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The determinants of smart government systems adoption by public sector organizations in Saudi Arabia

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ABSTRACT

This study investigates the determinants of smart government systems that are used in public service organizations in Saudi Arabia. The world's developed nations have conducted studies on smart government systems, but little research has been done on the Middle East, particularly in Saudi Arabia. This study fills the lacuna in the literature. Based on a number of theories including the Technology, Organization, and Environment framework (TOE), Unified Theory of Acceptance and Use of Technology (UTAUT), and Technology Acceptance Models (TAM), the study established an integrated conceptual research model. Online survey questionnaires were sent to 2060 employees in four ministries and after the second reminder a total of 427 completed answers were received, of which 419 (22% response rate) were deemed useable for the analysis. Multivariate statistical analysis was used to analyze the data and results indicated that 51% of the variance (R^2 = 0.51) of employees' perceptions of smart government systems is explained by independent determinants. Findings show that security concerns (t (419) = 2.051, p < 0.041), ICT strategy (t (419) = 4.215, p < 0.000), managerial support (t (419) = 5.027, p < 0.000), incentives (t (419) = 5.263, p < 0.000), and trust (t (419) = -1.957, p < 0.050) are significant predictors of smart government systems acceptance. Meanwhile cultural values (t (419) = 0.669, p < 0.504) and religious values (t (419) = 1.082, p < 0.280) have no significant effect on the attitude to smart system adoption. Perception was found to have a strong significant effect on adoption of smart government systems (t (419) = 8.411, p < 0.000). These results have significant implications for the Saudi government's drive to implement smart government systems in all its agencies.

1. Introduction

Today, information and communication technologies (ICT), especially the internet and mobile telephony, have revolutionized all aspects of everyday life [1–3]. ICT refers to a set of artefacts, elements and techniques used for capturing, storing, processing, managing and disseminating information [4,5]. The rapid and far-reaching advances in technology and its implementation by business organizations, governments, communities and civil groups have become the center of attention in the past few decades [1]. Current literature confirms the prevalent belief that ICTs play a central role in the socio-economic fabric of countries, especially those in the developing world [4,6–8]. ICTs may cause dramatic changes to the ways in which organizations conduct their business processes, operations and activities [9]. For example, the use of recent technologies such as big data and business analytics has changed

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decision-making culture, enabling organizations to make better and more effective decisions [10,11]. In the current competitive business environment, organizations worldwide are utilizing ICT to enhance their market and/or industry share [5,8,12].

Research indicates that ICTs have the potential to affect various economic and societal dimensions such as Gross Domestic Product (GDP), education, healthcare, employment, productivity, poverty reduction and quality of life [7]. In addition, ICTs are frequently recognized as vital for business organizations [12–14]. Evidence from theoretical and empirical studies shows that the effective and extensive use of technology is a determining factor of firms' success, especially in terms of productivity, profitability, efficiency and growth [4,7,12]. ICTs may offer certain benefits to organizations such as reducing costs, improving decision-making processes, facilitating business-related communication and collaboration, enhancing responsiveness and improving overall flexibility [4]. Most public sector organizations have come to appreciate the benefits of "e-government," or the electronic delivery of information and services to individuals, corporations, and other public sector departments [15,16]. The online capabilities of e-governments provide the basis for transforming traditional government services [17,18]. For instance, by enhancing the delivery and availability of these services and governance as well as by improving access to information, the usage of e-government services is intended to improve openness, accountability in public administration, and quality of life [15,18].

In recent times, many governments around the globe have started to advance their service delivery models and enhance their public sector performance by utilizing emerging technologies coupled with innovative strategies. These include, for example, Big Data, open data strategies, artificial intelligence, cloud computing, smart cards, sensors, Internet of Things (IoT) and social media [19–23]. The extensive use of these technologies, together with various innovative strategies such as citizens interacting with governments, represent the latest stages of e-government innovation and have been referred to as "smart government" [24,25]. Public sector organizations - with the use of smart government initiatives - could improve democracy, public participation, collaboration, transparency, governance procedures and societal values [26–28].

Governments around the world now understand the ubiquity of technology and its production of a huge quantity of data [25,29]. Information-smart government technology could aid institutions in better understanding complex economic and social issues, meeting citizens' needs, and fostering better connections with stakeholders and businesses. Decision-making processes can also be enhanced by this wide availability of data, since governments could make better decisions grounded in reliable and accurate information [30,31]. Agility and responsiveness would improve for public sector organizations with the combination of smart computing technology, information, and innovations [20,26].

Saudi Arabia, one the world's top twenty economies [32], has one of the largest and fastest-growing ICT companies in the Middle East, and significant growth is expected in the next decade. The Saudi government has devised an economic blueprint for the future, known as Saudi Vision 2030 [33], the goal of which is the National Transformation Program (NTP) to be completed by the year 2030 [34]. With the help of many national ICT policies, programs, and initiatives, it seeks to turn the nation into a knowledge-based society and a digital economy [35,36], including the e-government technology which is necessary for the public sector. However, the subject of how to expand the use of these technologies in public sector agencies has not yet been addressed in scholarly literature, despite increased interest in the technology underlying smart government. Even if smart government programs have the ability to provide companies with several advantages, there are still many developing nations, particularly in the Middle East and, more specifically, Saudi Arabia, where smart government is not yet widely embraced [25,37,38].

Currently, most smart government initiatives around the developing world are still in either the initial or pilot testing stages [22,26,39,40]. Smart government involves the use of all kinds of technologies such as mobile device applications and wireless to enhance services [41–43]. Smart government has been described by Kim and Kim [44] as a government that uses IT and the Internet as tools for better implementation of services to the public, redesign administrative functions, and realize democracy. Mahlangu and Ruhode [45] defined it as: "Effective and efficient public administration, quality of public services and the participation of residents in making decisions about the city. Information and communication technologies are used in e-administration, to improve democratization and services delivery, as well as support decisions made by public authorities". Smart government represents the resource integration and system integration that occurs between the external functional departments and the internal business mechanisms of the government.

Research indicates that the availability of technological innovations alone does not guarantee their acceptance by government bureaucracies and their staff [14]. This remains one of the major problems for many institutions [14]. Indeed, individuals' willingness to accept and apply a new ICT is essential for determining the success of any ICT project [37,46,47]. The values and intended benefits of emerging technologies will not be recognized unless they are effectively embraced by people in the workplace [14]. It is subsequently very important to understand why and how people and organizations adopt and use emerging innovative technologies [2,14]. Although numerous studies have investigated the adoption of technological innovation, not much research has attempted to understand its acceptance at the individual level [2,14,15].

