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Probing Determinants Affecting Intention to Adopt Cloud Technology in E-Government Systems

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Abstract: Adopting e-government services presents numerous challenges for governmental sectors in developing countries. These problems can fail some projects involving e-government. Therefore, a solution is required to address these problems. This paper presents a conceptual model and measurement to identify crucial factors that impact cloud computing technology in e-government to address the issues with e-government. According to the recent studies on technology adoption models, a theoretical model is proposed in this study. Extracting items from the literature and adapting them, creates the measurement scales for the proposed model's structures. Through the use of face validity, pre-testing, and a pilot study, the authors confirm the scales' content validity and reliability. The data used for this study were collected by the authors from 40 information technology IT professionals for the pilot study in the top 10 government departments in Libya who are responsible for many IT decisions in e-government. In this study, the authors first examine the reliability of the scale using Cronbach's alpha and perform exploratory factor analysis to assess the scales' validity. The data were analyzed using partial least squares structural equation modelling (PLS-SEM). The findings demonstrate that the scale measurements satisfy the standard requirements for the validity and reliability According to previous studies on cloud computing adoption from the IS perspectives, this paper theoretically provides a combination model for investigating the cloud-based implementation services to provide a more comprehensive model and the objective is to develop an empirical instrument for analyzing countries' e-government adoption of cloud computing.

Keywords: intention to adopt; cloud computing; e-government; measurement

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1. Introduction

Electronic government (e-Gov) can be referred to as using ICTs to provide government services and innovate business processes to improve relationships between the government and other stakeholders [1]. Through the widespread use of e-Gov in the public sectors, the governments and the general public stand to gain significantly from the adaptation, including increased productivity, easier function transition, increased openness, and high-quality service [2]. However, IT infrastructure, financial resources, trust in new technology, and corruption are the most crucial challenging factors and hurdles for the implementation of e-government [3]. Moreover, recent reports from the United Nations [4] and International Telecommunication Union (ITU) demonstrate that several countries have low indices as a result of inadequate technologies, with limited resources, trust, and connectivity in some of the problems faced by developing countries. As a result, it is challenging for these nations to meet the standards for e-government deployment, and governments continue to face issues with inefficient business processes driven by inadequate IT utilization [5]

At the same time, Libya is trying to succeed in its implementation of e-government [6–8]. E-government implementation in Libya is hindered by a challenge of inefficiency in terms of cost and maintenance efficiency of currently used IT technology platforms [9–11]. Therefore, cloud computing, which is the next-generation IT revolution's core aspect, has recently gained popularity and has been extensively implemented by businesses and individuals [6]. Because cloud technology only requires a minimal amount of local IT infrastructure, it may also significantly alter the e-government's technological environment constructions and offer new ways to address the challenges related to insufficient IT infrastructure [7]. Therefore, governments that employ cloud services may be able to assign responsibilities of building and maintaining the "backend" infrastructure and alternatively use data centers that are within major metropolises areas [8,9]. Furthermore, according to Gartner, 60% of public sector firms will utilize cloud computing to increase productivity. Hence, cloud computing is suggested to help governments to execute their services to citizens, and enhance citizen participation while saving on costs [10,11] In fact, 94% of enterprises are benefiting from cloud computing and the worldwide expansion of the cloud computing markets is likely to reach $623.3 billion in 2023 [12]. Moreover, as a result of multiple gains in cloud implementation, many countries worldwide have started adopting cloud technology for e-governments [13]. For instance, some countries, such as developed countries (USA, UK, EU, Singapore, and Japan), have adopted cloudification movements for higher efficiency in order to address various challenges ranging from insufficient services. Moreover, 99.9% less downtime was shown. In addition, by switching to the cloud, GSA saved 72% cost annually. Therefore, the primary goal of e-government technology should be focused to employ all the invented ICT infrastructures to enhance the basic activities of government [14]. Despite the amazing benefits that governments in developed countries have extracted from cloud computing, there is a slow adoption rate by governments in developing nations [15,16]. A review of the literature by Sharma et al. (2020) revealed that only 13% of the cloud computing is established in developing economies, while 85% is established in developed economies. According to [17,18], very few research efforts in SLR have addressed the issues related to cloud computing within the context of e-government. Other research efforts have focused on evaluating the organizational adoption of cloud technology in certain industries including manufacturing, healthcare, and education [19–23]. Most of the literature on the e-Gov cloud [24,25] primarily focuses on describing the concepts of technological design and the analysis of its pros and cons [26–29].

Only a few studies [30–32] focused on the factors that affect the adoption of e-Gov cloud, and even fewer studies use the adoption model to examine the factors from the innovation adoption perspectives [33,34]. Furthermore, a review by Mohammed et al. [35] reveals that there is lack of studies that suggest better decision models to help select a compressive model to fit the specific requirements of e-services in all dimensions. However, previous studies mostly concentrated on technological factors but ignored other factors such as environmental or organizational factors. Therefore, studies have pointed out that, for cloud computing e-government adoption, it is necessary to include all the key aspects of technology, organization, and environment characteristics [17,36–38] and technical characteristics [39–41] for a holistic and better explanation. Moreover, several efforts are given to the direct effects of the technological perspectives, while the indirect effects are ignored in the adoption processes of e-government cloud technology.

This research aims to extensively explore the factors that influence the intention to cloud adoption in the e-government for efficient and effective services by analyses. The following factors were obtained for analysis: Relative advantage, Compatibility, Complexity, Trial-ability, Security, Availability, Technology readiness, Top management support, Transparency, Return on Investment, Government rules and regulations, and Service level agreement. Additionally, since the certified e-government implementation service in Libya still has less development since 2012, we believe that research on the next-generation innovation service—the cloud-based e-government service—is very timely. Moreover, there is only one study on cloud computing adoptions in Libya. The next section looks into the studies on cloud computing principles, their uses in the context of e-government, and the factors that impact the acceptance of e-government adoption. The theoretical model that is being offered and its constructs will be discussed in the next section. The instrument is then explained and validated. Lastly, the discussion and conclusion of the results round up the paper.

