ADOPTION OF MOBILE GOVERNMENT SERVICES USING AN EXTENDED UTAUT2 MODEL

Jalal Al-awj[1], Mohd Shahrul Nizam Mohd Danuri[1*], Norjihan Abdul Ghani[1], and Syarbaini Ahmad[2]

[1]Faculty of Computer Science and Information Technology, Universiti Malaya,
50603 Kuala Lumpur, Malaysia

[2]Faculty of Creative Multimedia and Computing, Universiti Islam Selangor,
Bandar Seri Putra, 43000 Kajang, Selangor, Malaysia

Emails: infotech_jalal@yahoo.com[1], msnizam@um.edu.my[1*] (Corresponding author), norjihan@um.edu.my[1], syarbaini@uis.edu.my[2]

ABSTRACT

The primary aim of this research is to formulate an extensive model for the adoption of mobile government (m-government) from the people's viewpoint. The research enhanced the Unified Theory of Acceptance and Use of Technology (UTAUT2) by incorporating various technological, political, and personal factors, including service diversity and quality, governmental trust, mobile internet, innovativeness, and self-efficacy. The proposed approach is subsequently evaluated using a comprehensive survey of 512 Yemeni citizens across two cities. The statistical research indicated that innovativeness was the most significant factor influencing citizens' intention to utilise m-government. The diversity and quality of services are the primary elements affecting citizens' utilisation of m-government services. The PLS analysis indicates that the suggested model accounts for 58% of citizens' intention to utilise m-government services. Moreover, the proposed augmentation of UTAUT2 in this study significantly enhanced the variance elucidated for the baseline model. The implications of the discoveries are examined.

Keywords: M-government; E-government; Technology adoption; UTAUT.

1.0 INTRODUCTION

E-government, or electronic government, is the use of computers, the Internet, and other Information and Communication Technologies (ICTs) to make it easier for individuals, government agencies, and companies to get public services [1]. Nonetheless, the swift proliferation, extensive adoption, and considerable acceptance of mobile technologies have given rise to a novel and more efficient mode of public service delivery termed m-government. M-government is referred to as the utilisation of wireless technology, including mobile phones and laptops, to deliver governmental services to all stakeholders involved in e-government, encompassing citizens [2]. In contrast to traditional e-government, m-government specifies numerous benefits, such as the capability to access governmental services at any time and from any location [3].

Even if mobile government services are useful, getting people to use them, especially in underdeveloped countries, is not easy [4]. Citizens may hesitate to use m-government services for several reasons, including inadequate knowledge, insufficient digital literacy, or apprehensions about trustworthiness [5, 6]. The effectiveness of mobile government services relies heavily on the rate of acceptance and the perceptions individuals hold regarding their use [5, 7]. Therefore, it is essential to ascertain and evaluate people's preferences and the determinants affecting their decision to embrace such innovations before commencing the implementation process for effective m-government services [8].

The main aim of this study is to ascertain the determinants that affect people's acceptance of m-government. The main objective is to create a complete model for the deployment of m-government. As a result, a conceptual model was constructed based on the expanded UTAUT2 and additional criteria identified as significantly impacting citizens' adoption of m-government, including self-efficacy, mobile internet, trust in government, innovativeness, and service quality [9].

2.0 BACKGROUND OF THE STUDY

Over the last twenty years, several governments have tried to use wireless technology to make public services better for residents. This is because mobile technologies have proliferated quickly, been widely accepted, and

become widely used. Nonetheless, numerous m-government efforts have faced obstacles, including poor adoption rates and individuals' reluctance to employ new technology for accessing public services, especially in underdeveloped nations [5, 8, 10]. The efficacy of mobile government services depends on their acceptance and usage by the public. Therefore, the provided services must be customised to address the distinct demands and preferences of the populace.

Numerous studies have investigated the determinants affecting citizens' acceptance of m-government services. These study initiatives have enhanced and broadened established adoption models and theories like TAM, DOI, Social Cognitive Theory (SCT), and Unified Theory of Acceptance and Use of Technology (UTAUT). A study investigating the perspectives of Saudi Arabian individuals regarding m-government adoption utilise UTAUT2 as its foundational model. The researchers improved this model by adding more factors, like perceived risk and innovativeness [11]. The integration of these two factors aimed to rectify possible deficiencies in UTAUT2 and improve the precision of its predictive efficacy. The results indicated that, despite elevated mobile penetration rates among Saudis, the uptake of m-government is minimal and does not meet anticipated levels. The study determined that all UTAUT2 criteria, together with innovativeness and risk considerations, significantly affect people's inclination to utilise m-government services.

Likewise, [12] employed UTAUT2 to ascertain the influence of behavioural intention on m-government utilisation from the viewpoint of Malaysian citizens. This study posits innovativeness as a moderating variable, in contrast to many investigations that identified personal innovativeness as an independent variable. The study determined that all UTAUT2 criteria were statistically significant and influenced the adoption of m-government.

A study was undertaken that integrated the Technology Acceptance Model (TAM) and Diffusion of Innovation (DOI) [13]. They included further characteristics to find out what makes consumers want to use m-government services. In contrast to other investigations that often identified utility as the key element in predicting usage intention, personal innovativeness was the most significant predictor of m-government acceptability and usage intention. This study suggests that decision-makers must prioritise comprehending the m-government landscape and services to guarantee the effective execution of m-government activities.

[14] conducted two focus group meetings to examine residents' requirements and perceptions regarding m-government. They discovered that multiple aspects influence people's adoption of m-government services, including usefulness, simplicity of use, trust, contentment, and service quality. Numerous participants in this study assert that m-government, as an electronic medium, can mitigate the proliferation of "Wasta," a form of corruption prevalent in some Arab nations that entails leveraging SI inside power structures to circumvent standard procedures. The study concluded by underscoring the significance of establishing m-government technical infrastructure and fostering the utilisation of these services in collaboration with the business sector.

3.0 RESEARCH MODEL DEVELOPMENT

Researchers have employed diverse models and theories, such as the Theory of Reasoned Action (TRA), Innovation Diffusion Theory (IDT), TAM, SCT, Model of PC Utilization (MPCU), Theory of Planned Behavior (TPB), and UTAUT, to discern and predict the determinants influencing technology adoption. This study utilised an augmented version of UTAUT2 by integrating and elaborating on technological, political, and personal variables. These criteria included elements such as service diversity and quality, trust, mobile internet, innovation, and self-efficacy.