Decisions about the adoption of ICT are frequently influenced by elements that are not just technological but also organizational, environmental, social, and demographic [14,22,48,49]. According to recent studies, countries' cultures and religious beliefs are important influences on people's decisions to adopt new technologies [50,51]. Arab countries have different cultural and social traits than Western and Asian-Pacific nations. Unlike these regions, Saudi society is characterized as a highly religious, tribal, collective and conservative one [52,53], and these are factors that could well likely encourage resistance to change [52]. Religious values and beliefs are hypothesized to affect individuals' attitudes to e-government [53]. It is plausible to anticipate that these distinctions will have an impact on the adoption of ICT advances in Arab nations such as Saudi Arabia, in ways that may be fundamentally different from industrialized Western society [15]. This view is corroborated by research, which shows that Saudi Arabia's technological acceptance factors differ from those of developed nations [54]. There is a mutual relationship between social-cultural, managerial, and technological phenomena. It is crucial to research how these principles affect the adoption of cutting-edge solutions like smart government systems.

A project for electronic government named YESSER was launched by the Saudi Arabian government in 2005. It aimed to give every Saudi citizen access to computerized government services [36]. Yet for various reasons the implementation of e-government projects was delayed or simply failed and, to date, there is no evidence to justify this large investment [36,55,56]. The Saudi government utilized wireless modems and mobile services in an early endeavor to build a smart government in order to provide services efficiently. Currently, these services are used for airport security, weather prediction, traffic data, emergency help, tracking of missing vehicles, and notification of taxes and bills [57]. Despite the Saudi ICT market's tremendous expansion, evidence reveals that e-government technology adoption has slowed [36,55]. Only by identifying the factors that influence individual employees' acceptance of technology in Saudi public sector enterprises will the issue of low-level technological innovation adoption be resolved.

The theoretical model used in this research is based on theories that seek to explain IS/IT adoption, including: theory of reasoned action (TRA) [58]; theory of planned behavior (TPB) [59]; technology acceptance model (TAM) [60]; TAM 2 [61]; TAM 3 [62]; unified theory of acceptance and use of technology (UTAUT) [63]; diffusion of innovation (DOI) [64]; and technology, organization, and environment (TOE) framework [65]. This study utilizes an integrated model based on the strengths and limitations of previous theories and models. The study collects data from Saudi bureaucracies, specifically the Ministry of Health, Ministry of Foreign Affairs, Ministry of Education and Ministry of Justice. The goal is to look into some of the organizational, social, cultural, and religious elements that affect employees' opinions about the adoption of smart government systems.

1.1. Objectives of the study

This study's main goal is to find out what influences Saudi Arabia's public sector organizations' adoption of smart government systems (SGS). The specific research objectives are as follows.

a) To investigate how employees in Saudi Arabia perceive SGS in light of security concerns.
b) To determine how the ICT strategy has affected Saudi Arabian employees' perceptions of SGS.
c) To evaluate the impact of managerial support on the perception of SGS by employees in Saudi Arabia.
d) To examine the impact of incentives on how employees in Saudi Arabia perceive SGS.
e) To investigate the effect of trust on how Saudi Arabian employees view SGS.
f) To investigate the effect of cultural values on how Saudi Arabian employees view SGS.
g) To determine how Saudi Arabian employees perceive SGS in relation to their religious beliefs.
h) To investigate the effect of perception on SGS acceptance by Saudi Arabian employees.

1.2. Motivation of the study

This study intends to explore the elements influencing Saudi Arabian public sector workers' opinions of smart government technology and the impact on actual use. Smart technology is essential for the modernization of the public sector, but the problem is that significant barriers hinder widespread smart government services acceptance and usage [22]. Although there is increasing interest in the technology behind smart government, research literature has not yet provided a solution to the question of how to boost their utilization in public sector enterprises [66]. In Saudi Arabia, the concept of smart government systems is relatively new, and its implementation has attracted the attention of many researchers. The possible factors influencing how innovation is accepted need to be better understood [22,67]. Scholars and practitioners have long struggled to understand the characteristics that guide user acceptability of workplace innovation [61,68].

Although the adoption of smart government services has been the subject of much recent research, very little emphasis has been given to identifying the primary elements that influence this acceptance [66]. The adoption of m-government or smart government in the GCC, according to some writers, is not taken seriously by academicians and practitioners [37], or elsewhere in the Arab region [69,70]. Smart government projects have the potential to benefit these groups greatly, but for a variety of reasons, it is still not commonly used in developing nations [37,38]. Many published studies on ICT in government concentrate on Western and Asian nations [17,71] but there is a lacuna in the literature concerning the impact of cultural and religious factors on innovative technology adoption [72,73].

In the Middle East, and Saudi Arabia is no exception, there is relatively little empirical analysis on the use of smart government systems. Despite the Saudi ICT market's rapid expansion, evidence suggests that e-government technology adoption is quite moderate [36,55,56]. This research has included the growing importance of cultural and religious aspects to technology adoption in public sector organizations. It is subsequently very important to understand why and how people and organizations adopt and use emerging innovative technologies [37,61]. Although numerous studies have investigated the adoption of technological innovation, not much research has attempted to understand its acceptance at the individual level [2,14,15]. Most studies carried out on management issues appear to disregard religion as a factor [14,74]. The adoption of smart government is still in its early stages in Saudi Arabia, and no prior research has looked into the elements that can motivate an organization to implement smart government technologies in the country's public sector. By creating a comprehensive model that can explain the adoption of various technologies, this research hopes to close a gap in the literature.

2. Theoretical framework and research model

The model created for this research is built on the following: technology acceptance models by Davis [60]; the technology,

organization, and environment framework by Tornatzky and Fleischer [65]; and the unified theory of acceptance and use of technology devised by Venkatesh et al. [63]. The proposed model created for this study combines and broadens the aforementioned models for technology adoption in order to fully account for the key technological, organizational, environmental, social, and demographic aspects. These will be viewed as moderators affecting how IT department staff members perceive the outcomes of implementing smart government solutions.

The theory of reasoned action is the most frequently used IS/IT theoretical paradigm at the personal level (TRA) [58]. This is followed by the theory of planned behavior (TPB) [59], technology acceptance model (TAM) (Davis, 1989), TAM 2 [61]; TAM 3 [62], and unified theory of acceptance and use of technology (UTAUT) [63]. The two main adoption models at the organizational level are: firstly, diffusion of innovation (DOI) [64]; and secondly, the technology, organization, and environment (TOE) framework [65].