2. Literature Review

2.1. Barriers of E-Government in Underdeveloped Countries

In developing countries and the Middle East (MENA) region in specific, understanding the main issues and challenges that could lead to e-government project failure is essential. Based on the 2020 report on United Nations' e-government, MENA countries have moderate values in the e-government's development index while other regions fall below the global average. This indicates that there are gaps in e-government development and the persistence of the digital divide. Malodia et al. [42] reveals that up to 60% of e-government projects either fail completely or only partially succeed. Specifically, up to 25% of the e-government projects in developed nations never reach the growth point of the project life cycle, with 35% failing to attain maturity. Meanwhile, another study points out that, in developing nations, there is a high failure rate of up to 35% total failure, up to 50% partial failures, and only 15% success [42–45]. This is more severe in developing countries as up to 80% of e-government projects have not been successful in attaining their key goals to deliver the potential of more effective and efficient public services. They are still struggling with the issues of inefficient business processes due to inadequate IT usage [3,46,47].

One factor that may contribute to the problem to implement an effective e-government service in developing countries is the lack of suitable IT infrastructures [35,48]. These issues could cause e-governments projects to fail [49]. Further, based on the researcher's investigations, there are several problems that prevent appropriate utilization of e-government, which we categorize into technical and nontechnical problems, as seen in Table 1:

Table 1. Challenges of e-government in underdeveloped countries.

Issues	Examples	Source
Technical barres	• licensing of software and the traditional infrastructural support. • insufficient network capability • inadequate system integrations • hardware and software ineffectively maintained • complexity and unsuitability of the existing systems • lack of trust in e-government and online services • lack of hardware security in the public sectors • inability to provide information and services when needed • lack of fast response to citizen's request, making the e-service delivery to be ineffective	[3,9,40,50–54]
Non-technical barres	• the existing infrastructures incur more corruption costs during transformation and adaptations of the software and infrastructures • poor coordination and management of the departments, air-conditioning, electronic wastes, and power usage • lack of accountability and management policies are the biggest challenges of experienced supply-sides and obstructions for the less developed and developing countries	[35,55–59]

Additional issues with innovation are identified in the literature. Before committing to adopt new technology, users usually have trust in its benefits. The trust in certain technologies reflects ideas about its positive aspects on a specific technology with insufficient technological. Consequently, a solution is required to address these problems. Trust is a key determinant in technology adoption [60,61].

2.2. Cloud Computing

According to the US National Institute for Standards and Technology (NIST), cloud computing is defined as a method of providing a total and sufficient network access on-demand to a shared pool of reconfigurable computing resources with little effort and service provider interaction [62]. The five characteristics of cloud computing technology as described by NIST are wide network access, on-demand self-services, pooling of the resources, measurable service, and quick elasticity. According to [63], these characteristics have the following advantages, as seen in Figure 1:

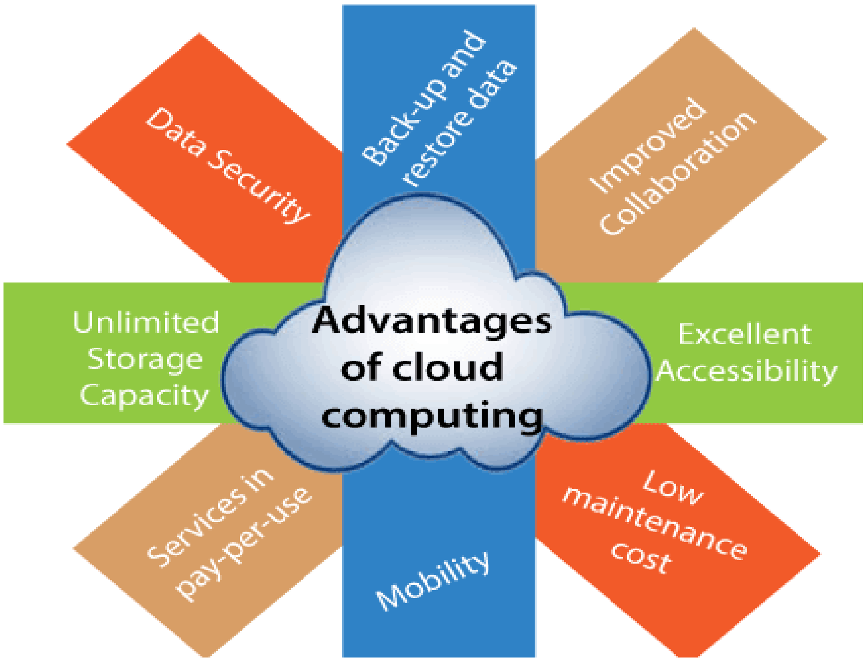

Figure 1. Advantages of Cloud Computing.

The cloud service model, on the other hand, is regarded as a service-oriented scheme that provides descriptions of cloud services at various abstraction levels [64]. These models include Software as a Service (SaaS), Platform as a Service (PaaS), and Infrastructure as a Service (IaaS). According to the SaaS business architecture, cloud service providers (CSP) manage and execute the computing infrastructure, application software, and operating systems. However, in the PaaS architecture, CSP is solely in charge of providing, operating, and maintaining computing resources and system software Contrarily, in the IaaS model, the customer manages the operation and maintenance of the operating system and software programs while the CSP delivers a set of computing resources virtually (such as memory space, network bandwidth, and processing power) to the clients.

2.3. Adoption of the Cloud Technology in Terms of E-Government

Based on its characteristics, cloud computing could be effectively used to render efficient e-government services. The use of cloud computing e-government implementation is appropriate due to its practicable properties. Understanding the gains of cloud computing for e-government implementation may result in the intention to adopt e-government [16,17,65]. Cloud computing can be easily implemented by e-government sector organizations without the need for expensive equipment. Organizations can increase and decrease network load capacity as loads rise rather than acquiring additional hardware and software [63,66–68]. A number of countries are implementing cloud technology based on their limited infrastructures.

Although cloud computing technology offers a number of benefits, government organizations have been careful toward adopting the new technologies. There are several concerns around the adoption of cloud computing for e-government due to its new innovation and the relative growth of market for cloud facilities [15,17,69]. Thus, it is vital to explore the key factors which take into account e-government and cloud computing characteristics. It can assist decision-makers in these countries to implement cloud computing for e-government services.

