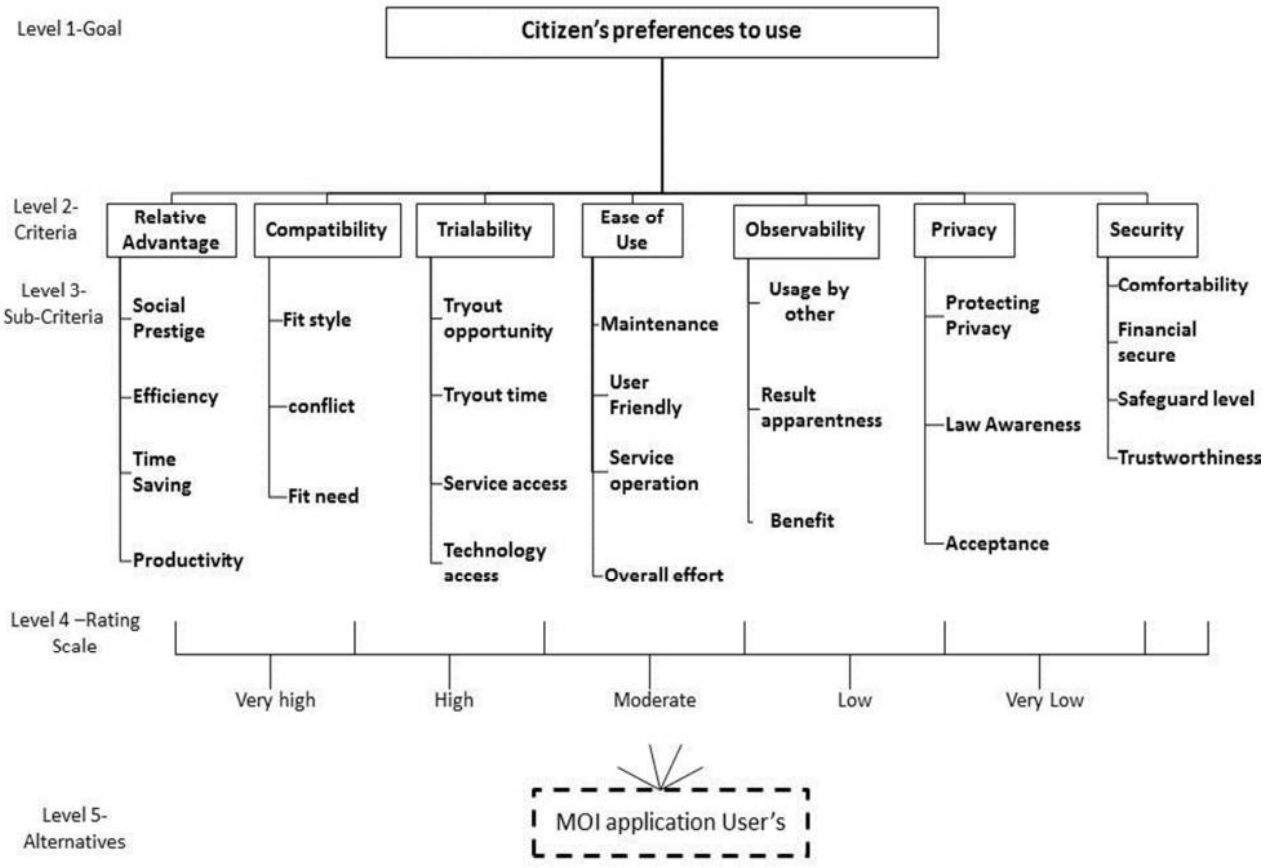
Table 2:
The Main Criteria and Sub-Criteria