The authors deployed TAM because it is one of the best models for explaining the adoption of technology by people [75]. According to Bryan and Zuva [76] one of the reasons for its popularity is that it clarifies behavioral intention (BI) applicable to IT adoption in broad contexts. Another reason is that the model anticipates the user's IT consent and purpose in the workplace [76]. Low et al. [77] and Mohdhar and Shaalan [78] noted another reason for the popularity of TAM; it explains the determinants of users' acceptance of a wide range of computing technologies. Another model used in this study is the UTAUT formulated by Venkatesh et al. [63]. The category known as social dimension incorporates social norms and beliefs. This dimension can be understood by referring to social influence as explained in the UTAUT model. As observed by Chen et al. [79], if an invention is used publicly, the social impact usually works better if the goal is meaningful. According to Tornatzky and Fleischer [65] the technology-organization-environment framework (TOE) explains technology adoption based on organizational and environmental contexts.

The TOE model is described by Baker [80] as having wide-ranging applicability and explanatory power for several technological, industrial, and national/cultural contexts. Organizational resources and features are the main factors constituting the model's rationale while the industry infrastructure, regulatory environment and availability of technology service providers constitute the model's environmental context [80]. In Fig. 1 the proposed research model is shown.

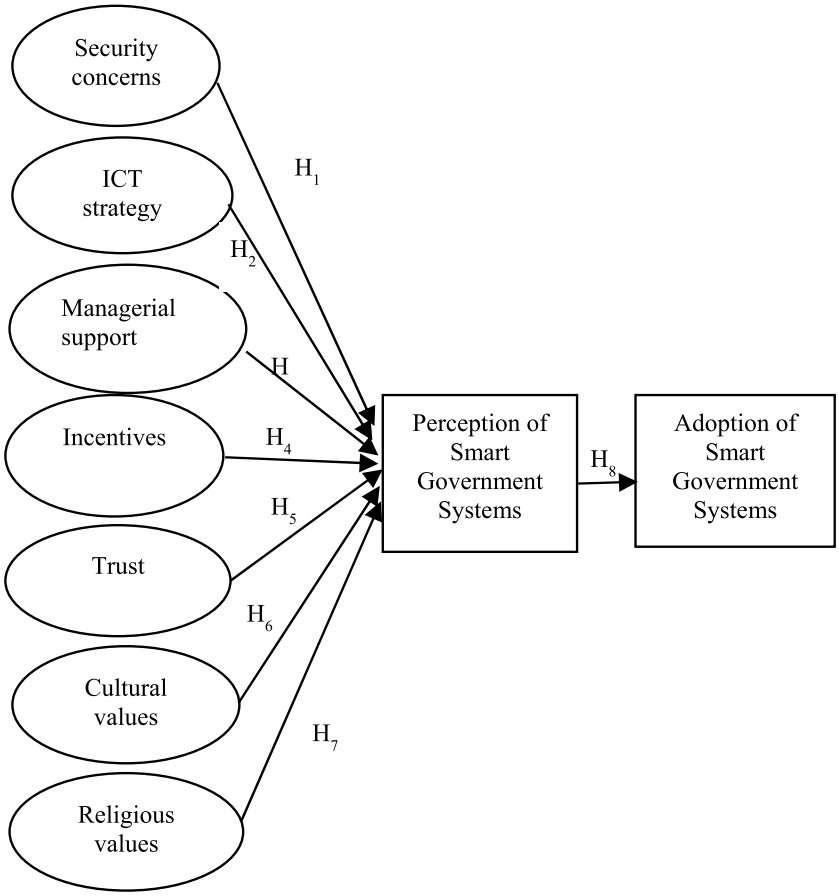

Fig. 1. Hypothesized model.

3. Hypotheses development

3.1. Security concerns

Perhaps the most critical aspect of smart government systems acceptance and implementation in the workplace is security concerns, given the nature of the digital world. At present, the privacy of those using the large network in smart technologies is at risk of serious security violations, essentially because there are various applications that can be used to get past the security system [81]. A very important issue that has not yet been fully reviewed in the refinement of smart government systems is information security [82]. Data protection and preservation are essential to smart government systems to ensure information is shared responsibly [83–85]. Security concerns play a significant role in adopting and taking up the smart government systems in public service organizations [86]. Employees will be encouraged to embrace these systems when they feel that data and information is secured and protected. These give rise to the following hypothesis.

H1. Security concerns have an impact on the perceptions of SGS by public service employees in Saudi Arabia.

3.2. ICT strategy

A strategy is usually described in terms of determining the goals and objectives that need to be achieved [87]. Strategies are the overarching guidelines and policies that need to be devised so that employees know how to use smart government systems and for what reason in the public service. This has been noted in the work by Alghamdi et al. [88] and Alomari et al. [89]. For example, the role of ICT strategy is to enhance operational activities so that interactions among government, businesses and citizens are executed effectively and efficiently [90,91]. Furthermore, the government's policymakers use ICT strategies to find quicker and more efficient ways to improve services to the public and all relevant stakeholders [92–94].

Nonetheless, attention needs to be paid in a national smart government strategy to the key issues involved in determining a holistic vision, while concentrating on the long-term strategies. It is vital to effectively eliminate problems [95]. An initiative may have various objectives, which include the need to offer smart services that seek to enhance modern public services and make them more efficient [30]. There may be varied and distinct core objectives of an initiative, possibly consisting of encouraging smart government and greater involvement of the population in interacting with government activities [38]. When an effective strategy is in place, organizations can achieve information system refinement. A few authors like Mansoor [96] and Anthopoulos and Reddick [97] asserted that a smart government system essentially seeks to increase effectiveness, transparency, collaboration and ease with which government processes are carried out by all those responsible for them, including citizens, government and businesses. It is only possible to attain ICT adoption successfully when an effective plan is in place to provide direction to the whole implementation process [98,99]. Based on this reasoning, the second hypothesis is put forward.

H2. ICT strategy has an impact on the perceptions of SGS by public service employees in Saudi Arabia.

3.3. Managerial support

It is imperative to have management support to ensure that the adoption of technology innovation is successful [100]. Support from management is one of the facilitating conditions that make it possible for people to employ technology and effectively use it in the workplace. The claim that managerial support affects how readily people accept technology was supported [101]. When support is clearly articulated, personnel realize that they will learn how technology is to be used whenever and as required. It was remarked by Alshawi et al. [102] that limited or a lack of support from management served as a disincentive for employees to use technology consistently or for the long-term. Consequently, they exhibited less intention to accept technology. This gives rise to the following hypothesis.