To have a better knowledge of early adoption, some research studies explore and analyze the factors of cloud adoption for e-government. For instance, based on interviews, Ali et al. [30] established that the main factors in Australian regional councils were data storage location, internet connectivity, data backups, cost, and integration. Similarly, Elena and Johnson [31] used semi-structured interviews to demonstrate the significance of perceived rewards and opportunities, organizational risk culture, and observed risks in the UK government. The key forces behind cloud adoption, according to Mohammed and Ibrahim [70], are cost savings and the requirement for scalability. Some studies utilized the IT adoption theories to investigate what influences the use of the e-Gov cloud in many countries.

Mohammed et al. [65] proposed a theoretical model based on DOI and fit-viability model and developed a measurement system that comprises relative advantage, compatibility, security, trial-ability, and complexity. To develop a conceptual model, Salahuddin et al. [33] incorporated DOI and the characteristics of IT personnel. The study shows that relative advantage, IT personnel knowledge, and compatibility are what drive factors for Malaysian governments [34]. Shin [71], proposed a theoretical model based on the Technology Acceptance Model (TAM) and the Theory of Reasoned Action (TRA). The model incorporates particular impacting factors with the existing TAM constructs, including accessibility, reliability, availability, and security. These factors are inspired by some fundamental beliefs about the advantages, accessibility, availability, and security of cloud computing technologies as improving constructs to predict user acceptance. By evaluating the users' perceptions on working in the public sectors, the model was empirically validated. Results indicated that user intention influenced how cloud services are perceived to be.

On the basis of experimental data, Kuiper et al. [72] analyzed a theoretical model based on the general diffusion of innovation (DOI) hypothesis. A diagram of an inertia system was described to represent the perspective of a European Commission on the implementation of cloud technology in the public sector. Results indicate that, in addition to the innovation factors (such as the relative advantage, observability, compatibility, trialability, and complexity), the risk influences the implementation of cloud in the public sectors. These factors include collaboration, traceability, persuading IT managers, legal issues and security, perception of the cloud definition, and the risk. Additional time-specific contributing factors include feelings, the climate (energy usage and emission), economy, culture, politics, and staff shortages in the IT industry [72].

Wang et al. [32] conducted an extensive research based on interviews to analyze the factors that are believed to influence the deployment of cloud computing by Australian municipal government using the Technology Organization Environment (TOE) framework and the Diffusion of Innovation (DOI) model. According to the findings, relative advantage, compatibility, readiness of the technology, competitive pressure, and cost were the primary factors influencing cloud computing adoption. While the majority of previous research tends to focus on examining the direct effects of technological perspectives, several of these studies examined the implementation of cloud technology from an integrated viewpoint on innovation, technology, organizations, and the environment. However, the reviews lack any quantitative measurements. Using the quantitative measurements in the framework is crucial since they improve the objectivity and accuracy of the decision-making process [32].

In summary, while the research converges on a number of factor dimensions, most of the factors explored in the past studies involve the aspects of cloud technology, which comprise relative advantage, functionality, and compatibility, and there is limited systemic understanding of the suitable factors for each dimension (organization, environment, and technical perspective). Similarly, Abied et al. [18] analyzed the literature already in existence regarding the suggested models to move e-government services to the cloud. These models were extensively evaluated and classified into various categories. It was concluded that there was not enough research that experimentally looked at the direct and indirect factors that influence the implementation of cloud computing for e-governments. Technical elements such as trust have a great influence on cloud technology adoption, but with limited empirical studies. Further, there are limited studies that emphasize on how the trust dimension can facilitate adopting the CC [18].

3. IT Adoption Theories and Cloud Computing Adoption Models at Organization-Level

3.1. TOE (Technology, Organization, and Environment)

The TOE framework defines the organizational structure in three contexts, (Technology, Organization, and Environment), which influence how firms adopt and deploy new technological innovations [73]. Zhu et al. [74] examined the Information Systems (ISs) adoption in corporate organizations. The TOE framework was primarily used in IT-related studies intended to look into their implementation possibilities. It presents a meaningful analytical framework to investigate the implementation and acculturation of various IT-related innovation. The framework has emerged as a key theoretical road map for the adoption of information technology, as the adoption of complex IT innovations necessitates favorable technological cases, supportive environmental strategies and organizational structures [75]. The factors influencing IT adoption must be identified in theoretical models in order to better understand adoption patterns. According to [17], the TOE model has reportedly proven more useful than previous models for analyzing technology adoption. Several works have employed the TOE frameworks to identify different adoption of IT strategy. Additionally, recent years have seen the use of this framework to determine the factors that impact IT adoption in a variety of emerging IT innovation contexts, which comprise cloud computing [76]. The TOE will serve as the research's foundational theory, in which the DOI factors and other external factors will be situated.

3.2. Theory of Innovation Diffusion

To explain the factors affecting an individual's decisions to use and adopt innovations, DOI was proposed [77]. In other words, DOI theory is concerned with "how", "why", and "at what rate" novel ideas, technologies, and operational breakthroughs throughout the organization, society, or a country. The "how" has to do with how innovations are made. The "why", which refers to the unique qualities of the innovation that are viewed as determining its adoption and serves as the reason for why businesses adopt or reject an innovation, is essentially important [78]. The model recommends five characteristics, such as relative advantage, observability, compatibility, trial-ability, and complexity for the implementation of cloud innovations [19]. However, it is employed mostly in studies related to information systems (ISs) to aid in the explanation of an organization's readiness and decision to implement new technology [75]. It has been used in the information systems (ISs) and technology studies to understand how various innovations are adopted. This theory was predominantly used for cloud computing compare with other theories [40,79–82].

4. Justification of Integration of TOE and DOI Theories

To understand how advanced technologies are adopted, a number of researchers have claimed that the methods that combine several theoretical perspectives need to be taken into consideration [83]. An in-depth understanding of the literature, where the factors are tailored to particular innovations that have been analyzed [84,85], can help one to better identify the relevant decisions of the organization to implement any given innovation. In previous time, various studies were extensively focused on the technological adoption of cloud-based services [11]. Most of the studies [86–88] which consider the implementing new technologies from the level of organization either applied the TOE framework or the DOI theory [19,34]. The two models have a robust experimental support in research studies [89,90].