Criteria	Sub-Criteria	Definition	Source
Relative Advantage (Usefulness)	Social prestige	Utilization of m-government services enhances citizens' prestige	(Moore & Benbasat, 1991)
	Efficiency	Using m-government services increases efficiency compared with the traditional way	
	Time saving	Using m-government services will save citizens time compared with the time consumed using a traditional method	
	Productivity	Using m-government services does not affecting work progress	
Compatibility	Fit style	M-government services fit well with the current technology style	(Moore & Benbasat, 1991)
	Conflict	M-government services do not conflict with the traditional system	
	Fit needs	M-government services fit the citizens' needs	
Trialability	Tryout opportunity	Citizens have the chance to try out the system before it is launched	(Moore &Benbasat, 1991)
	Tryout time	Citizens have the chance within a period of time to test m-government services before they are launched	
	Technology access	Citizens have proper access to the technology (using smart mobile	

		devices) before the implementation	
	Service access	Citizens have proper access to m-government services	
Ease of Use (Complexity)	Maintenance	It is easy to maintain the issues related to applying the services through m-government services	(Davis, 1989; Moore & Benbasat, 1991)
	User friendly	Using m-government services is easier compared with the traditional method	
	Service operation	It is easy to operate the service compared with a traditional service	
	Overall effort	It takes less effort compared with the traditional way	
Observability	Usage by others	Lots of people are using m-government services	(Moore & Benbasat, 1991)
	Result apparentness	Results of using m-government services are apparent to citizens	
	Benefits	There is proper information on the benefits of using m-government services	
Privacy	Protecting privacy	Citizens feel safe using their personal information	(Suo et al., 2013)
	Law awareness	Citizens are aware of their rights	
	Acceptance	Citizens accept logging in to find their personal information	
Security	Comfortability	Citizens feel comfortable when using a secure process	(Bélanger & Carter 2008; Fang, Chan, Brzezinski & Xu, 2005)
	Financially secure	Citizens believe that the services are financially secure	
	Safeguard level	Citizens feel that enough safeguards are provided to protect them	
	Trustworthiness	Citizens believe they are adequately protected	

		by government law	

Figure 3:
The Hierarchy Structure for Citizens' Preferences for Using M-Government Services



After building the AHP model hierarchy, the next phase is measurement and data collection. Particularly regarding the preferences for using the Ministry of Interior (MOI) application's services in the UAE, data were collected from the users of this application. A questionnaire was designed based on a nine-point scale, as suggested by Saaty (2008), which covers the seven main criteria (relative advantage, compatibility, trialability, ease of use, observability, privacy, and security) and subsequent sub-criteria of the attributes. The questionnaire was pilot tested with the expert opinion-one with special skills or knowledge of subject (Walton, 2010)- of the MOI application collected from MOI users' contacts, and some of the items had to be rephrased to make them more representative of the intended constructs. An evaluation was made by 20 MOI application senior users who have been selected from the MOI mobile application database according to years of experience using the application. Applying for mobile service more than 30 per year, most the services applied without any failure or mistakes and has clear understanding about the study. In addition, they provided feedback and filled out a user satisfaction survey. The users have been contacted through their mobile instruments. This study used the geometric mean approach instead of the arithmetic approach to combine the individual pairwise comparison judgment metrics, as suggested by Saaty, in order to apply the consensus pairwise comparison judgment metrics for all users.

The next stage in the AHP is to determine the pairwise comparison among the criteria. As suggested by Saaty (2008), a nine-point scale was used to determine the pairwise comparison,

as shown in Table 3. For example, if the user identified that relative advantage is more important than ease of use, then the relative advantage was rated "5" and the ease of use was rated "1/5" in this comparison, and so on.

Table 3:
The Fundamental 9-Point Scale for Pairwise Comparisons

Intensity of importance	Definition	Explanation
1	Equal importance	Two criteria contribute equally to the Objective
3	Moderate importance	Experience and judgment slightly favor one over another
5	Strong importance	Judgment and experience strongly favor one over another
7	Very strong importance	A criterion is favored very strongly over the other and its dominance is demonstrated in practice
9	Extreme importance	Important of one over another affirmed on the highest possible order
2,4,6,8	For comparison between the above values	Used to represent compromise judgment between the priorities listed above