H3. Managerial support has an impact on the perceptions of smart government systems usage in Saudi Arabia.

3.4. Incentives

The study by Isik [103] has shown that incentives and technology adoption are significantly related to each other. Individual employees are motivated to adopt technology in the presence of incentives. When incentives are offered by the government to those using hybrid cars, the positive attitudes of the public towards buying such cars increased. For other kinds of technology, an identical case can be formulated, in which technology pairing with certain appealing incentives can motivate individuals to accept the latest technology. The way the technology adoption process is influenced by providing incentives has been examined by Milliou and Petrakis [104]. These authors deduced that when a technology is considered as providing a competitive advantage, this perceived benefit is converted into an incentive. Consequently, the organization is encouraged to deploy technology. It is not necessary for the incentives to always be in monetary forms or bonuses; they can actually be formal or informal, like providing sufficient time for individuals to use the innovation [14]. The study presents the following hypothesis.

H4. Incentives have an impact on the perceptions of smart government systems usage in Saudi Arabia.

3.5. Trust

Trust is one of the important elements that affect the acceptance of technological innovation by individual employees within the organization. In this research trust was considered an essential factor that influences public sector employees' perceptions of adopting smart government systems in Saudi Arabia. Previous research has stressed the impact that security and trust challenges have on the development and application of smart government technologies in public sector agencies [105,106]. Employees accept technology when they have a strong sense of trust in the systems, and they are confident that the technology will not pose any privacy and security threat to them in personal or public life [105–108]. Hence, the stated hypothesis below is posited.

H5. Trust has an impact on the perceptions of smart government system usage in Saudi Arabia.

3.6. Cultural values

For a long time, culture has been considered a key aspect of anthropology, and it is now a significant part of organizational studies. Family, religion, communication, language and other activities are carried out to impart culture so that beliefs, truth, logic, values, rules and activities can be expressed. Studies have revealed that cultural values have an impact on how well people adopt technology [109–111]. For example, the perceived behavior of using 3G mobile services in Singapore and Malaysia has been affected by cultural values like beliefs [110,112]. The influence of cultural values on the acceptance of technology has been studied by Taherdoost et al. [113] and Mun et al. [114]. Hence, the hypothesis given below is posited for analysis.

H6. Culture has an impact on the perceptions of smart government system usage in Saudi Arabia.

3.7. Religious values

Nearly 75% of the world's population follows a certain religion or faith; hence, it is typically accepted that religion is a source of values [115]. A significant factor that is responsible for the rejection of the latest technologies is its incompatibility with cultural values, practices and traditions [116,117]. In previous studies it was recognized that culture had a significant effect on technology adoption, particularly in the developed countries like the Arab states, where Islam is the most important pillar of culture [118]. It is important to identify and understand whether a practice or activity is from a culture or a religion as it can become confusing. Religion is a set of teaching which comes from Divinity, and it has some collections of principles and guidelines. Culture can change based on world situations such as social, economic, and financial conditions. Different cultures have their norms and guidelines. Religions have core beliefs and principles. The practices and interpretations of religions may evolve over time across different regions and cultures. Different cultures exhibit variations in their religion practices over time [119,120]. Culture of different people can be different based on the social ways of their lives, ideas and customs even when they have the same religion. Cultures evolve and change but religion stays the same. In this research culture and religion was set as parallel independent variable as religion transcends culture.

According to Abu Nadi [121], Islam is the bedrock of the culture of Saudi Arabia, and guides the moral values and behaviors of its people. Researchers are giving greater attention to the analysis of religious beliefs of employees in the field of management-related studies [122]. Comprehending the importance of the way Islamic ideals and beliefs influence organizations cannot be undervalued [122]. Though internationally, values have been examined extensively, there are limited studies that focus on Islamic values [115]. The majority of research carried out in the field of management appears to disregard religion as a factor [74,122]. This is because most researchers, who are mostly Western, make the assumption that a neutral perspective is held by the organizations on religion, and employees do not bring their beliefs to work. This assumption is not applicable to the way activities are performed in Middle Eastern countries [122,123]. Subsequently, the following hypothesis is put forward for testing.

H7. Religious values have an impact on the perceptions of smart government system usage in Saudi Arabia.

3.8. Employees' perceptions of smart government systems

The perception of individuals regarding the new system affects their adoption of that system [105]. According to Weihrich and Koontz [106], a person's perception of a technology is a prerequisite for its acceptance. The adoption of new technology is strongly linked to employees' personal perceptions of new technologies [124,125]. A positive perception is more likely to encourage individuals to adopt technology, so based on this assumption the following hypothesis is put forth.

H8. Employees' perceptions of smart government systems have an impact on their adoption in Saudi Arabia.

4. Methods

The research assessed how personnel in four Saudi government organizations' IT division, specifically Ministry of Health, Ministry of Foreign Affairs, Ministry of Justice and Ministry of Education, perceive the implementation of smart government systems. These ministries have been selected because they are considered to be the major ministries. Several steps were taken to ensure that the study followed the standards of ethical practice and ethical approval was obtained from the University of Canberra's Human Research Ethics Committee. Participation in this study was voluntary, data was collected anonymously, the consent letter stated that participants are under no obligation to take part, and they may decline to participate at any time of the study.

An online survey questionnaire was sent to 2060 employees in these four ministries. After two reminders a total of 427 completed answers were received, of which 419 were deemed useable resulting in a 22% response rate which is considered acceptable in social sciences research. The reason for the low response rate is due to the fact that public services in Middle Eastern countries are typically hesitant to participate in this type of research because they are unfamiliar with it [14]. Multivariate statistical analysis, correlation and multiple regressions were employed to analyze the data. The Statistical Package for Social Sciences (SPSS) and structural equation modeling (SEM) were also used to examine the data. The survey research instruments, definition of the construct and sources can be found in appendix 1.

5. Results and discussion

5.1. Inter-item correlations among study variables

Inter-item correlations assess the extent to which scores on one item are related to scores on all other items in a scale. Table 1 summarizes the correlations which measure linear relationships among the independent and dependent variables. Pearson correlation matrix reveals that perception is significantly related to security concerns ($r = 0.543$, $p < 0.01$), ICT s trategy ($r = 0.725$, $p < 0.01$), managerial support ($r = 0.748$, $p < 0.01$), incentives ($r = 0.679$, $p < 0.01$), trust ($r = 0.574$, $p < 0.01$), cultural values ($r = 0.602$, $p < 0.01$) and religious values ($r = 0.329$, $p < 0.01$). A strong positive correlation exists between the perception and adoption of smart government systems ($r = 0.725$, $p < 0.01$). According to the findings, the correlations between dependent and independent variables range from $r = 0.329$ to $r = 0.748$, while the correlation among independent variables ranges from $r = 0.281$ to $r = 0.714$. This means that the study does not have any multicollinearity issues. According to Hair Jr et al. [126] a high correlation (generally 0.90 and above) in the correlation matrix is the first indication of substantial collinearity [127].