According to [91], integration of multiple theoretical perspectives can help us better understand how new technologies are adopted. However, it was found that when the DOI model and TOE framework are combined, pre-post implementation of cloud computing technology is explained more effectively than when either approach is used alone [17,92]. Additionally, there are relatively few pre-adoption studies on cloud technology. Several IT innovations were widely exploited, including TOE and DOI models [91]. They are similar in various ways, for example, TOE framework and DOI model both consider the technological and organizational setting. However, the two frameworks differ in a number of ways. Unlike in TOE, DOI does not take the environmental context into account; instead, it considers it as a component of the organizational and technological framework. Contrarily, DOI takes into account a wider variety of innovation characteristics, whereas TOE ignores some of the characteristics [93].

One main reason for integrating the TOE framework and DOI model is the fact that the two frameworks are dependable and consistent [94]. All the five DOI characteristics are the main factors that considerably affect the implementation rate of the innovations. Rogers revealed that five factors of the innovation, which include the relative advantage, observability, compatibility, complexity, and trial ability, signified about 48–86% of the variance in the implementation rates [95]. Similarly, TOE and DOI models can indicate the factors systematically both from inside and outside the organizational and technological aspects. However, the TOE frameworks do not provide the characteristics of the innovation and DOI models do not take into account the environmental influence. Therefore, combining the two models may contribute by adding more to the general factors of organization, technology, and environment [89]. Thus, the TOE and DOI factors are combined to create the variables' sets that indicate the identified antecedents frequently used in the recent IT related studies. These models show a variety of measurable aspects of technology adoption. For example, the TOE provided a better explanation of intra-firm adoption of innovation, but the DOI provided a better explanation of the innovation aspects of technology implementation. This dimension is essential to the adoption of CC [96,97]. Similarly, certain factors such as security, trust, and availability, must be explored to better understand the nature of cloud computing technology. This is because there are a few limitations to the adoption of CC in the organizations. All of these factors are categorized into three groups: The Organization, Technology, and Environment factors.

This is correlated with the Rogers' diffusion of innovation theory, given that it focuses on both the internal and external condition of organizations, including the technical features in the study of the diffusion drivers for new technologies. Since the TOE takes into account the several aspects of an organization when assessing both diffusion and adoption of the technology, it is believed that TOE has a greater explanatory capability than other models of adoption, particularly in the organizational contexts. Additional information about the benefits of integrating the TOE and DOI for this research is provided in Table 1. The claims made by researchers in offering a more complete and complementary explanation of the IT adoption phenomenon are confirmed when two well-known theoretical models are integrated with the mediator or moderate effect [79,88]. In general, the DOI model is suitable for identifying specific variables in each category while the TOE framework is used in selecting the categories that are relevant for determining factors as seen in Table 2. Hence, merging the two frameworks will improve their understanding and help in adoption.

Table 2. Advantages of combining the TOE and, DOI.

Benefit	TOE	DOI	TOE + DOI
• Any new innovation technology adoption considers the context of the environment	√		√
• A better understanding of how new innovation technologies are adopted within an organization	√		√
• Focus on assessing how new innovations are adopted based on their innovation characteristics	√	√	√
• Combination framework is useful for understanding the adoption of a variety of information systems	√	√	√
• A theoretical foundation and empirical support	√	√	√
• The whole IS adoption phenomenon is better understood with the help of this combination			√

5. Theoretical Foundation and Proposed Model

The research conceptual model proposed for the analysis is substantially supported by incorporating the TOE framework with DOI models and integrating a trust measure as a distinct component. This model is based on our earlier discussion of the TOE and DOI models. Figure 2 shows our conceptual framework for the study. This model consists of four aspects, according to which cloud technology adoption in e-governments will be influenced. These aspects comprise organizational, technological, environmental, and innovation-related elements. These can be achieved using a review of the cloud computing studies on the TOE and DOI models. In detail, these factors are an overview of the numerous distinct implementations factors that other researchers have utilized in their studies. These factors serve as guideline to develop our research model as shown in the next step of the research. This initial determining factor was taken from previous studies and used to develop the research framework. Using the TOE, the factors were divided into two categories: organization and environment. Furthermore, in applying the DOI theory to develop the initial research model, 14 factors in total emerged from the literature.