After determining the pairwise comparison, a check for consistency is required. To check the consistency index (CI), the formula below was used, as suggested by Thomas (1980):

$$CI = \frac{\lambda_{max} - n}{n - 1}$$

Where λ_{max} is the maximum eigenvalue of the matrix of the importance ratios and n is the number of elements. Later on, the consistency ratio (CR) was used to assess whether a matrix was sufficiently consistent or not. The CR was calculated using the ratio of the CI to the random index (RI), which is the CI of a matrix of comparisons generated randomly. Table 4 present the Random index according to the n (size of matrix or number of criteria). For example, if number of main criteria n=7, this mean that RI= 1.35.

$$CR = \frac{CI}{RI}$$

Random pairwise comparisons were simulated to produce average random indices for different sized matrices. Saaty (1983) stated that the inconsistency is acceptable if the CR is smaller or equal to 0.10.

Table 4:
Random Index

Size of Matrix (n)	1	2	3	4	5	6	7	9	9	10
Random Consistency	0.00	0.00	0.52	0.89	1.11	1.25	1.35	1.40	1.45	1.49

Analysis

As suggested by Saaty (1990), this study used the geometric mean approach instead of the arithmetic approach to combine the individual pairwise comparison judgment metrics to

apply the consensus pairwise comparison judgment metrics for all the users. Table 5 presents the geometric means of pairwise comparisons for the users of the MOI mobile application for the main criteria. For example, by creating the comparison matrix for the main criteria, one of the respondent rate the relative advantage – compatibility as 1/8 which mean that the respondent found that both factors are rated between very strong and extreme importance from the perspective of MOI mobile application's compatibility. Where other respondent rate the same relation as 5 which mean that both factors are rated between very strong and extreme importance from the perspective of MOI mobile application's relative advantage. After that the average of all respondents is measured for each relationship in the matrix (the average of the relative advantage – compatibility = 4.05). Afterwards, the relative priority was defined for each main criterion by calculating the priority vector, as shown in the last column of Table 5. Saaty (1990) introduced a "consistency principle" for calculating priority vectors. The consistency principle that says $a_{ik} = a_{ij} - a_{jk}$ and the subsequent argument for using the special case of the consistency matrix were formed by elements $a_{ik} = \frac{Wi}{Wj}$, where Wi and Wj are the elements of the priority weight vector corresponding to criteria i and j.

Table 5:
Geometric Means of Pairwise Comparisons for the Main Criteria

	Relative Advantage	**Compatibility**	**Trialability**	**Ease of Use**	**Observability**	**Privacy**	**Security**	**Priority Vector**
Relative Advantage	1	4.05	5.63	0.35	3.03	1.30	0.31	0.17
Compatibility	0.25	1	5.60	0.30	2.90	0.70	0.31	0.10
Trialability	0.18	0.18	1	1.10	1.53	0.37	0.15	0.06
Ease of Use	2.90	3.32	0.91	1	6.60	1.57	0.57	0.22
Observability	0.33	0.35	0.66	0.15	1	0.65	0.48	0.05
Privacy	0.77	1.43	2.68	0.64	1.54	1	3.69	0.18
Security	3.19	3.26	6.54	1.76	2.09	0.27	1	0.22
								CR = 0.00 < 0.10 (Acceptable)

It is evident that ease of use and the perceived security have the highest priority and are jointly preferred overall the criteria, which are weighted at 0.22, and the perceived privacy is the next competitive priority at 0.18, followed by relative advantage, which has a priority of 0.17, and the least important is the observability, at 0.05. The consistency ratio (CR) for the main criteria and sub-criteria is acceptable because it is below the upper limit, which is 0.01, as shown in Table 5.

Table 6 shows that social prestige is mostly preferred by the user, which is weighted at 0.39. The second preferred sub-criterion of the relative advantage is time saving, the weight of which is 0.25. The least preferred sub-criterion is efficiency, which was weighted at 0.17. The CR value shows that the result is consistent.