The evaluation and synthesis of pertinent literature on Information Systems indicate that UTAUT is regarded as one of the most thorough adoption models. The theory was formed through the amalgamation of eight established theories and models (TRA, IDT, TAM, MM, SCT, TAM2, MPCU, and TPB). Nevertheless, UTAUT was formulated to forecast the adoption determinants mostly within the organisational framework [9, 15]. Consequently, numerous extensions of this theory have been developed to examine adoption from a consumer perspective, either by incorporating further endogenous and exogenous factors or by modifying the theory for a consumer setting. One such study is the expanded UTAUT2 [9, 15]. The objective of this extension was to examine technology acceptance from a consumer standpoint. Venkatesh asserts that the suggested extension in UTAUT2 significantly enhanced the variance accounted for in behavioural intention and technology usage behaviour, increasing from 56% to 74% and from 40% to 52%, respectively.

Venkatesh identified seven independent variables that forecast technology adoption from the users' viewpoint. The variables include PE, EE, SI, enabling conditions, hedonic motivation, habit, and price value. Two of the seven suggested independent variables in UTAUT2 were modified in the proposed model to align with the setting of this investigation. The practice was abandoned due to the nascent nature of m-government in Yemen and the scarcity of accessible services. [11] abandoned the habit in examining the m-government phenomenon in KSA, concluding that the absence of actual users precludes the existence of a habit due to a lack of utilisation. Furthermore, [9] identified habit as a significant determinant from a consumer standpoint in contexts such as mobile internet, social media, or television streaming. Conversely, this does not apply to government services, which individuals utilise just as required.

Second, price value, which relates to the cost and pricing structure of acquiring the service, is seen as one of the benefits of m-government. This is why it was combined with the PE variable as a cost value of getting government services on mobile phones. In his examination of mobile internet, Venkatesh analysed price value

from a commercial consumer standpoint, wherein users must incur costs to access specific services. Conversely, this does not apply to m-government since services are predominantly complementary or incur no extra expense relative to conventional methods. Furthermore, citizens do not need to purchase supplementary equipment; they merely need to utilise their current mobile phones to access government services. Utilising mobile phone services incurs a cost for citizens, including a reduction in commuting expenses to use the service. Consequently, the cost advantage was integrated into the PE variable. Fig. 1 illustrates the model proposed in this study:

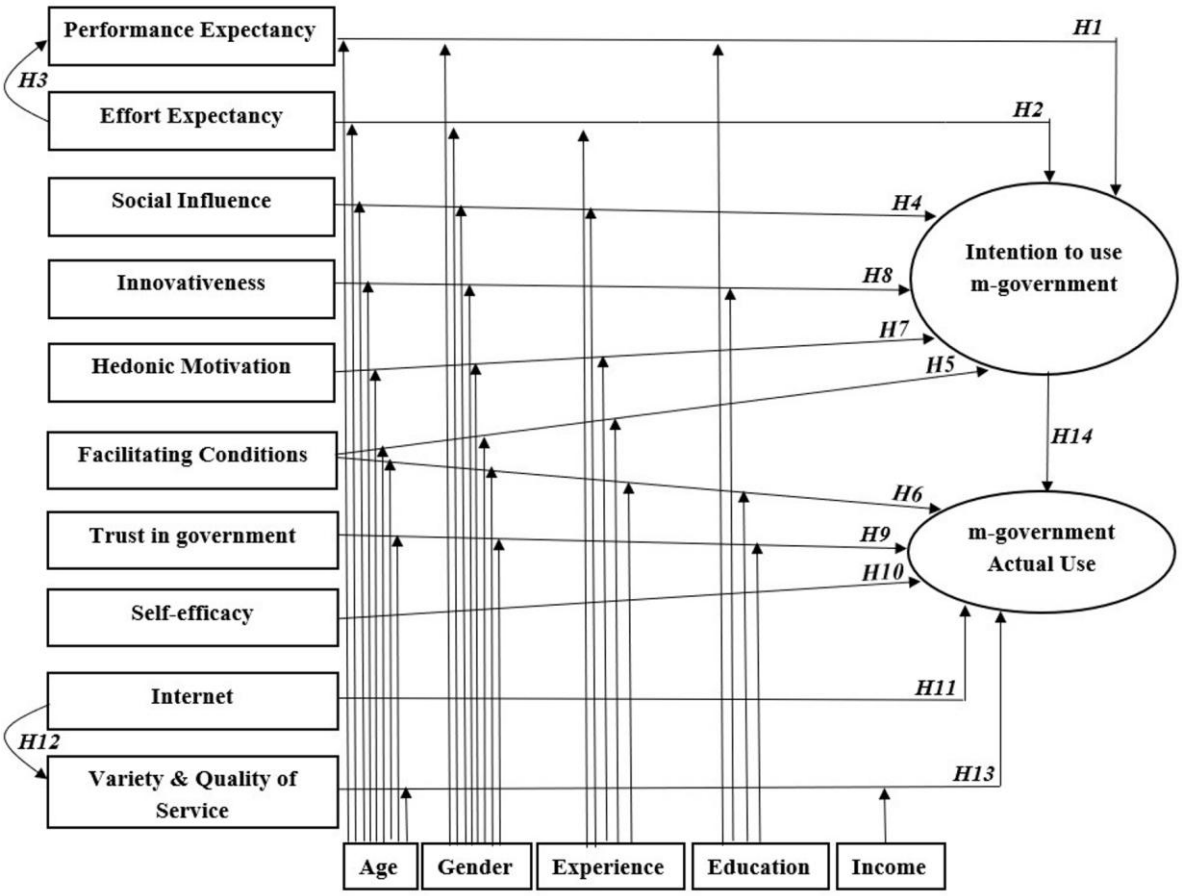

Fig. 1: M-government Adoption Model.

- *Performance Expectancy (PE)*

PE is referred to as the extent to which an individual perceives that utilising the innovation will enhance their job performance [15]. PE was formulated based on five characteristics, such as the perceived usefulness (TAM/TAM2), extrinsic motivation (MM), job-fit (MPCU), relative advantage (IDT), and outcome expectancies (SCT).