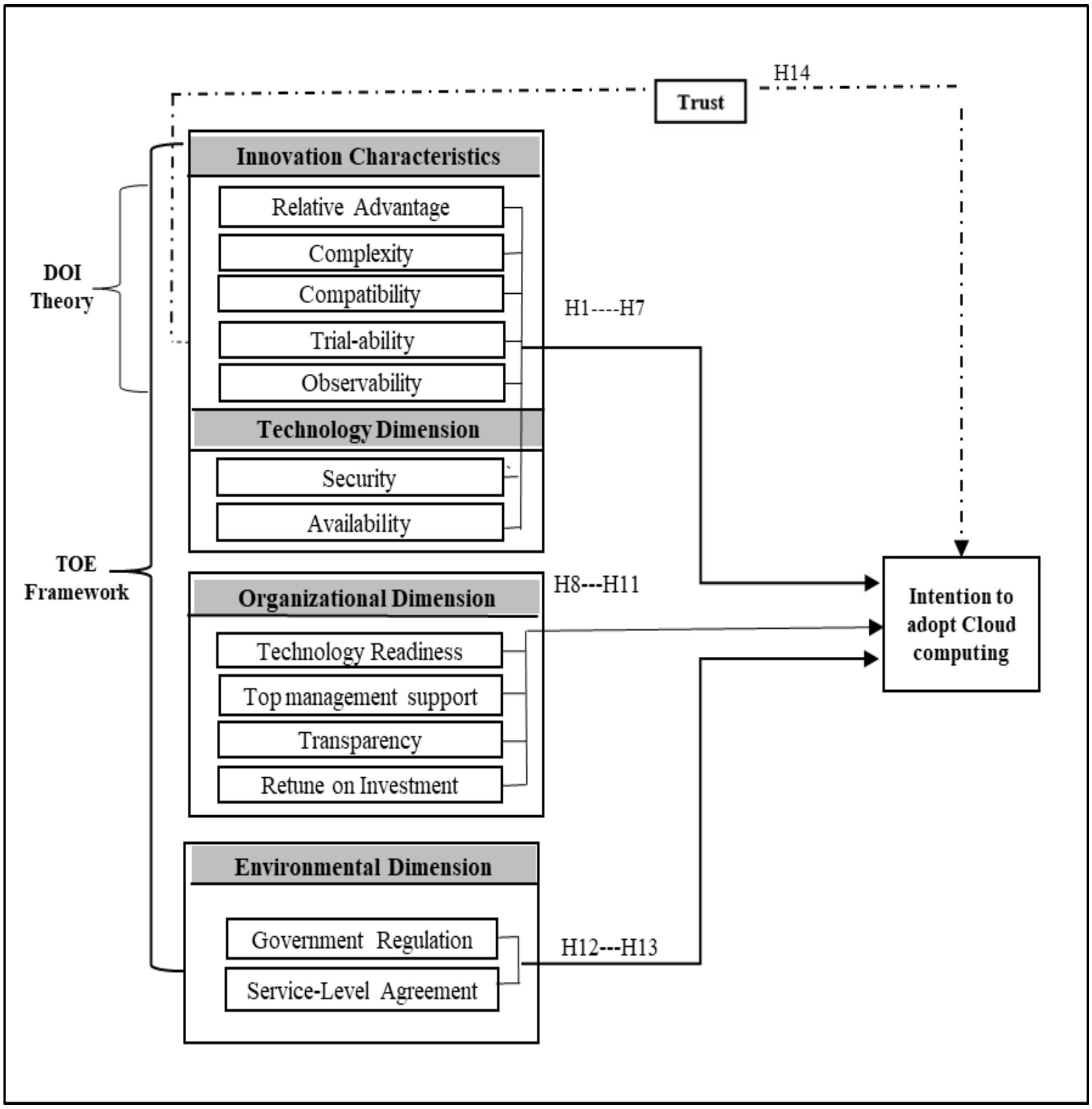

Figure 2. Research Framework.

In conclusion, combining the organizational, technological, and environmental contexts of the TOE framework with the DOI model innovation characteristics, as shown in Figure 1, addresses the calls by researchers to build a more comprehensive model or framework that can help better understanding of the IT innovation diffusion. These theories overlapped based on the characteristics that reinforce the explanation of adoption aspect.

5.1. Hypotheses Developed Based on the Conceptual Research Model

Using our conceptual model and insight from previous research, we present 14 hypotheses for assessing the validity of each of our constructs, as seen in Figure 2.

5.2. Innovation Characteristics Context

5.2.1. Relative Advantage

Cloud services offer enormous benefits to organizations, including the capacity to do activities more quickly; they are less labor-intensive, improve efficiency and quality, and are more powerful [8]. Furthermore, the relative advantage factor is linked to reduced costs, response rate to business requirements, and greater efficiency, as well as mobility [32]. Moreover, the relative advantage factor is linked to reduced costs, responsiveness to business requirements, and greater efficiency, as well as mobility [98,99]. Relative advantage is important to exhibit the value of innovation to adopters and go beyond the previous state [100]. Prior to adopters' decision to embrace innovation, they are always curious to find the value relevant to them [77]. From past research, perceived relative advantage impacts positively on the value of CC. Hence, the following hypothesis is developed:

H1a. *Relative advantage positively affects the intention to adopt cloud computing for e-government in Libya.*

5.2.2. Compatibility

This indicates how well an innovation is compatible with the user's present conventions, procedures, and technical specifications [75]. From a business perspective, innovation must be well-suited with the companies' norms and technological specifications it has been adopted for. In any studies evaluating the diffusion process of innovation, compatibility was found to be an important factor [32,101,102]. According to the findings by Ali et al. (2020a), the cloud-based services compatibility with other IT services may experience similar problems as those often faced by IT management as cloud technology advances.

H2a. *Compatibility is a positive influence on Libya's decision to adopt cloud computing.*

5.2.3. Complexity

Complex technology is defined as any technology that is hard to acquire, understand and use. Therefore, user-friendliness is an important feature that technologies must possess in order to increase adoption rates [103]. The decision to adopt any new technology has been shown to be heavily influenced by complexity [11,84]. The commonality that is established across business functions, through the automation of management processes provided by cloud technology reduces the complexity of IT services. The previous studies have used complexity as a factor from the DOI theory to look at how it affects the adoption of some advanced technology. Therefore, we develop the following hypothesis:

H3a. *Complexity negatively effects on Libya's decision to adopt cloud computing.*

5.2.4. Trialability

Trialability is another essential factor in the cloud computing context [33]. Trial-ability enables organizations to experience and try the cloud solutions before actual adoption, hence organizations will decide about cloud adoption or discard. Alshamaila et al. [104], Morgan and Conboy [81], and Chiregi and Navimipour [105] studied the factors in the cloud computing context. Moreover, Ref. [65] evaluated the trial-ability influence on task-technology fit [80] and argues that it is the extent to which cloud computing can be tested by applying some services that generate an impression of the cloud computing adoption to implement the e-government. Therefore, the following hypothesis is developed

H4a. *Trial-ability positively affects Libya's decision to adopt cloud computing.*

5.2.5. Observability

The more likely the potential adopters see the results of the innovations, the more likely they can embrace it. Accordingly, perceived observability positively influences the rate of adoption of an innovation CC [106,107]. Therefore, observability is the degree to which the results of cloud services can be seen or observed by others [108]. Results demonstrability, on the other hand, is the ability of results to be visible and quantifiable from the innovation being adopted. Studies on innovation diffusion within information systems have emphasized the significance of these factors in impacting decisions on the implementation [17,72,109,110]. Hence, we can posit that:

H5a. *Observability positively affects Libya's decision to adopt cloud computing.*

5.3. Technology Context

5.3.1. Security

Security can provide better and more reliable protection for the organization's data than other computing platforms [111]. One major problem that hinders many organizations to use cloud services is the security issue [17,112,113]. In this study, security is referred to as the protection of data, services, and data centers. In previous studies, security has been identified as a significant factor in TOE framework that is used to check the impact of various technologies implementations, including the cloud-based services and e-businesses [99]. Hence, the following hypothesis is postulated

H6a. *Security negative affects Libya's decision to adopt cloud computing.*

5.3.2. Availability

It has been mentioned to be significant when considering cloud adoption [114]. Since cloud computing offers its services online, it is expected to be always accessible. Availability is a state of being able to ensure people can utilize any information resource whenever needed [115]. On the contrary, the loss of availability is critical when a serious incident happens when using cloud services. Availability has been found in the previous studies to be one of the major important factors for cloud implementation [9,110,116,117]. The technological availability of the needed infrastructures enables the adoption of this technology [38,118]. Hence, the following hypothesis is postulated:

H7a. *Availability positively affects Libya's decision to adopt cloud computing.*

5.4. Organizational Context

5.4.1. Technology Readiness

Various empirical studies suggested that TR (technology readiness) has a considerable influence on the implementation of technology [28,119]. The decision of an organization to implement cloud technology in e-Gov (e-government) is heavily impacted by TR, including the availability of IT infrastructure and IT expertise [10]. Cloud computing in e-Gov can be easily implemented with a reliable internet connection, high bandwidth, and fast internet speeds. Therefore, it is hypothesized as follows:

H8. *Technology readiness positively affects Libya's decision to adopt cloud computing.*

5.4.2. Top Management Support

The top management support plays a significant role in the cloud computing adoption as it guides the resource allocations, the process re-engineering, and the incorporation of services [6,120]. These findings conform to those presented by [30], which show that organizations could not implement new technology innovation if the top management is not supportive. According to [91,99], previous studies have examined the influence of top management support on the implementation of different innovation of technologies. Therefore, we postulate the following hypothesis:

H9. *Top management support significantly effects on Libya's decision to adopt cloud computing.*

5.4.3. Transparency

Transparency is one of the new dominant factors and is completely correlated to an IT innovation adoption such as cloud computing [121–123]. Transparency considers a fundamental part of cloud service utilization since it helps resource corruption and brings in accountability [124,125]. It also entails offering a synchronous and asynchronous data relating to the applications and customers' data to allow them to acquire sufficient visibility of incidents regarding their assets hosted in the cloud environments [126]. According to the study, transparency can be enhanced and achieved if the focus is given to utilizing new invitations in service provision. Most importantly, the public decision-making process is improved with transparency [125,127,128]. Transparency can encourage adoption as it is linked with active interactions between the citizens and public sectors [129].

Consequently, the transparency of public decision-making has attracted a number of IT adoption studies. Hence, we develop the following hypothesis:

H10. *Transparency positively affects the intention on Libya's decision to adopt cloud computing.*

5.4.4. Return on Investment

To assess cost benefit, the net present value is utilized in most cases [130]. In addition, as one of the success elements for electronic government, financial support and funding are key factors [33]. However, in developing nations, financial resources are one of the main challenges of e-government. However, according to the literature, cloud computing can help in cost saving, which is one of the major problems to the cloud adoption [131]. Cloud computing helps firms to save or minimize capital costs while lowering operational costs [24,26,29]. This contributes to Return on Investment of cloud computing having a major impact on the e-government service implementations. Hence, we can posit that:

H11. *Return on Investment positively affects Libya's decision to adopt cloud computing.*

5.5. Environmental Context

5.5.1. Government Rules and Regulations

This could be described as major support mechanisms offered by government to encourage the expansion of cloud computing adoption for IS innovation [91,99]. Ref. [132] claimed that government regulation is one of the main factors that influence the implementation of new technology innovations. Governments can encourage the use of cloud technology by creating regulations to protect enterprises that use cloud-based services [133,134]. Therefore, we postulate the following hypothesis:

H12. *The government regulations negatively affect Libya's decision to adopt cloud computing.*

5.5.2. Service Level Agreement

According to [135,136], lack of compliance with the SLA (service level agreement) by cloud service providers is another reason that causes the slow rate of cloud implementation, given that, if the requirements of the SLA are not met by cloud providers and attempt to down-times promptly, it will greatly undermine the quality performance [61,131,137,138]. Moreover, SLAs are significant factors that need to be carefully considered before considering implementing the cloud [28,139]. According to the study, there lacks a standard format for SLA and it entirely relies upon the service provider [140]. Hence, organizations are not sure of the specific services rendered by the cloud service providers. Few research efforts have considered SLA as a key determining factor for cloud adoption in their studies [131]. SLA concerns greatly discourage governments from adopting cloud services. Hence, we formulate the following hypothesis:

H13. *Service level agreement positively affects Libya's decision to adopt cloud computing.*

6. Trust Mediator Effects

The influencing mechanisms of IT adoption are not given enough attention, despite that a number of research efforts have explored the direct relationship between the IT adoption characteristics and the technology [8,18,60]. Most of the previous works on the use of the e-government cloud are no exception. Before deciding to adopt new technology, users frequently establish their trust in it [69,141]. This trust is a reflection of their perceptions of the positive characteristics of that technology. Trust encompasses both the technology itself and cloud service providers The more the e-government agents trusts the cloud technology, the more the inclination to cloud service adoption gets stronger [142]. This study assumes that an organization will utilize cloud computing to a greater extent if it is ready and confident to store its resources in a third party's cloud. Therefore, this study will investigate how cloud trust works as a mediating factor between technological qualities and adoption. This is because technological characteristics can affect the shaping of trusts such as security, reliability, helpfulness, quality, and functionality of a technology [143–145]. It was established in the literature that technology characteristics have a positive effect on trust and that trust has a direct positive influence on the implementation of new technology [102,146–149].

The mediator was also incorporated in this study because it provides a unique view on cloud-based services and it has significant benefits that are important to consider before adopting new technology in both direct and indirect ways [150,151]. This is due to the fact that these organizations can decide who would benefit from new technology and can better understand the adoption process and any possible challenges. When two well-known theoretical models are integrated with the direct and indirect effects, the claims presented by Chong et al. [152] and Wang et al. [153] in giving a more complementary and comprehensive explanation of the IT implementation characteristics are validated. Accordingly, trust is a key determinant in technology adoption and has direct and indirect effects on new IT innovation [154]. It is even considered more important than any technical skills required to interact within the system [155]. However, with limited empirical studies [141] and having not evaluated the fundamental paths involved in this core relationship, that brings about the need to extend the knowledge in this field [156].

Trusting innovations shows confidence regarding the favorable elements of a specific innovation [60]. In addition, trust does not concentrate only on trusting the cloud provider, it is also an issue to distrust the technology in consideration and its abilities to offer the required services without loss of data or service interruptions. Most IS research studies have examined trust in humans or human organizations such as trade partners, e-commerce vendors, and virtual team members [147]. However, lately, there is acknowledgement that many people also trust the technology artifact itself. This, according to Lankton et al. [146], is termed as trust in technology. The human technology relations push researchers to study trust in online structures and also emphasizes on the trust aspect due to its posited principal effects during the initial stage of intention formation in the adoption of e-government cloud services [8,157]. The aforementioned discussion is supported by Liang [60], arguing that trust in new technology functions as a major factor influencing decision-makers to outsource a system.