Table 6:

Geometric Means of Pairwise Comparisons for the Sub-Criterion: Relative Advantage

	Social Prestige	Efficiency	Time Saving	Productivity	Priority Vector
Social Prestige	1.00	5.84	2.08	3.64	0.39
Efficiency	0.17	1.00	3.31	0.15	0.17
Time Saving	0.48	0.30	1.00	6.60	0.25
Productivity	0.27	6.89	0.15	1.00	0.19
CR = 0.01 < 0.10 (Acceptable)					

As shown in Table 7, the highest preferred sub-criterion of the compatibility is the conflict, which is weighted at 0.42, followed by the compatibility's fit style of citizens to use these m-government services, which is weighted at 0.38. The least preferred sub-criterion is the fit need, in which the users think that it does not meet their needs, so it is weighted at 0.20. The CR value shows that the result is highly consistent.

Table 7:
Geometric Means of Pairwise Comparisons for the Sub-Criterion: Compatibility

	Fit Style	Conflict	Fit Need	Priority Vector
Fit Style	1.00	1.22	1.43	0.38
Conflict	0.82	1.00	2.87	0.42
Fit Need	0.70	0.35	1.00	0.20
CR = 0.00 < 0.10 (Acceptable)				

As mentioned above, the trialability is the degree of interfering with the users to use the trial version of these application services in an interval of time before the launch of these services. The tryout apparentness of the trial version is highly preferred by the users, which was weighted at 0.32, followed by the technology access before the trial version is implemented, which was weighted at 0.31, as shown in Table 8. The least preferred sub-criterion is the service access to this trial version, the weight of which is 0.15. The CR value shows that the result is highly consistent.

Table 8:
Geometric Means of Pairwise Comparisons for the Sub-Criterion: Trialability

	Tryout Apparentness	Tryout Time	Service Access	Technology Access	Priority Vector
Tryout Apparentness	1	4.20	2.11	0.32	0.32
Tryout Time	0.24	1	2.04	1.23	0.22
Service Access	0.47	0.49	1	0.91	0.15
Technology Access	3.13	0.82	1.09	1	0.31
CR = 0.00 < 0.10 (Acceptable)					

Table 9 shows how much easier the application of m-government services is. The results show that the user friendliness of the application is the most important for the users, the weight of which is 0.55, and the least important is the overall effort required to use this application, so its weight is 0.05.

Table 9:
Geometric Means of Pairwise Comparisons for the Sub-Criterion: Ease of Use

	Maintenance	**User Friendly**	**Service Operation**	**Overall Effort**	**Priority Vector**
Maintenance	1	0.31	2.87	4.80	0.25
User Friendly	3.27	1	4.25	7.80	0.55
Service Operation	0.35	0.24	1	5.80	0.16
Overall Effort	0.21	0.13	0.17	1	0.05
CR = 0.00 < 0.10 (Acceptable)					

The degree to which the application is visible to the individual and he or she can tell others about it is called observability, which is shown in Table 10. The usage by others' sub-criterion means that many people use the services and the user is following them. It is highly rated by the individual, and its weight is 0.61. The lowest rated is the benefit of this application, the weight of which is 0.16. The CR result shows the consistency of the data given.

Table 10:
Geometric Means of Pairwise Comparisons for the Sub-Criterion: Observability

	Usage by Others	**Result Apparentness**	**Benefit**	**Priority Vector**
Usage by Others	1	4.07	2.86	0.61
Result Apparentness	0.25	1	2.08	0.23
Benefit	0.35	0.48	1	0.16
CR = 0.00 < 0.10 (Acceptable)				

Table 11 shows the perceived privacy for the individual regarding his or her personal information. The highly prioritized sub-criterion is the protection privacy,which is weighted at 0.55, and the lowest sub-criterion is law awareness, which is weighted at 0.13. The CR result shows the consistency of the data.