Venkatesh posits that perceived ease of use (PEOU) and its foundational characteristics are the most robust and consequential determinants of usage intention among the five obligatory and discretionary models. Numerous studies have identified that perceived ease (PE) or its foundational elements significantly influence the intention to utilise mobile government (m-government) services [11, 12, 16, 17]. Consequently, to elucidate the effect of PEOU on the intention to utilise m-government services, the subsequent hypothesis was proposed:

H1: *There is a direct and positive influence of PE on Intention to use m-government services.*

- *Effort expectancy (EE)*

EE is referred to as the level of convenience linked to the utilisation of a system [15]. Three constructs from the existing models pertain EE, which are perceived ease of use (TAM/TAM2), ease of use (IDT), and complexity (MPCU). Many scholars found that EE will majorly influence behavioural intention in voluntary and mandatory contexts [11, 12, 16, 17]. Consequently, to explain the influence of EE on intention to use m-government services, the subsequent hypotheses were formulated:

H2: *There is a direct and positive influence of EE on Intention to use m-government services.*
H3: *There is a direct and positive influence of EE on PE.*

- *Social Influence (SI)*

SI is referred to as the extent to which an individual perceives that significant others believe he/she should adopt the new system [15]. This construct was developed according to three constructs, which are the subjective norm (TAM2, TRA, TPB), image (IDT), and social factors (MPCU). The SI of prominent individuals, like family members, friends, or idols, was identified as a crucial factor in the intention to use [11, 12, 16, 18]. Therefore, the following hypothesis was formulated:

H4: *There is a direct and positive influence of SI on Intention to use m-government services.*

- *Facilitating Conditions (FC)*

FC refers to the individual's conviction that the technical infrastructure is adequate to facilitate the utilisation of the system [15]. FC used three constructs from different earlier models, which are facilitating conditions (MPCU), perceived behavioural control (TPB), and compatibility (IDT).

Venkatesh et al. discovered that FC serves as a robust predictor of the actual usage of innovation, but not of the desire to utilise it [15]. The previous scholar examined the impact of FC from an organisational standpoint, noting that "numerous elements of facilitating conditions, such as training and support, will be readily accessible within an organization and relatively consistent among users" [9]. Nonetheless, the facilitation differs from the customer's viewpoint, as mobile devices, technological generations, and application vendors fluctuate across various environments. Venkatesh contends that a consumer with access to advantageous FCs is more inclined to have a greater inclination to adopt an innovation [9]. Consequently, to elucidate the impact of FC on the intention and actual utilisation of m-government, the subsequent hypotheses were proposed:

H5: *There is a direct and positive influence of FC on Intention to use m-government services.*
H6: *There is a direct and positive influence of FC on m-government Actual use.*

- *Hedonic Motivation (HM)*

HM is referred as the enjoyment and amusement obtained from utilising an innovation [9]. The concept of HM is also well-known in IS literature by different names, such as perceived enjoyment and intrinsic factors. Many studies have found the extent of pleasure, satisfaction, and joy to be strong determinants of intention to use innovations from an individual's perspective [9, 11-13]. Therefore, in order to examine the correlation between HM and the intention to utilise m-government, the subsequent hypothesis was put in place:

H7: *There is a direct and positive influence of HM on Intention to use m-government services.*

- *Innovativeness*

Innovativeness is referred as "the degree to which an individual or other unit of adoption is relatively earlier in adopting new ideas than other members of a social system" [19]. Similarly, [20] perceives technology innovativeness as "The willingness of an individual to try out any new information technology". Based on the definitions above, it is clear that the individual's personality and technical aptitude play a role in innovativeness.

[19] discovered that some demographics, such as literacy and educational attainment, can affect an individual's innovativeness, whereas other factors, such as age, do not significantly impact innovativeness levels. He also discovered that certain individuals may exhibit innovation, navigate significant ambiguity, and react favourably in unforeseen circumstances, even in the absence of prior experience. It has been disclosed that individual innovativeness serves as the foremost determinant of the intention to engage with m-government services [13]. Furthermore, numerous research emphasise the impact of innovativeness on the utilisation of m-services [11, 12, 20]. Consequently, the subsequent hypothesis was posited:

H8: *There is a direct and positive influence of innovativeness on Intention to use m-government services.*

- *Trust in government*

Several studies reported that even when citizens strongly intend to use electronic services, they remain reluctant to actual use due to trust, security, and privacy concerns [5, 8, 10]. Trust is referred to as the evaluation of assurance in the electronic marketer's dependability and ethical standards [21].

The research identifies several forms of trust, including organisational trust, trust in staff competencies and responsiveness, and faith in the internet as a secure and dependable platform for government-related processes and transactions [13, 20, 22]. [23] categorised confidence in e-government as institutional-based trust, reliant on government agencies to deliver, sustain, and ensure services. This institutional trust is also linked to interpersonal trust for the provider's abilities, skills, and expertise [22]. Numerous research have identified empirical evidence in the literature about the impact of trust on the intention and actual utilisation of m-government [11, 13, 16, 18, 24, 25]. Consequently, the subsequent hypothesis was developed and presented:

H9: *There is a direct and positive influence of trust on m-government Actual use.*

- *Self-efficacy (SE)*

SE is referred to as the belief in one's ability to execute a specific action or behaviour [15]. A wide range of studies investigated the impact of SE on several technology acceptance applications [22, 25]. This study provided definitive proof of a direct correlation between SE and technological activity. In this study, SE refers to an individual's beliefs about their ability to manage and navigate the challenges associated with using m-government services. Consequently, the subsequent hypothesis was established to examine the correlation between SE and the utilisation of m-government:

H10: *There is a direct and positive influence of SE on m-government Actual use.*

- *Mobile internet*

The implementation of m-government services necessitates adequate internet access. Citizens may hesitate to utilise m-government services due to poor quality or expensive costs associated with wireless internet. [26] identified mobile infrastructure as a significant factor influencing m-government utilisation. In Yemen, three out of four mobile telecommunications firms continue to utilise 2G technology; however, their data plans remain prohibitively expensive. Yemen is classified as one of the most costly countries for 1GB of data, with an average price above 15 USD per 1GB. In comparison to other nations, the average cost of 1GB in Malaysia is about 0.90 USD, while in Saudi Arabia, it is 1.4 USD [27]. Poor and costly services can affect how likely people are to use m-government services and how often they really do. This framework primarily prioritises the accessibility, quality, and cost of wireless internet. Thus, the following hypotheses were formulated to assess the impact of internet connectivity on the use of m-government services:

H11: *There is a positive influence of internet on m-government Actual use.*
H12: *There is a positive influence of internet on m-government VQoS.*

- *Variety and Quality of Services (VQoS)*

Quality of service can refer to many aspects, such as information quality, system quality, and user satisfaction. It can be referred as "the discrepancy between the user perceptions and expectations regarding a specific service" [24]. Researchers argued that users' satisfaction can be predicted by their expectations before using the service and their perceptions of quality after their actual use. The higher the user satisfaction, the higher the adoption rate of the service [22]. Several factors can influence the users' satisfaction, such as service performance, functionality, responsiveness, customer support, assurance, and reliability.