This study will explore the major impacts of cloud trust between technological characteristics (DOI) and the intention of the Libyan government on cloud computing adoption for e-government. This aims to clarify the adoption process within an e-government context and provide a new perspective on the adoption of cloud computing research, particularly e-government. Additionally, in order to maximize the benefits of using cloud computing innovation for e-government, it is also vital to consider the characteristics of the decision-makers and their understanding of how to use it.

H14. *Trust has a significant influence and mediates the relationship between the intention to adopt cloud computing and the technological dimension*.

7. Research Methodology

7.1. Research Design

This study used a positivist technique to formulate the hypotheses, and a priori assumptions for statistically validation in a comprehensive analysis to evaluate the proposed approach. It was decided to follow the positivist approach because it is focuses on testing the concept [158]. Using it, a model's relationship between independent and dependent variables can be validated to adopt cloud computing. The nonrandom purposive sampling method was employed for this pilot study. It is a nonprobability sampling method that ensures the informant's expertise and trustworthiness [159].

7.2. Instrument Development

An instrument is designed to assess an IT professional's perspective on the desire to employ cloud computing for e-government services by taking into account the literature on theoretical constructs, characteristics of cloud computing, and the e-government context. The procedure for developing and validating instruments is described in the following subsections.

7.2.1. Designing Instruments and Developing Scales

Instrument design is essentially based on the concepts found in the research studies on the adoption of cloud computing as well as the DOI and TOE frameworks, which are theories about how technologies are adopted. The designed questionnaire (as an instrument) is divided into four components to assess respondents' perceptions of the 14 suggested dimensions of the proposed model, which include contexts for the diffusion of innovation, organizational contexts, technological, and environmental factors. These factors are all believed to have influences on the organizations to employ cloud technology, based on the proposed model and the literature. As a result, it is essential to determine the scales of these factors. The definition of each construct is evaluated according to the studies and theories employed in order to generate the instrument scales (items for each construct). Then, each construct's dimensions are determined. One or more items from the literature are modified to measure each dimension while taking into account the setting and the topic of the inquiry (cloud computing) (e-government). Table 3 provides a comprehensive list of structures, their dimensions, the number of items for each construct, and related references.

Table 3. Questionnaire Items Development Based on Literature.

Construct	N	Dimensions	Reference
Relative advantage	4	Communication speed—cost reduction—efficiency—mobile data	[43,133,144,160]
Complexity	5	Ease of Implementation—clarity—easy to learn—time	[109,161,162]
Compatibility	5	Fit with work norms—integrating with existing systems—Requiring technical changes	[33,144,160,161]
Trial ability	4	Testing before actual use—sufficiency of testing time—availability of trials	[33,107,163]
Observability	5	Better visibility, integration-as-a-service	[72,100,106]
Security	4	Adequacy of security techniques—data protection—data privacy and confidentiality	[17,33,110,161]
Availability	3	Flow of data—recovery—uptime—resources busy	[164,165]
Technology readiness	5	Necessary technical requirements—Internet connection—computational capabilities- IT-related skills	[33,110,144]
Top management support	4	Interest—leadership engagement—commitment	[133,144,160,162]
Investment in new ROI	5	Infrastructure—time and effort—maintenance costs—hiring IT expertise—training costs	[33,166,167]
Transparency	6	Corruption eradication—information transparency—process transparency—public participation	[38,59,129]
Government laws and regulation	5	Security rules, policies—privacy laws—standard legislation—legal protection	[39,43,160]
Service Level Agreement (SLA)	5	SLA objectives—risk control—QoS guarantees—security standards—disaster recovery—location of data	[121–123]
Trust	4	Trust in technology—trusting intention	[8,168–170]
Intention to adopt cloud	4	Recommending—evaluating/planning—initiating the applying process	[11,144]

7.2.2. Pilot Study, Sampling and Data Collection

The pilot study uses a smaller version of the real data collection process, which involves gathering information from a small number of real sample respondents [171]. By carrying out the pilot study, the instrument's reliability can be evaluated, and it may then be suggested that measures from a scale be dropped to improve its reliability. In this study, data were collected among the IT professionals (Senior Manager, IT managers, Executive Manager and CIO, etc., see Table 4) working in e-government departments who are the study's intended audience. The strategy that was preferred was purposive sampling because only those people who were qualified for the study were chosen as participants:

Table 4. Demographic information of the respondents.

Construct	Construct	Frequency	Percentage (%)
Gender	Male	31	76.32%
	Female	9	23.68%
Age	35–40	4	10.53%
	41–45	10	26.32%
	46–50	13	34.21%
	Over 50	11	28.95%
Education level	Bachelor of Science	17	44.74%
	Diploma	4	10.53%
	Master	16	42.11%
	PhD	1	2.63%
Field of study	Computer Science	13	31.58%
	IT	16	42.11%
	Engineering	3	7.89%
	Management	5	13.16%
	Others	2	5.26 %
Position in organizations	Senior Manager	10	26.32%
	Information Technology Manager	5	13.16%
	IT managers	9	23.68%
	Chief Technology Officers	2	5.26 %
	Executive Manager	6	15.79%
	IT Network Manager	4	10.53%
	Chief Information Officer	2	5.26 %
Experience	1–5 Years	4	10.53%
	5–10 Years	11	28.95%
	Above 10 Years	23	60.53%
E-services type	Information Publishing	4	10.53%
	One-way Interactive	6	15.79%
	Two-ways Interactive	13	34.21%
	Transactional	15	39.47%
Cloud computing knowledge	Little knowledge	5	13.16%
	Some knowledge	8	21.05%
	Good fundamental knowledge	14	36.48%
	An expert	11	28.95%
Total		38	100%

IT professionals of the top ten active e-government departments in Libya according to National Centre for Information and Based on report from Bureau of Statistics and Census (BSC) in Libya [172], those in charge of implementing, maintaining, and managing e-government initiatives and who are directly involved in ministries that are well-authorized and influenced in the decision-making processes including their understanding of the policies for the adoption of new innovations based on their expertise and perceptions on cloud technology [173]. In addition, Kyriakou et al. [109] emphasize the importance of being available, willingness for participation, and having the capacity to articulate, express, and reflect on one's experiences and ideas. Based on the study by Baker et al. [174], a sample size of 10–20% of the actual data size of the study is considered to be a reasonable size for a pilot study. Hard copy was chosen to maximize the likelihood of success in collecting the data, due to its easy access, over a period. The actual sample size of this study is 200 decision-makers. The pilot study survey managed successfully to distribute questionnaires and collected 40 samples, thus achieving an overall response rate of 20% of the whole sample size for the main study (200). However, two respondents were excluded because they answered one question from each part of the survey. Table 4 presents the 38 respondents.