Table 11:
Geometric Means of Pairwise Comparisons for the Sub-Criterion: Perceived Privacy

	Protecting Privacy	**Law Awareness**	**Acceptance**	**Priority Vector**
Protecting Privacy	1	3.80	1.94	0.55
Law Awareness	0.26	1	0.36	0.13
Acceptance	0.52	2.81	1	0.32
				CR = 0.00 < 0.10 (Acceptable)

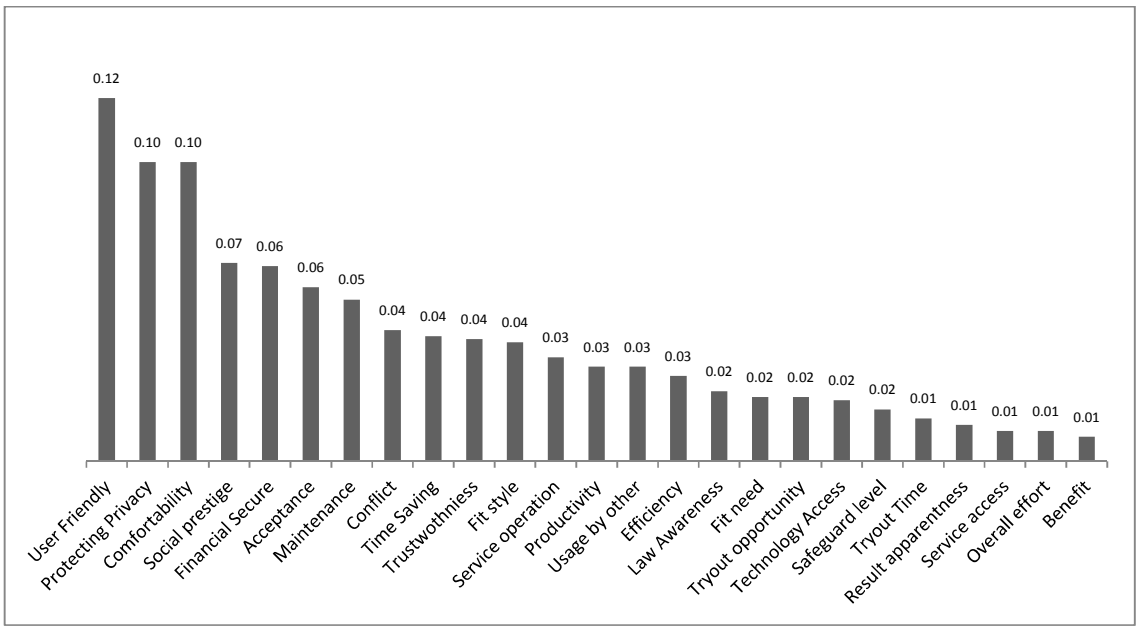
The perceived security sub-criteria are shown in Table 12, which shows that the comfortability of the individual is highly rated at a weight of 0.42, and the least preferred sub-criterion is the safeguarded level, which is weighted at 0.08. The CR result shows the consistency of the data.

Table 12:
Geometric Means of Pairwise Comparisons for the Sub-Criterion: Perceived Security

	Comfortability	**Financially Secure**	**Safeguard Level**	**Trustworthiness**	**Priority Vector**
Comfortability	1	2.11	5.00	2.10	0.45
Financial Secure	0.47	1	5.27	1.53	0.29
Safeguard Level	0.2	0.19	1	0.49	0.08
Trustworthiness	0.48	0.65	2.04	1	0.18
					CR = 0.00 < 0.10 (Acceptable)

The last step is calculating the global priority weights for the alternative of using pairwise comparison. Global priority was derived by multiplying each main criterion by its sub-criteria (Saaty, 2008). In this research, we used seven criteria (relative advantage, compatibility, trialability, ease of use, observability, perceived privacy, and perceived security) and one alternative, which is the MOI application's user. Figure 4 shows the derived priority for all the sub-criteria, along with their global priority level. The ease of use sub-criterion (user friendly) has the highest priority, the weight of which is 0.12, followed by protecting privacy and comfortability, which are the sub-criteria of perceived security and have the same priority weight, which is 0.10. The least important sub-criteria are the benefit, overall effort, service access, result apparentness, and tryout time, whose weights are 0.01.