The availability of resources is essential for the adoption of electronic services, as citizens will continue to rely on traditional government until adequately supported with resources [22]. The service itself is one of the most essential resources. [28] determined that the accessibility and diversity of services will enhance citizens' propensity to embrace m-government services. In a similar vein, [26] identified that the availability and accessibility of m-government services significantly influence their utilisation in India. They underscored that the offered services must be universally accessible across all platforms and should be economically viable.

As per [18], research about the availability and scope of services remains insufficient to reach a definitive conclusion. A pilot research was done to assess citizens' perceptions of service quality and availability. It indicates that despite a significant intention among certain residents to utilise m-government, their actual usage remains insufficiently low. This may be attributable to the limited variety of offered services. Consequently, the subsequent hypothesis was formulated to examine this relationship:

H13: *There is a direct and positive influence of VQoS on m-government Actual Use.*

4.0 METHODOLOGY AND RESEARCH INSTRUMENT

This research utilised a positivist mindset and a deductive approach to assess certain hypotheses grounded in the expanded UTAUT2, in conjunction with additional factors affecting m-government uptake. A quantitative method was employed to identify the determinants influencing citizens' adoption of m-government services in Yemen, enabling objective measurement, hypothesis testing, and the generalisation of findings to a wider population.

The principal approach for data collection was a survey methodology. A self-administered questionnaire was created utilising validated tools from prior studies on e-government and m-government uptake. The research encompassed ten independent variables: PE, EE, SI, FC, HM, INNV, SE, INT, and VQoS. It also analysed two dependent variables: Intention to Use and Actual Use. The questionnaire was developed in English, translated into Arabic, and content-validated through expert evaluation.

A pilot study was performed to enhance the instrument and evaluate its reliability through Cronbach's Alpha. The concluding survey was executed in two principal cities in Yemen, aiming to engage respondents from many backgrounds, including universities, government institutions, NGOs, private enterprises, retail establishments, and

internet cafés, to guarantee representativeness. A total of 750 questionnaires were disseminated, yielding 512 valid replies for analysis.

This study investigated the influence of ten independent variables on two separate dependent variables. This study analysed the dimensions of PE, EE, SI, facilitating conditions, hedonic motivation, service variety and quality, mobile internet, trust, innovativeness, self-efficacy, behavioural intention, and usage behaviour. All items were evaluated using a 5-point Likert scale, ranging from strongly disagree (1) to strongly agree (5).

The data analysis was performed in two stages. The preliminary stage entailed assessing the measurement model, incorporating tests for convergent validity, discriminant validity, and reliability, executed with SPSS and SmartPLS to verify the precision and consistency of the measuring tools. The evaluation of the structural model was place in the second phase, during which the study hypotheses were tested using Partial Least Squares Structural Equation Modeling (PLS-SEM). Bootstrapping techniques were utilised to analyse the relevance of the routes within the model, offering a thorough evaluation of the hypothesised relationships.

This methodological framework allowed for rigorous testing of the conceptual model and aided in identifying key factors influencing m-government adoption in Yemen.

5.0 DATA ANALYSIS AND RESULTS

Altogether, 750 questionnaires were randomly disseminated across two cities in the Republic of Yemen. A total of 551 replies were obtained. 39 out of 551 responses were excluded due to various missing answers or noticeable similarities in responses to different questions. Of the 512 valid responses retained for further analysis, 377 (73.6%) reported prior experience with m-government. Conversely, 135 individuals (26.4%) were aware of m-government services but lacked experience in utilising them. Table 1 presents the frequencies of the demographic variables.

5.1 Measurement Model

This section is concerned with reporting the steps that were undertaken to test this research's instruments, including two statistical tests, reliability, and factor analysis. The former was used to measure the construct's internal consistency, whereas the latter was utilised to assess the scale validity.

- *Convergent reliability and validity*

According to [31], concept reliability and validity pertain to the extent to which the concept is devoid of random errors, as stated in [31]. It also pertains to the consistency and stability of pieces within the same instrument. Smart-PLS was employed to evaluate construct reliability and validity through three distinct tests: Cronbach's Alpha, Composite Reliability (CR), and Average Variance Extracted (AVE). Generally, numerous researchers recommend a minimum acceptable Cronbach's Alpha of 0.70 [32, 33]. Similarly, the threshold of Composite Reliability is 0.70 [32]. Table 2 illustrates the results of the constructs' convergent validity.

AVE is the last test that was used to assess the convergent validity. According to [34], AVE reflects the commonality average for each latent variable in a reflective model. AVE should be greater than 0.5 in an adequate model [33, 34].

- *Discriminant validity*

The researcher employed Confirmatory Factor Analysis (CFA) through Smart-PLS software to assess and validate the measurement scales, specifically focusing on discriminant validity. CFA is regarded as one of the most suitable validation techniques, particularly when utilising pre-validated measurement scales [35]. Discriminant validity is established for two primary objectives. The primary objective is to verify that the measurement scales of a construct exhibit higher loadings on that construct in comparison to their loadings on other constructs.

As shown in Table 3, the loading of each item is the highest on its construct compared to the other constructs. Moreover, the loading of each item on its construct has exceeded the threshold of 0.60 recommended by (Garson 2016). The table also shows no significant overlap and cross-loading between the items of the different constructs.

The second objective of establishing discriminant validity is to ensure that the square root of the Average Variance Extracted (AVE) for each construct is larger than the correlation with other constructs [33]. The Fornell-Larcker Criterion test was utilised using Smart-PLS.

Table 4 above shows that the square root of the AVE for each construct is more significant than its correlation with the other constructs. Moreover, the loading of each item is the highest on its respective construct compared to the other constructs. Consequently, it can be asserted that both discriminant and convergent validity have been satisfactorily achieved in this study.