5.2. Validity and reliability of the instrument

5.2.1. Validity of the instrument

The extent to which a test actually measures what it pretends to be measuring is known as construct validity [128]. Convergent validity describes how closely two conceptual measurements that ought to be related in theory are actually related. The study instrument's validity was evaluated using convergent and discriminant validity. Indicators such as standardized factor loadings and average variance extracted (AVE) were assessed to get convergent and discriminant validity. Table 2 shows that convergent validity comprises the entire factor loadings ranging from 0.733 to 0.960, which are suitable for this study's aims. Each item under a construct was greatly weighed within the specific constructs; this outcome is believed to confirm the constructs' convergent validity and discriminant validity are sufficient when the average variance extracted (AVE) of the constructs loading is greater than 0.50. Shown here is the constructs account for at least 50% of the measure variation [129]. The square roots of the AVE scores are higher than the correlations' coefficients between the constructs [130]. Thus, it is concluded that construct divergent validity has been established. The average variance extracted (AVE) exceeded the threshold value of 0.5 [131]. The average variance extracted (AVE) score, according to the findings, lies between 0.771 and 0.949, which is greater than the recommended score. Therefore, study instruments have an acceptable level of discriminant validity.

5.2.2. Internal consistency (reliability)

Internal consistency is a measure of reliability. When a measurement is said to be reliable, it means that it consistently produces the same result, given that all other factors are held constant [132]. Cronbach's alpha is the most widely used method to measure an instrument's reliability. Reliability is usually expressed numerically. Higher coefficient indicates the instrument's high reliability. Classical test theory views an observed response as consisting of the sum of the true score and error [133]. Cronbach's α values in Table 2 were above the threshold of 0.70 and ranged from 0.732 to 0.947 across the dimensions of Smart Government Systems (SGS), which are statistically high and acceptable. According to DeVellis and Thorpe [134], Cronbach's α reliability between 0.70 and 0.80 is respectable while values between 0.8 and 0.9 are deemed to be very good. The results show that most of the study instruments exhibit strong reliability.

Table 1
Inter-correlations between variables of the study.

	SC	ICTS	MS	INC	TR	CU	RV	PER
SEC	1.000	.707[a]	.472[a]	.473[a]	.482[a]	.390[a]	.281[a]	.543[a]
ICT	.707[a]	1.000	.703[a]	.558[a]	.568[a]	.568[a]	.312[a]	.725[a]
MAS	.472[a]	.703[a]	1.000	.550[a]	.461[a]	.570[a]	.304[a]	.748[a]
INC	.473[a]	.558[a]	.550[a]	1.000	.643[a]	.548[a]	.401[a]	.679[a]
TRU	.482[a]	.568[a]	.461[a]	.643[a]	1.000	.714[a]	.461[a]	.574[a]
CUV	.390[a]	.568[a]	.570[a]	.548[a]	.714[a]	1.000	.423[a]	.602[a]
REV	.281[a]	.312[a]	.304[a]	.401[a]	.461[a]	.423[a]	1.000	.329[a]
PER	.543[a]	.725[a]	.748[a]	.679[a]	.574[a]	.602[a]	.329[b]	1.000

Legend: SEC=Security concerns, ICT=ICT Strategy, MAS = Managerial support, INC=Incentives, TRU = Trust, CUV=Cultural values, REV=Religious values, PER = Perception, [a] Correlation is significant at the 0.01 level.

Table 2
Reliability and factor analysis for convergent validity.

Factor	Factor Loading	Cronbach's Alpha	AVE
Security concerns		0.894	0.853
Security concerns 1	0.856		
Security concerns 2	0.807		
Security concerns 3	0.910		
Security concerns 4	0.839		
Security concerns 5	0.853		
ICT strategy		0.903	0.838
ICT strategy 1	0.875		
ICT strategy 2	0.791		
ICT strategy 3	0.876		
ICT strategy 4	0.795		
ICT strategy 5	0.855		
Managerial support		0.929	0.808
Managerial support 1	0.839		
Managerial support 2	0.775		
Managerial support 3	0.777		
Managerial support 4	0.799		
Managerial support 5	0.851		
Incentives		0.900	0.845
Incentives 1	0.866		
Incentives 2	0.786		
Incentives 3	0.794		
Incentives 4	0.899		
Incentives 5	0.878		
Trust		0.894	0.771
Trust 1	0.811		
Trust 2	0.755		
Trust 3	0.729		
Trust 4	0.733		
Trust 5	0.826		
Culture		0.947	0.848
Cultural 1	0.878		
Cultural 2	0.891		
Cultural 3	0.797		
Cultural 4	0.844		
Cultural 5	0.832		
Religious values		0.900	0.845
Religious value 1	0.864		
Religious value 2	0.912		
Religious value 3	0.781		
Religious value 4	0.836		
Religious value 5	0.833		
Perceptions		0.732	0.949
Perceptions 1	0.939		
Perceptions 2	0.930		
Perceptions 3	0.960		
Perceptions 4	0.955		
Perceptions 5	0.959		

Table 3
Regression model for all factors with perception of SGS.

Independent Variables	Unstandardized Coefficients (B)	Standardized Coefficients Beta	T	R^2	F	Sig.
				.855	27.702	.001*
(Constant)	.090		.600			.549
Security	.051	.059	2.051			.041*
ICT strategy	.134	.158	4.215			.000**
Managerial supp	.139	.169	5.027			.000**
Incentives	.155	.165	5.263			.000**
Trust	.053	.068	1.957			.050*
Culture	.019	.022	.669			.504
Religious values	.026	.026	1.082			.280

Dependent Variable: Perception.

6. Discussion of hypotheses testing

Hypothesis 1. Hypothesis H_1 investigates the impact of security concerns on employees' perceptions of smart government systems usage in Saudi public service organizations. The results presented in Table 3 demonstrate that security concerns exert a significant impact on employees' perceptions of the adoption and usage of smart government systems. Individual employees will be inclined to embrace these systems if management can ensure that security and privacy issues are protected in the online domain. Results of the security concerns are supported by other studies [52,135] in that employees are willing to adopt them if authorities can convincingly ensure smart government systems are safe from hacking.