Figure 4:
Global Priority for the MOI Application's User



Discussion

The UAE government strives to provide services to citizens in an easy way in order to gain their trust. That is why governments take advantage of the availability of the Internet and smart devices to provide services through mobile applications. After considering the main criteria affecting the citizens' preferences for using m-government services, the AHP was used to filter out the most important criteria that affect the use of m-government services. The result shows that ease of use and perceived security have the highest priority weight (0.22), which means that the citizens found the MOI application easy to use and that the platform of the application was highly clear and could be used by different individuals with no concern for their demographic characteristics. Abdelghaffar and Magdy (2012) found in their study that ease of use is insignificant to predict the response to use of m-government services, which is contrary to the results found in this study. In addition, from the security side, the citizens found that this application is highly secure and that the users can trust in using their visa or credit card as a payment method. Furthermore, the study shows how much more important ease of use is to the citizens,which is contraryto other studies that found that ease of use is less important to predict the usage (Abdelghaffar & Magdy, 2012; Rokhman, 2011). On the other hand, the result also shows that relative advantage (0.17) and perceived privacy (0.18) have a moderate priority, which means that (in terms of relative advantage) the individuals perceived the application in a way that is different than they expected and that this application saved them time and increased their productivity because they could use it anytime and anywhere due to the availability of the Internet. Also, regarding perceived privacy, the application uses the individual's personal information, and the individual accepts use of his or her personal information with little worry about privacy because all of the information is securely protected and the individual is aware of his or her rights. Abdelghaffar and Magdy (2012) found that the user's trust (trust is the degree of a user's belief and faith in the government services to ensure security and privacy) is less important and does not affect the use of the government services, which is contrary to the result found

in this study,which shows how important it is to provide security and privacy to the user. This result shows how much the government needs to care about security and privacy in order to gain the trust of the individual. Once the individual has lost the trust,he or she will not be able to use the government services via the smart devices. Conversely, observability (0.05) and trialability (0.06) had the least priority, which shows that these services are not visible to the individual, that fewer users use it, and that the overall effort is more comparable to the traditional method. In addition, the individual did not get the chance to try out these services within a certain period of time before the launch of the service in order to provide comments and resolve the application bugs. This means that the MOI did not care much about sharing the trial version of the application with users before launching.

The result of ranking the sub-criteria in Figure 4 was that the sub-criterion user friendly, the weight of which is 0.12, is highly preferred by the MOI application users, which means that the users found the application to be easy to use. The next important sub-criteria are protecting privacy and comfortability, which are weighted at 0.10 and show that the MOI application highly protects the individual's personal information and that the individual feels confident using the service. Also, the users appreciate that the application matches their prestige because it matches recent technology, and they are confident when applying for the online payment and accepting it confidentially, which is shown in the sub-criteria social prestige, financially secure, and acceptance, with weights of 0.07, 0.06, and 0.06, respectively. On the other hand, the study found that the least important sub-criteria are tryout time, result apparentness, service access, and benefit, which are weighted at 0.01. These results show that the users did not get the chance to test the trial version of the MOI application before the service was launched, and they did not get the chance to access the service to provide their feedback. Also, they did not observe the advantage of using the application over the traditional method. In addition, the overall benefit of this application is not clear to them.

Theoretical Contribution

From a theoretical perspective, this study makes several contributions. First, it fills an important gap in the literature because it helps to highlight the importance of interaction between the government and the citizens by understanding citizens' needs, such as by investigating the preferential criteria and challenges that influence the success of m-government services that are required by citizens to access government services through mobile devices. Second, it adds value by incorporating both the TAM and DOI theories, including perceived privacy and perceived security, into a single hierarchy structuring model as a pioneering method in the context of m-government services.

Third, the study examines the main criteria and sub-criteria using the AHP method by investigating the key factors (main criteria and sub-criteria) that influence the usage of m-government services. This provides more insight to researchers in the same field using the same method to prioritize the key factors needed for decision making. Fourth, this research contributes to knowledge by providing a new understanding of the sub-criteria that either highly influenced or had less of influence on the users of m-government services, which have been ranked to depict the criteria's degree of significance to influence the usage of m-government services.