Table 1: Sociodemographic distribution

Category		Count	Percentage
Sex	Man	370	72.3
	Woman	142	27.7
Education	High school	85	16.6
	Diploma	55	10.7
	Bachelor	278	54.3
	Master	64	12.5
	Doctorate	30	5.9
Age	18-20	43	8.4
	20-30	191	37.3
	31-40	190	37.1
	41-50	63	12.3
	> 50	25	4.9
Employment status	Public sector staff	141	27.5
	Private enterprise	104	20.3
	Self-employed	79	15.4
	Academic enrollee	125	24.4
	Not currently employed	63	12.3
Internet experience	< 1	5	1
	1-3	63	12.3
	4-6	117	22.9
	> 6	327	63.9
Mobile internet usage frequency	Several times a day	445	86.9
	Every day or two	55	10.7
	Once a week	7	1.4
	Once a month or less	5	1
Income	Less than 50k	172	33.6
	50-100k	142	27.7
	101-200k	81	15.8
	More than 200k	117	22.9

Table 2: Constructs' Convergent Validity

Latent variable	Indicator count	α Coeff.	Construct Reliability	AVE Score
AU	2	0.831	0.921	0.853
EE	4	0.882	0.918	0.738
FC	4	0.869	0.911	0.718
HM	3	0.857	0.913	0.777
INNV	3	0.776	0.868	0.687
IU	3	0.921	0.950	0.864
NET	3	0.850	0.909	0.770
PE	4	0.864	0.907	0.710
SE	4	0.879	0.917	0.734
SI	3	0.735	0.850	0.654
TRUST	3	0.922	0.951	0.866
VQoS	8	0.944	0.953	0.719

Table 3: Results of Confirmatory Factor Analysis (CFA)

	AU	EE	FC	HM	INNV	IU	NET	PE	SE	SI	TRUST	VQoS
AU1	**0.903**	0.270	0.332	0.310	0.305	0.360	0.224	0.258	0.262	0.179	0.289	0.268
AU2	**0.944**	0.359	0.430	0.321	0.384	0.377	0.325	0.283	0.375	0.253	0.411	0.406
EE1	0.275	**0.869**	0.646	0.478	0.502	0.453	0.106	0.591	0.503	0.344	0.230	0.020
EE2	0.316	**0.848**	0.624	0.402	0.401	0.382	0.169	0.494	0.492	0.352	0.346	0.116
EE3	0.301	**0.875**	0.636	0.444	0.469	0.416	0.166	0.511	0.509	0.355	0.343	0.120
EE4	0.300	**0.843**	0.668	0.539	0.558	0.498	0.132	0.579	0.579	0.349	0.253	0.028
FC1	0.384	0.633	**0.840**	0.452	0.503	0.442	0.189	0.497	0.534	0.364	0.305	0.101
FC2	0.355	0.703	**0.857**	0.471	0.525	0.427	0.198	0.489	0.567	0.354	0.340	0.103
FC3	0.313	0.592	**0.837**	0.577	0.495	0.474	0.190	0.465	0.474	0.296	0.328	0.156
FC4	0.365	0.623	**0.855**	0.552	0.489	0.496	0.155	0.569	0.512	0.352	0.321	0.119
HM1	0.328	0.507	0.564	**0.890**	0.505	0.576	0.194	0.558	0.486	0.336	0.292	0.120
HM2	0.287	0.461	0.554	**0.873**	0.466	0.533	0.165	0.555	0.442	0.267	0.290	0.110
HM3	0.288	0.481	0.491	**0.882**	0.536	0.631	0.082	0.611	0.460	0.299	0.218	0.043
INNV1	0.305	0.463	0.478	0.570	**0.826**	0.638	0.130	0.446	0.509	0.310	0.260	0.105
INNV2	0.311	0.412	0.449	0.343	**0.796**	0.433	0.218	0.325	0.528	0.359	0.283	0.133
INNV3	0.325	0.531	0.543	0.468	**0.863**	0.538	0.231	0.417	0.565	0.319	0.287	0.110
IU1	0.313	0.434	0.468	0.589	0.591	**0.906**	0.145	0.488	0.424	0.359	0.238	0.076
IU2	0.372	0.499	0.517	0.629	0.626	**0.942**	0.218	0.533	0.453	0.417	0.256	0.131
IU3	0.422	0.497	0.527	0.624	0.628	**0.939**	0.207	0.520	0.467	0.386	0.259	0.135
NET1	0.262	0.155	0.211	0.188	0.227	0.206	**0.864**	0.100	0.236	0.215	0.456	0.581
NET2	0.272	0.122	0.148	0.112	0.184	0.151	**0.902**	0.031	0.166	0.205	0.452	0.634
NET3	0.264	0.158	0.210	0.133	0.184	0.186	**0.866**	0.095	0.169	0.233	0.488	0.632
PE1	0.303	0.560	0.513	0.564	0.431	0.480	0.043	**0.838**	0.426	0.280	0.179	-0.020
PE2	0.207	0.495	0.509	0.531	0.402	0.432	0.024	**0.836**	0.369	0.295	0.174	0.001
PE3	0.253	0.557	0.490	0.521	0.395	0.460	0.124	**0.861**	0.412	0.336	0.230	0.062
PE4	0.223	0.534	0.500	0.584	0.411	0.488	0.092	**0.835**	0.371	0.336	0.191	0.014
SE1	0.309	0.516	0.538	0.504	0.565	0.466	0.170	0.420	**0.863**	0.390	0.311	0.141
SE2	0.307	0.574	0.573	0.457	0.619	0.444	0.208	0.413	**0.884**	0.421	0.315	0.147
SE3	0.303	0.548	0.523	0.408	0.551	0.391	0.204	0.383	**0.853**	0.354	0.337	0.139
SE4	0.288	0.450	0.471	0.430	0.461	0.348	0.157	0.390	**0.827**	0.287	0.358	0.130
SI1	0.163	0.249	0.235	0.239	0.261	0.300	0.151	0.266	0.241	**0.752**	0.123	0.134
SI2	0.174	0.392	0.382	0.270	0.318	0.333	0.245	0.330	0.382	**0.823**	0.297	0.224
SI3	0.236	0.340	0.352	0.315	0.365	0.374	0.201	0.302	0.394	**0.848**	0.262	0.200
TRUST1	0.364	0.342	0.380	0.282	0.304	0.257	0.486	0.238	0.371	0.256	**0.924**	0.472
TRUST2	0.365	0.303	0.346	0.270	0.323	0.247	0.508	0.215	0.373	0.276	**0.949**	0.505
TRUST3	0.350	0.292	0.338	0.286	0.297	0.252	0.484	0.187	0.329	0.267	**0.918**	0.498
VQoS1	0.270	0.078	0.152	0.048	0.141	0.090	0.680	-0.001	0.214	0.197	0.525	**0.818**
VQoS2	0.306	0.072	0.146	0.095	0.149	0.123	0.634	0.036	0.168	0.214	0.434	**0.859**
VQoS3	0.324	0.068	0.127	0.047	0.128	0.083	0.580	-0.021	0.145	0.190	0.453	**0.840**
VQoS4	0.317	0.078	0.115	0.116	0.134	0.148	0.669	0.010	0.137	0.239	0.521	**0.892**
VQoS5	0.267	0.040	0.058	0.016	0.091	0.066	0.637	-0.059	0.070	0.190	0.440	**0.870**
VQoS6	0.342	0.071	0.153	0.140	0.114	0.132	0.539	0.075	0.140	0.166	0.424	**0.826**
VQoS7	0.341	0.071	0.113	0.108	0.069	0.101	0.514	0.040	0.092	0.184	0.437	**0.833**
VQoS8	0.345	0.051	0.089	0.093	0.111	0.090	0.538	0.014	0.139	0.196	0.365	**0.840**