Hypothesis 2. Hypothesis H_2 investigates the impact of ICT strategy on employees' perceptions of smart government systems usage in the Saudi ministries. The finding shows that the ICT strategy strongly affects employees' perceptions of the adoption and usage of smart government systems. A strong ICT strategy helps personnel to realize that it will be essential for them to adopt the new system as directed by management. Otherwise, there might be serious consequences. Results are supported by Al-Amawi [136], Almuraqab et al. [37] and Alonazi et al. [137], who discovered that ICT strategy significantly affects whether employees use smart government systems.

Hypothesis 3. Hypothesis H_3 investigates the impact of managerial support on employees' perceptions of smart government systems usage. The results presented in Table 3 demonstrate that managerial support strongly influences employees' perceptions of the adoption and usage of smart government systems. Employees' technology adoption is expedited when there is adequate managerial support and executives are willing to provide essential facilities for employees to adopt the new systems. Wang et al. [100], Alyammahi [138] and Alajmi et al. [139] revealed that managerial support is essential for the adoption of smart governance in emerging nations like Saudi Arabia. This supports the findings that managerial cooperation is crucial for the effective application of technical innovation.

Hypothesis 4. Hypothesis H_4 explores the impact of incentives on employees' perceptions of smart government systems in the Saudi ministries, and the results show that incentives wield a significant impact on users' perceptions and adoption of technology. Employees may feel there is an incentive to adopt the system and they act on it positively. Incentives can be formal or informal including bonus, monetary support, recognition, time flexibility, awards and other benefits. This result is supported by the studies conducted by Isik [103] and Milliou and Petrakis [104], in that incentives can motivate employees to adopt a new technology.

Hypothesis 5. Hypothesis H_5 investigates the impact of trust on employees' perceptions of smart government systems. The results show that trust can guide employees' perceptions and usage of technology in the workplace.

Hypothesis 6. Hypothesis H_6 looks at the impact of culture on employees' perceptions of smart government systems in the four ministries. Table 3 shows that culture has no significant impact on employees' perceptions. There is a Beta value of −0.019 and a p-value 0.504. As a result, the study failed to reject H_6 as invalid, implying that there is no significant link between culture and perceptions of smart government systems (SGS) adoption in the four ministries. The result is consistent with many studies that did not find cultural values guided attitudes toward usage of smart systems in the workplace [138,140,141]. This result is supported by the findings of Arslan [142] on smart government acceptance in 26 countries, which found a link between individualism and a higher rate of smart government system adoption. The finding for cultural values is consistent with many studies in the literature that did not conclude that culture affected people's perceptions and adoption of smart systems [138,140,141].

Hypothesis 7. Hypothesis H_7 assesses the impact of religious values on employees' perceptions of smart government systems (SGS) adoption in the four ministries. The Beta value was −0.026 while the p-value was 0.280, more than 0.05. This suggests that in the four ministries there is no link between religious values and perceptions of smart government systems (SGS) adoption. This outcome finds support in research by Al-Amawi [136], who reported that social factors do not have a statistically significant impact on citizens adopting smart government systems.

The results in Table 3 reveal that the following variables wielded a significant impact on perceptions of smart government systems (SGS). By looking at the p-value of the *t*-test for each predictor, we can see that 5 (Security (SC), ICT strategy (ICT), Managerial support (MS), Incentives (INC), and trust (TR)) of the 7 predictors contribute to the model. The following 2 predictors do not, i.e., culture (CU) and religious values (RV). As can be seen each of the five variables were positively and significantly correlated with the perception of SGS, indicating that those with higher scores on these variables tend to have better perceptions.

Hypothesis 8. Hypothesis H_8 set out to determine if employees' perceptions exert any influence on how they use smart government systems. As per the data in Table 4, they do have a substantial impact on the adoption and use of smart government technologies, according to the employees' perceptions. This result is in line with earlier studies showing a strong correlation between perception and

Table 4
Regression model for perception of SGS adoption.

Independent Variables	Unstandardized Coefficients (B)	Standardized Coefficients Beta	T	R^2	F	Sig.
				.145	70.742	.001*
(Constant)	.977		3.795			.000**
Perception	.402	.381	8.411			.000**

Dependent Variable: Adoption.

acceptance of technological improvements [60,105,138,140,143,144].

7. Conclusion and implications

This study was conducted in response to the need for more thorough investigation into the elements influencing Saudi government ministry employees' adoption of smart government systems. It is the only such study done in Saudi Arabia on how personnel in four ministries' IT departments evaluate the adoption of smart government technology. Managers must be aware of the technological, organizational, environmental, demographic, and social elements in order to improve the adoption rate of SGS in the public sector. The study sheds light on employees' behavioral intentions to use smart government systems. Reliability and validity tests were conducted of the instrument through expert opinions and a pilot study, average variance extracted (AVE), Cronbach's alpha, and factor loadings. The results of the reliability coefficient Cronbach's α value showed that all of the constructs have high reliability of more than 0.70. Data was collected from four ministries - Ministry of Health (MOH), Ministry of Foreign Affairs (MOFA), Ministry of Justice (MOJ), and Ministry of Education (MOE) - and analyzed using multivariate statistical analysis. Results revealed that perception was significantly linked to security concerns ($r = 0.543$, $p < 0.01$), ICT strategy ($r = 0.725$, $p < 0.01$), managerial support ($r = 0.748$, $p < 0.01$), incentives ($r = 0.679$), $p < 0.01$), and trust ($r = 0.574$, $p < 0.01$). In the meantime cultural and religious values were found to have no significant effect on perception. In fact, a strong significant effect of perception on the adoption of smart government systems was discovered, with an alpha level of (0.000). It was discovered that employee views had a statistically significant impact on whether smart government technology was adopted. A summary of the results of hypotheses testing is presented in Table 5 and test of the proposed model is shown in Fig. 2.

7.1. Theoretical implications

The study makes a strong theoretical contribution by filling a gap in our knowledge of smart government systems adoption in Saudi Arabia, specifically its public sector organizations. It also extends the current technology acceptance models and theories by developing a comprehensive model which incorporates factors derived from different paradigms. The unique and comprehensive conceptual model presented here takes into account the weaknesses and strengths of earlier models and theories and combines the most convincing elements that can explain the adoption of technological innovation in particular research setting in the Middle Eastern country context where a different socio-cultural and managerial practices are prevalent. The research enhanced our knowledge and understanding of the factors affecting the adoption of technological innovation such as smart government systems in the workplace context in Saudi Arabia, which is relatively an unexplored issue in the literature.