Practical Contribution

In practical terms, this research will enable decision-makers (or software developers) who are responsible for designing m-government initiatives to better understand the criteria preferred

by the users of m-government services they develop. As shown in the findings, understanding the m-government environment is crucial for implementing successful initiatives in the future. The knowledge provided by the study can assist decision-makers in gaining an in-depth understanding of TAM and DOI factors that can be used to successfully implement m-government services, as required by the citizens. In addition, this study can assist the stakeholder (outsourcing who is interested in implementing services for the government) in understanding the citizens' preference criteria in order to increase the usage of m-government services or to consult with the government to implement them in successful ways that fulfill the citizens' needs.

This study also offers the decision-makers who are responsible for m-government initiatives a richer understanding of the high-priority criteria or low-priority criteria that should be implemented in a timetable according to the citizens' demands. Finally, the AHP structure model provides the decision-makers with a framework or a roadmap for m-government services, by which future initiatives can be evaluated and prioritized.

Limitations of the study and future direction

Despite the theoretical and practical contributions, as is the case with any research study, the current research also has some limitations. First, the results are based on the judgments of individuals in terms of their situation rather than technology adopted by the actual organization. This is because individual judgments will change when they gain more experience (Venkateshet al., 2003). Second, this study did not consider the effects of demographic variables on each criterion in using m-government services. Therefore, further studies can test the effects of demographic variables on the citizens' preferences for using m-government services. For example, gender, age, and level of education can be used. Third, the study tested the factors of one alternative application, the MOI application. Other studies can test them for more alternative applications. Fourth, the study only investigates the main construct from DOI and TAM with additional two variables such as perceived security and perceived privacy. Future studies should consider other external variables that can fit the nature of future study. Fifth, the variables in the study are belongs to the literature reviews without taking into consideration the user's preferences. Therefore, future study can explore other suitable variables according to the user requirements through focus group discussion. Finally, this study was applied to government applications without considering mobile applications of the private sector and semi-governments since the governments are focused on individuals rather than businesses.

Conclusion

The expansion of Internet sources made the use of mobile phones more prevalent. At the government level, technology has a significant influence on the informational network, which is integrated centrally for people living in the country. M-government, through which information and knowledge are transmitted to people in society who own mobile phones and have access to Internet technology, is complementary to e-government. This paper was focused on finding out the key critical factors that influence citizens' preferences for using m-government services in the UAE using DOI and TAM theories with the external variables of perceived privacy and perceived security. AHP was used to validate and prioritize the key criteria that affect the use of m-government services. Users of MOI mobile applications have been selected to judge upon their preferences according to the main and sub-criteria founded from the literature review.

The study found that the criteria ease of use is highly preferred which goes with finding of Abu-Shanab and Haider (2015) who found that ease of use is one of the most important factor the user's preferences and contradict with who found that ease of use is less important. Furthermore, the main criteria perceived security and perceived privacy are also highly preferred by the citizens who are using MOI applications. This finding of both main criteria perceived security and perceived privacy are matching the results of the other literature (Alhujran & AlMigdadi 2013; Chang, Kannan & Fellow, 2003; Kumar & Sinha, 2007; Suo, Liu, Wan & Zhou, 2013) which found that both criteria are highly important in investigating mobile technology. On the other hand, the criteria observability and trialability are both the least preferred when using m-government services, which contradict the finding of Al-Busaidi, (2012) who mentions that observability is significant to the use of m-government services. In addition, Al-Busaidi, (2012) found that trialability is less significant to the use of m-government services and Conrad et al. (2012) discussed that if the complexity is high (less ease of use) then trialability should be high.

Briefly, the findings imply that decision-maker and software developer should take different initiatives to develop m-government services according to the citizen's preferences. Theoretically, the integration of both DOI and TAM theories with perceived security and perceived privacy provides a new conceptual framework to investigate the user's preferences to use m-government services. Furthermore, the AHP method arrives at a theoretical understanding by structuring the criteria or the factors of m-government services and prioritizing them to provide a decision-making outcome. Practically, the findings assist the decision-maker and software developer to start a new initiative strategy in developing m-government services according to the user's preferences and judgment.

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