Table 4: Fornell-Larcker test results

	AU	EE	FC	HM	INNV	IU	NET	PE	SE	SI	TRUST	VQoS
AU	**0.924**											
EE	0.346	**0.859**										
FC	0.419	0.752	**0.847**									
HM	0.341	0.548	0.606	**0.881**								
INNV	0.377	0.569	0.593	0.572	**0.829**							
IU	0.399	0.514	0.543	0.661	0.662	**0.929**						
NET	0.303	0.165	0.215	0.164	0.226	0.206	**0.877**					
PE	0.294	0.638	0.597	0.654	0.487	0.553	0.085	**0.843**				
SE	0.352	0.610	0.615	0.525	0.642	0.482	0.216	0.469	**0.857**			
SI	0.239	0.407	0.403	0.342	0.393	0.417	0.248	0.371	0.425	**0.809**		
TRUST	0.387	0.336	0.381	0.300	0.331	0.270	0.530	0.230	0.385	0.286	**0.930**	
VQoS	0.374	0.078	0.141	0.101	0.137	0.124	0.702	0.017	0.162	0.232	0.528	**0.848**

5.2 Structural Model

This section presents the results of the structural model testing conducted through Structural Equation Modeling (SEM) through Partial Least Square (PLS) analysis. Numerous studies advocate for the application of SEM in Information Systems and behavioural science [9, 15, 34]. The application of this technique with Smart-PLS software allows for the simultaneous exploration of the overall structural model. PLS was introduced in the late 1960s to analyse causal relationships among latent variables [34]. According to [36], "in large and complex models with latent variables, PLS is virtually without competition." [34] stated, "For more complex path models, it is essential to utilise specialised PLS software." Smart-PLS is arguably the most widely utilised option. The PLS results are presented in Fig. 2, Table 5, and Table 6 below:

This study utilised ten independent variables derived from the literature to elucidate two dependent variables. The independent variables include PE, EE, SI, FC, HM, INNV, SE, INT, and VQoS. The two dependent variables are Intention to Use (IU) and Use Behaviour (AU) concerning m-government services. IU serves as a moderating variable for the AU variable.

The R-squared result in SEM-PLS reflects the proportion of variance in the dependent variable that can be explained by the independent variables, as noted in [34]. According to [37], an adequate model should have an R-squared value of at least 0.10. Table 6 indicates that the model accounts for 58% of the variance in citizens' intention to utilise mobile government services. [13] indicated that "this is a significant percentage, as over 50% of citizens' intention to utilise mobile services can be elucidated by comprehending the models' specific variables." The variance explained (R-squared) exceeds the 56% reported in the original UTAUT study by [15].

Multiple researchers have indicated the R-squared as an indicator of the goodness-of-fit of their models [38, 39]. The variance explained in this study exceeded 50%, indicating a satisfactory goodness-of-fit for the model. Additionally, Smart-PLS software has implemented various tests to evaluate the model's goodness-of-fit. The tests include the Standardised Root Mean Square Residual (SRMR) and the Root Mean Squared covariance matrix (RMS_theta). Table 7 presents the findings from the PLS model-fit summary.

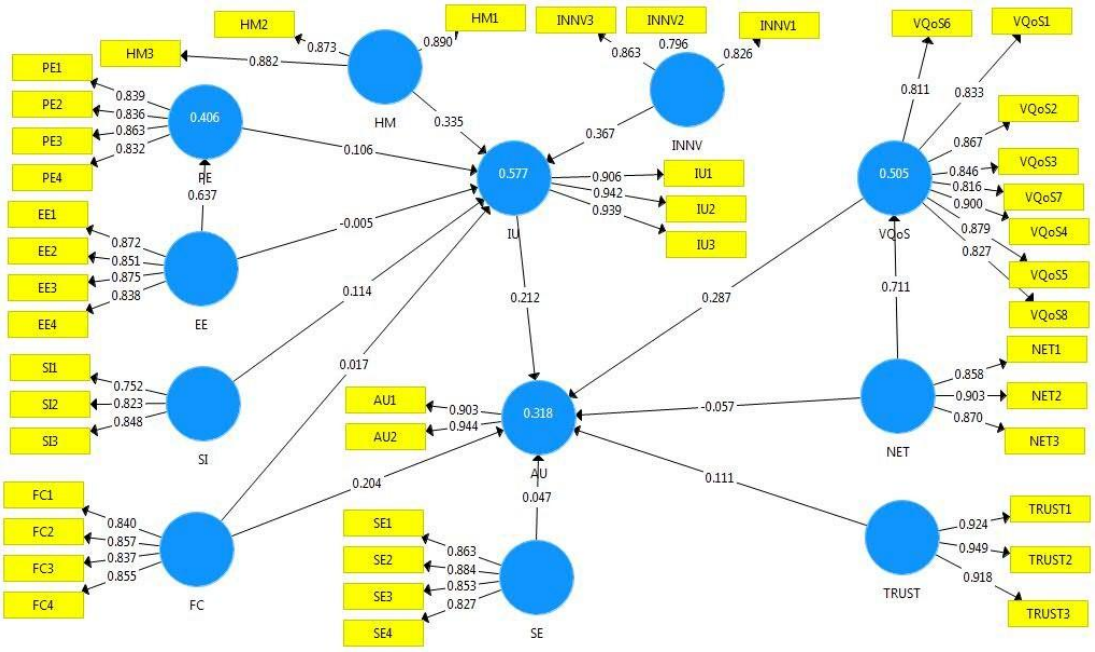

Fig. 2: Measurement Model (PLS)