7.2. Practical implications

The findings will enhance policymakers' and decision-makers' understanding of the processes involved in a public sector organizations' adoption of smart government systems. One of the main achievements of this study is the creation and analysis of a novel, multi-perspective conceptual model illustrating the key factors affecting Saudi Arabian public service employee's adoption of smart government technologies in workplace settings. The results will help the Saudi government and policy makers to develop guidelines, policies and procedures in implementation technological innovation in the public service organizations. The results also have important implications for various levels or types of managers and practitioners who are responsible for introducing new technologies into the workplace. The findings will help managers to: firstly, consider more carefully the effective adoption and usage of smart government systems; and secondly, help reduce the related costs. Managers will be able to identify any problem areas that employees face in adopting smart government systems and improve their level of expertise in using new technology.

7.3. Key lesson learnt

The findings of the study provide some lesson for the researchers and practioners working for the middle eastern region. It is likely

Table 5
Summary of results of hypotheses testing.

Hypotheses	Path Direction	St. Estimate	CR	P	Result
H_1	SC → PER	.051	2.051	.041*	Accepted
H_2	ICTS→ PER	.134	4.215	.000**	Accepted
H_3	MS→ PER	.139	5.027	.000**	Accepted
H_4	INC→ PER	.155	5.263	.000**	Accepted
H_5	TR→ PER	.053	1.957	.050*	Accepted
H_6	CU→ PER	.019	.669	.504	Rejected
H_7	RV→ PER	.026	1.082	.280	Rejected
H_8	PER→ ADP	.402	8.411	.000**	Accepted

SC = Security concerns, ICTS = ICT Strategy, MS = Managerial support, INC = Incentives, TR = Trust, CU = Culture, RV = Religious values, PER = Perception, ADP = Adoption; ** means significant at the 0.01 level, and * means significant at the 0.05 level.

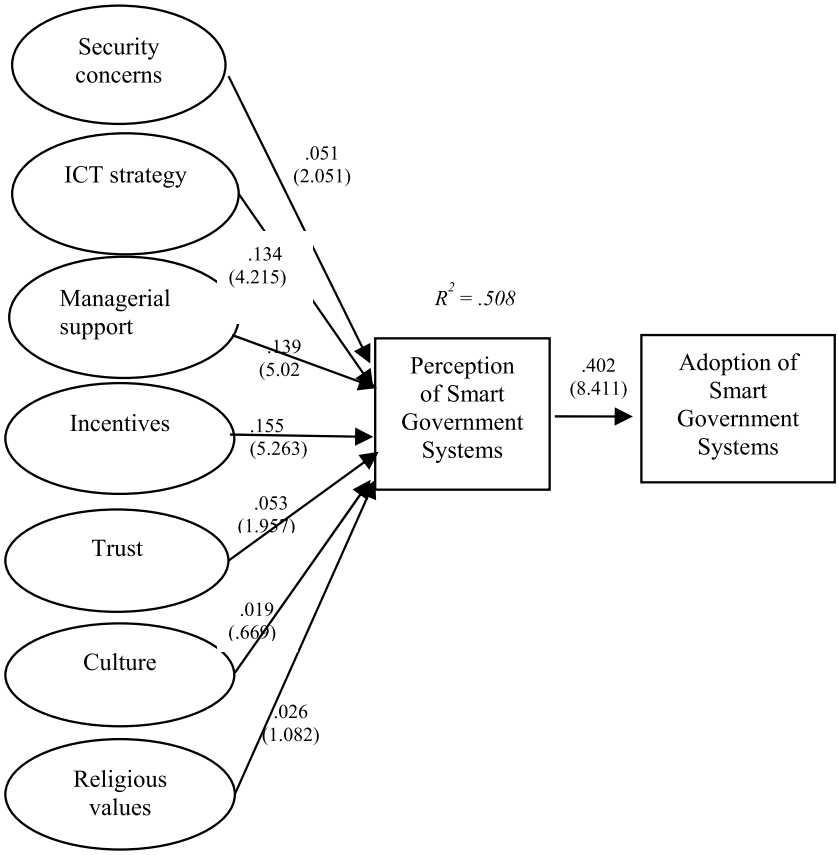

Fig. 2. Test of the proposed model.

that the results reported here would help policymakers and those responsible for making decisions understand the steps that should be followed for implementing smart government systems. The outcomes offer valuable directives to the government for creating and guiding its strategies and policies with respect to the adoption of the latest innovations. There are significant implications of this study's outcomes in terms of assisting public sector management in identifying organizational and social benefits of using emerging new technologies so that the processes provide better services to public. The acceptance of technological innovations by public sector organizations' employees is a significant first step towards smart government up-take in the wider community and assist organizations to provide better services. The study will help the community by getting people to understand why it is being done, and provide better services including system availability, transparency, good service and accessibility. When there is a successful and efficient adoption of smart government systems, the government may be able to devise solutions for complex social issues, fulfil the requirements of citizens and enhance relationships between the government and public.

8. Limitations and suggestions for future research

Every study that has ever been conducted has limitations. This study was carried out specifically in four Saudi Arabian ministries. If similar research was conducted in another public sector agency, the results might differ due to the environmental conditions and circumstances. The study's geographic scope is another limitation. The issue of generalizability is a widely evident limitation in the majority of technology acceptance research. This study was conducted solely in Saudi Arabia, and this could mean the results are not generalizable to other countries or the private sector. This research did not employ a qualitative research strategy due to time constraints. In order to better test the model, the qualitative approach could be used to provide a deeper insight into the adaptation and usage level of SGS by government public sector employees. Qualitative information could enrich our understanding of the factors affecting people's beliefs, perceptions, and opinions of adopting smart government systems.

The possible future directions of research in every field are limited only by our ability to ask questions. This study suggests possibilities for some future research to be undertaken in the technology adoption areas. The findings of this study can be applied to different organizational circumstances with comparable features, breadth, and context. However, additional investigation is required to widen and validate the study's findings and consequences. To validate the evaluations of experienced respondents regarding the importance of characteristics for effectiveness, the author suggests conducting this kind of study in other Middle Eastern and Arab countries. It is necessary to do cross-cultural research on this issue in these countries to comprehend the perceptional variations and

potential explanatory reasons.