Table 5: PLS-SEM analysis

Hypothesized Link	Direct Effect Estimate	Bootstrapped Mean	Std. Error	Path coefficient
EE -> IU	-0.005	-0.005	0.050	-0.005
EE -> PE	0.637	0.637	0.036	0.637***
FC -> AU	0.204	0.200	0.058	0.204***
FC -> IU	0.017	0.016	0.060	0.017
HM -> IU	0.335	0.337	0.051	0.335***
INNV -> IU	0.367	0.364	0.047	0.367***
IU -> AU	0.212	0.212	0.047	0.212***
NET -> AU	-0.057	-0.059	0.056	-0.057
NET -> VQoS	0.711	0.711	0.025	0.711***
PE -> IU	0.106	0.107	0.048	0.106*
SE -> AU	0.047	0.051	0.051	0.047
SI -> IU	0.114	0.115	0.031	0.114***
TRUST -> AU	0.111	0.113	0.054	0.111*
VQoS -> AU	0.287	0.289	0.056	0.287***

Table 6: R-squared results

Dependent variable	R-squared
IU	0.577
AU	0.318
PE	0.466
VQoS	0.505

Table 7: PLS model-fit summary results

Test	Result
RMS_theta	0.120
SRMR	0.048

SRMR is the difference between the observed correlation and the model-implied correlation matrix. According to [41], the use of SRMR is recommended as a measure of goodness-of-fit for SEM-PLS to prevent model misspecification. According to [42], an SRMR value below 0.10 (or 0.08 in a more conservative interpretation) is deemed satisfactory for indicating a good fit [40]. RMS_theta represents the root mean squared residual covariance matrix derived from the residuals of the outer model [43]. This model is purely reflective; as noted by [40], "this fit measure is useful to assess purely reflective models because the outer model residuals in formative models are not meaningful." RMS_theta evaluates the degree of correlation among the residuals of the outer model, with results ideally approaching zero [40]. Based on the R-squared values and model-fit results, we conclude that this model exhibits satisfactory goodness-of-fit.

5.3 Hypotheses testing

The study illustrates the results of the PLS algorithm and bootstrapping to test the research hypotheses and identify the contribution of each variable to its respective dependent variable. SEM-PLS was employed with the PLS algorithm to assess the strength of each structural path. The bootstrapping analysis was subsequently performed to assess the significance of each path through T-statistics, thereby validating or refuting the hypotheses. Table 8 presents the findings of the bootstrapping analysis.

Table 8: PLS bootstrapping results

Code	Hypothesis Summary	T-Stat	β	Status
H1	PE positively affects IU	2.202	0.106*	Supported
H2	EE has no significant effect on IU	0.101	-0.005	Not Supported
H3	EE significantly enhances PE	17.946	0.637***	Supported
H4	SI significantly influences IU	3.747	0.114***	Supported
H5	FC does not affect IU	0.286	0.017	Not Supported
H6	FC contributes to AU	3.551	0.204***	Supported
H7	HM plays a strong role in IU	6.599	0.335***	Supported
H8	INNV positively drives IU	7.873	0.367***	Supported
H9	Trust positively affects AU	2.038	0.111*	Supported
H10	SE shows no effect on AU	0.907	0.047	Not Supported
H11	NET does not impact AU	1.009	-0.057	Not Supported
H12	NET significantly boosts VQoS	28.717	0.711***	Supported
H13	VQoS supports AU	5.082	0.287***	Supported
H14	IU contributes significantly to AU	4.46	0.212***	Supported

Amongst the fourteen hypotheses that were tested, the bootstrapping results found that only ten were supported, which are related to the following constructs: PE (PE-> IU), FC (FC-> AU), HM (HM-> IU), innovativeness (INNV-> IU), SI (SI-> IU), Trust (trust-> AU), intention to use (IU-> AU), variety and quality of service (VQoS-> AU), EE (EE-> PE), and internet (INT-> VQoS). The bootstrapping results demonstrate that personal innovativeness followed by HM (perceived enjoyment) are the most significant factors influencing citizens' intention to use m-government services. The VQoS factor was found to be the most influential factor affecting the citizens' use behaviour.

6.0 DISCUSSION

E-government has several benefits, such as making the government more efficient, open, and accountable, as well as fighting corruption and bribery. The execution of e-government has frequently failed in many developing nations, mostly due to insufficient infrastructure, low internet penetration, digital divide, and pervasive computer illiteracy. The rapid expansion of mobile and wireless technology in recent years has resulted in the rise of m-government as a feasible alternative for nations, due to the extensive penetration and acceptance of mobile phones among their populations. M-government enhances public service delivery by guaranteeing accessibility at all times and locations.

The efficacy of m-government services depends on the acceptance and usage rates among citizens. Many academics argue that comprehending the determinants of citizens' acceptance or rejection of new information technology developments is a vital and intricate concern in information systems research. It is imperative to recognise and evaluate individuals' preferences and the determinants affecting their choices to engage with m-government services.

This study seeks to determine the factors affecting the uptake of m-government services in Yemen. The study augmented UTAUT2 by incorporating diverse technological, political, and behavioural elements, such as service diversity and quality, mobile internet, trust, innovativeness, and self-efficacy, in conjunction with five demographic variables: age, gender, education, experience, and income. The statistical analysis revealed that seven of the 10 elements evaluated were statistically significant, correlating with the variables: innovativeness, hedonic motivation, social impact, PE, service variety and quality, facilitating conditions, and trust. The findings

demonstrated that innovativeness (T= 7.873, β= 367, p<0.001) was the most influential factor affecting the participants' behavioural intention. Conversely, the diversity and calibre of service (T= 5.082, β= 287, p< 0.001) surfaced as the paramount factor influencing m-government services usage behaviour.

The PLS analysis indicated a significant relationship between perceived ease (PE) and the intention to utilise m-government services (β=0.106, T= 2.202, p<0.05). This discovery corroborates prior studies demonstrating that PE is a crucial determinant of technology adoption and usage intention [9, 11, 15, 16, 22, 24, 25, 44, 45]. Research indicates that PE serves as the primary predictor of e-government usage intention [22]. The author posited that citizens' intention to adopt an innovation is positively correlated with their expectations of the benefits derived from its use. In a similar vein, [15] identified PE as the primary factor influencing technology usage intention. The statistical analysis indicates that PE positively affects the intention to use m-government. This indicates that awareness of the utility of m-government, including cost and time savings, will affect citizens' attitudes toward utilising m-government services.

The PLS results indicated that SI had a substantial correlation with the desire to utilise m-government services (β=0.114, T=3.747, p<0.001). This finding aligns with prior research in the same domain [7, 11, 16, 18]. The analysis indicated that citizens are likely to utilise m-government services if influenced by individuals who affect their behaviour or upon receiving recommendations from such individuals. Participants are inclined to utilise m-government services due to the perception that users of these services possess greater prestige compared to their peers.

The PLS analysis results indicated a highly significant relationship between HM and intention to use (T= 6.599, p<0.001). This is consistent with numerous prior studies indicating that HM, referred to as perceived enjoyment in the literature, is a significant factor in technology adoption [9, 11, 13]. This result elucidates the elevated mean score of HM (4.4) and corroborates that participants who appreciate m-government services are more inclined to adopt them. Al-busaidi posits that the establishment of a pleasant service and environment may influence citizens' preferences regarding the utilisation of m-services.

The PLS analysis of the quantitative data indicated that Innovativeness exerts the most significant influence on m-government usage intention (T= 7.873, p<0.001). This finding aligns with the results of [13], which identified personal innovativeness as the primary predictor of m-government usage intention. Multiple studies indicate the impact of innovativeness on mobile service utilisation [11, 12, 20]. The hypothesis that innovativeness has a direct and positive influence on IU is supported.

The PLS analysis results reveal that the FC variable significantly influences m-government use behaviour (T=3.551, p<.001), demonstrating a substantial relationship between the two variables. The respondents assert that having knowledge and resources, including infrastructure, would facilitate their adoption and utilisation of new technologies and services, such as m-government. Moreover, they believe that m-government aligns with their lifestyle, preferred methods of operation, and the technologies they utilise. The findings align with previous research, indicating that FC affects technology use behaviour. [22] posits that resource availability will enhance citizens' awareness, thereby promoting the adoption of m-government. Similarly, [46] determined that resource availability (FC) is essential, particularly in developing nations characterised by a notable digital divide. The citizens' attitude towards utilising such services is significantly influenced by the availability of infrastructure and resources.

The PLS analysis of the survey's quantitative data indicated that Trust in government significantly influences m-government use behaviour (T= 2.038, β=111, p<.05). This finding aligns with previous research indicating that the transparency and reliability of government interactions positively affect trust in e-government services [25, 47]. Citizens are likely to adopt e/m-government services if they perceive that their governments and employees possess adequate competency and credibility to ensure the security of these systems [48]. Establishing and maintaining trust between government agencies and citizens is essential for the effective use of ICTs in public service delivery [49]. Furthermore, [25] contended that citizens are more likely to accept m-government when their trust in these services is enhanced. The researcher concluded that policymakers must ensure credibility and security in the implementation of m-government services, as these factors are essential for the success of such services.

The PLS analysis indicated that VQoS has a significant impact on m-government use behaviour (T= 5.082, β= 287, p< 0.001). This finding aligns with the average mean scores of VQoS (2.8) and AU (3.5), suggesting that negative perceptions of VQoS influenced m-government use behaviour. In a study on the factors influencing m-government use in India, it was found that the availability and accessibility of m-government services are among the most significant determinants [26]. Yemen remains in the initial phase of e-government implementation, characterised by insufficient service provision. This elucidates the significant impact and misconceptions regarding VQoS among the participants.

The quantitative results indicated that participants in this study possess a limited perception of the availability and quality of m-government services. This perception significantly influences their decision to adopt m-government services. The findings provided clear evidence that VQoS is the primary factor influencing m-government use behaviour. Consequently, policymakers and government officials must develop a strategy to enhance mobile services that align with citizens' expectations. The hypothesis positing a positive and direct relationship between VQoS and AU was supported.

7.0 CONCLUSION

- *Theoretical implications*

This research has produced a number of important contributions. This research introduces a comprehensive model for m-government adoption, focusing on the citizens' perspective. The research model expanded UTAUT2 by integrating various technological, political, and behavioural factors. This study's extension of UTAUT resulted in a significant increase in the variance explained for the baseline model (direct effects) in behavioural intention, rising to 58% compared to 35% in the original UTAUT and 44% in UTAUT2. The model integrates several factors that have been insufficiently addressed in the m-government literature, including trust in government, mobile internet, and the variety and quality of service. The empirical study demonstrated that these factors significantly influence citizens' use behaviour of m-government. The research model incorporated five demographic variables that affect the adoption of m-government: age, gender, experience, education, and income.

This study represents the inaugural investigation into m-government in Yemen, a nation recognised as one of the least developed countries. The literature indicates a scarcity of studies on m-government in both developed and least developed nations. This study aims to elucidate researchers' understanding of citizen perceptions regarding m-government services in these nations.

This research addresses a gap in the literature on m-government adoption by examining the phenomenon from various perspectives, including technological, political, social, and behavioural dimensions.

- *Practical implications*

The results of this research will help decision-makers and mobile service providers because they will learn more about what affects how people plan to use mobile services and how they really do use them. This understanding will enable decision-makers and providers to improve current services and create new ones that effectively engage citizens while addressing their needs and exceeding their expectations.

The survey results indicated a negative perception regarding infrastructure, mobile internet, service quality, and a significant lack of mutual trust between participants and government departments. Additionally, the results indicated that a negative perception of government agencies' capability and transparency in executing online transactions would influence participants' behavioural use of m-government services. Therefore, the government must focus on rebuilding mutual trust with citizens, as this can influence the adoption rate of m-government services. The study indicated that many participants are hesitant to utilise m-government services due to negative perceptions concerning the diversity and quality of these services. This indicates that government agencies ought to enhance the quality of current services and introduce new offerings.

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