Finally, this study was undertaken at a single point in time, specifically during 2019–2020. During these two years the COVID-19 pandemic changed completely the dynamics of government processes and objectives, and workers' lives were greatly up-ended by the spreading coronavirus and subsequent lockdowns. Future research on this topic could employ longitudinal methods to explain similar issues and investigate the causal effects of multiple factors and their relationships over time. This conceptual model could be tested in other public and private sector institutions, such as manufacturing or production indus

Tries or where technology acceptance and usage is growing. Lastly, future research should use the structural equation modelling-based approach such as SEM or SmartPLS to test the model with a larger sample size so that the study's rigor is enhanced.

Author contribution statement

Majharul Talukder: Conceived and designed the experiments; Analyzed and interpreted the data; Contributed reagents, materials, analysis tools or data; Wrote the paper.

Mohammed Alajmi: Conceived and designed the experiments; Performed the experiments; Analyzed and interpreted the data; Contributed reagents, materials, analysis tools or data; Wrote the paper.

Masoud Mohammadian: Conceived and designed the experiments; Contributed reagents, materials, analysis tools or data; Wrote the paper.

Data availability statement

Data will be made available on request.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Appendix 1. Survey instrument

Survey Instruments	Definition of the construct	Sources
Demographic information 1. What is your gender? Male, Female 2. What is your age group?≤30, 31–40, 41–50, 51–60, >61 3. What is your highest academic qualification? High School, Diploma, bachelor's degree, master's degree, Doctoral degree 4. Which of the categories describes your job position? Senior management, department manager, administration, technician, IT manager, other 5. What organization do you belong to? Ministry of Foreign Affairs, Ministry of Education, Ministry of Justice, Ministry of Health	Five demographic information are requested from respondents such as gender, age, academic qualification, job position and the ministry the employees are working with. This information will identify the demographics information about the respondent in the smart government system adoption within public service organization in Saudi Arabia.	Venkatesh et al. (2000) and Gefen and Straub (1997); Abbasi et al., 2015; Chawla and Joshi (2017); Eom et al. (2016)
Security concerns Smart government system usage is safe for work-related transactions. Smart government system is secure. Smart government system is very concerned about privacy issues. Smart government system has a high-level data security system in place. Smart government system has a reliable safety password system.	Security is treated as the most important concerns in the online world (Noelly & Saleh, 1989). The role of security is protecting the information from hacking and cyberwarfare so that data integrity is retained and protected (Aljifri & Navarro, 2003).	Aljifri & Navarro, 2003; Shareef et al. (2012), Safa et al., 2016; Zhu et al., 2006
ICT strategy Organization has a clear strategy about using the smart government system. Organization has a clear vision for establishing the smart government system. Organization has valid reasons to use the smart government system. ICT strategies support employees to use the smart government system.	ICT strategy refer to guidelines and policies that have been developed for the employees in order for them to use smart government systems.	Alghamdi et al. [88], Papp [145] Alomari et al. [89], Altameem [146]

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Survey Instruments	Definition of the construct	Sources
ICT strategies help the overall usage of the smart government system.		
Managerial support	Management support refers to whether the management provides support and encouragement and resources adopting smart government systems.	Low et al. [77], Talukder et al. [147] Igbaria et al. [148]
Management is keen for employees to use the smart government system.		
Employees are encouraged by management to utilize the smart government system.		
Smart government system is supported by the management in many ways.		
Management staff know how they can benefit from smart government system usage.		
Smart government system is supported by management because the right resources can be provided.		
Incentives	Incentives refers to individuals believe about benefits and consequences of using smart government technology. According to Isik (2004) and Kerr and Newell (2003) a positive relationship exists between technology adoption and incentives.	Talukder et al., 2014 Isik [103] Kerr and Newell [149] Gallagher and Muehlegger [150] Chang and Cheung [151]
I do my work in less time using the smart government system.		
I perform tasks more quickly through the smart government system.		
I become more productive with the help of the smart government system.		
My personal data is more secure through the smart government system.		
Using the smart government system enables me to be flexible in my work.		
Trust	Trust is an essential factor in organizations as transactions and services need to reflect integrity of the smart government system.	Alshehri [152], Alomari et al. [89], Alrowili et al. [153], Featherman and Pavlou [154] McKnight et al. [155]
I have confidence in using the smart government system.		
I trust the smart government system.		
Transactions via the smart government system are trustworthy.		
I trust in the benefits of using the smart government system.		
Smart government system is reliable for transactions.		
Cultural values	The participants had to identify the elements of goodness, rightness, fairness, and justness in smart government system for evaluating cultural issues.	Alsheddi, Sharma & Talukder (2020); Conner and Armitage [156]; Spaargaren [157]
People from my community encourage me to utilize smart the government system.		
Society will benefit from smart government system usage.		
People encourage others to use the smart government system.		
Adopting the smart government system is consistent with my cultural background, beliefs and assumptions.		
Society's perceptions about smart government system usage are positive.		
Religious values	Religious values refer to religious orientation and perception of using smart government technologies. Values with a religious orientation can shape the beliefs and behaviors of religious people (Wahab et al., 2016).	Wahab et al. [115] Lee et al. (2013)
It is important for me to work in a permissible (halal) ways.		
I have always followed every one of my organizations' rules.		
I always follow what my religion requires of me in the workplace.		
I am very strict about following my religious beliefs.		
My religious beliefs and practices are important to me.		
Perceptions of smart government systems	Pre-disposition to respond favorability and unfavorably to an object, event or institution. Behavioral beliefs and analysis of outcomes fuels a person's perception, such as their agreement or disagreement (Talukder, 2014). Using a five-point Likert scale, the participants had to state their feelings about smart government systems usage.	Talukder et al., 2014; Zobeidi et al., 2022; Lin 2011, Putzer and Park, 2010; Talukder, 2016
It is essential to use a smart government system to complete your job.		
It is appropriate to use a smart government system for your job.		
Smart government systems make things easier.		
It makes practical sense to use a smart government system.		
I like to use a smart government system.		
Adoption of smart government systems	Smart government system usage was measured using five indicator- actual amount of time usage, frequency of use, level of usage, number of features used and sophisticated	Al-Gahtani and King [158], Talukder et al. [147], Igbaria et al. [148]
On average, how much time do you spend per week using the smart government system in your		

(*continued on next page*)

(*continued*)

Survey Instruments	Definition of the construct	Sources
work? On average, how frequently do you use the smart government system for work? Please indicate your level of usage of the smart government system. How many different applications of the smart government system do you use? Do you use advanced features of the smart government system?	element of usage (Al-Gahtani & King, 1999, Talukder 2016),	

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