There were two (2) sections, A and B, to the questionnaire titled "Intention to Adopt Cloud Computing." Gender, years of experience, educational achievement, and other demographic data are among the questions in Section A that are used to evaluate respondents' general demographic data. In Table 4, the demographic data are presented. The 14 constructs used to develop the Model for the Intention to Adopt Cloud Computing for E-Government in Libya are measured in Section B using items that were developed based on established methods in the literature and the perspectives of stakeholders who are experts in the field of this study. Following Maroufkhani et al. [175], a five-point Likert scale was used to quantify the degree to which participants perceived their desire to use CC, which was supported by total of 73 closed-ended questions used to measure the 14 constructs in the model. Our ethical approval has been obtained from Faculty of Information system, University Technology Malaysia—UTM, Malaysia and Higher Institute of Science and Technology, AL Ryaina, Libya. The instrument was tested for content validity, construct validity, and reliability after a number of modifications. This study presents reports of construct validity and reliability.

7.2.3. Validity and Reliability

Validity is the extent to which an instrument measures what was claimed to be measured. Researchers can evaluate the validity of their research by verifying that it fits real-world reality and that what they are measuring is what they intended to measure [176]. By contrast, reliability refers to a measure's ability to produce consistent results, i.e., the result is devoid of measurement errors [177].

Content Validity

To verify the correctness of the instruments' contents, the questions of the survey were written in English and then translated into Arabic. To ensure the instrument contained all the necessary items for measuring each construct, an evaluation of the instrument was conducted. The instrument of the study was reviewed by nine experts with competence in questionnaire design. The minimal number of experts, according to Lynn [178], is five; however, the actual number may change depending on the availability of experts. The experts that participated in this research were from 10 public universities around the world and the questionnaire was developed by an expert panel comprising experienced researchers in the domain of Information Systems (IS). To validate the translated version of the questionnaire, four of the participants were fluent Arabic and English speakers, and the items of the questionnaire were based on existing studies. Therefore, the researchers were each asked to give suggestions and feedback on the instrument in order to ensure content validity. After their review, a few typos were corrected, and several questions and statements that were unclear were changed

Reliability of Scales and Data Analysis

A reliability test was conducted to assess the internal consistency of the measurements in each scale. In order to examine the instrument's reliability, the pilot testing data were analyzed using SPSS 25 and the (PLS-SEM) approach using Smart PLS. This involved evaluating the measurement model at both its initial and modified levels. This was carried out to evaluate the internal consistency reliability of the research instrument used in this study. The results of the analysis give a general idea of whether or not the research instrument is appropriate and to evaluate the internal consistency of the measurements in each scale a reliability test was performed. Therefore, the data collected from the pilot testing were analyzed using SPSS 25 software and the Partial Least Squares Structural Equation Modelling (PLS-SEM) method using Smart PLS to conduct a test on the reliability of the instrument by assessing the measurement model at both initial and modified levels. This was carried out in order to examine the internal consistency reliability of the research instrument in this study. The results of the analysis give a general idea of whether or not the research instrument is appropriate.

8. Assessment of Outcomes and Discussion

Statistics summarized:

Reliability of scales was employed to determine how reliable "Intention to Adopt Cloud Computing in e-government in Libya" was. Summary statistics are descriptive data produced by statistical descriptive analysis. Table 5 shows the statistics summary. The results are presented as Mean, Minimum, Maximum, and Variance.

Table 5. Summary of item statistics.

SN	Dimension/Construct	Mean	Minimum	Maximum	Variance	N of Items
1	Relative advantage	3.96	3.12	4.30	0.219	5
2	Compatibility	3.60	3.56	3.61	0.002	5
3	Complexity	3.59	3.54	3.68	0.003	5
4	Trialability	3.49	3.42	3.54	0.002	4
5	Observability	3.44	3.37	3.52	0.004	5
6	Security	3.80	3.61	4.42	0.181	4
7	Availability	3.87	3.81	3.93	0.004	4
8	Technology readiness	3.71	3.65	3.79	0.003	6
9	Top management support	3.44	3.40	3.52	0.004	5
10	Return on Investment	3.35	3.42	3.41	0.002	4
11	Transparency	3.56	3.52	3.72	0.003	5
12	Government laws and regulation	3.62	3.56	3.69	0.003	5
13	Service Level Agreement (SLA)	3.52	3.45	3.60	0.002	6
14	Trust	4.00	3.20	4.15	0.205	6
15	Intention to adopt CC	3.61	3.54	3.73	0.004	4

8.1. Evaluating the Measurement Model

Using the approach based on the Partial-Least Squares Structural Equation Modeling, we employed Smart PLS 4.0 software to evaluate the measurement models in our study. Assessing the reliability and construct validity is the main focus of the assessment and goodness of the proposed measurement model. Construct validity was defined by Hair et al. [179] as the agreement between the constructs and indicators. Additionally, it may be considered a prerequisite for building the theory and evaluating it [176]. Through discriminant and convergent validity, construct validity can be assessed. Two main phases were used to validate the measurement model for the study's constructs, which comprises the initial and the modified measurement models.

8.2. Initial and Modified Measurement Model

Using the composite reliability (CR), item loadings, and the average variance retrieved, the proposed measurement model of the research constructs was evaluated (AVE). Items loading of at least 0.7 demonstrated satisfactory indication for reliability of the measurement model. Moreover, the factor loadings of the 73 items measuring the 14 sub-constructs were evaluated to verify the initial measurement model validity. On the basis of the analysis, evaluating the initial measurement model gives the indicator measuring the constructs.

Based on the results for measuring the construct of "Intention to Adopt Cloud Computing", number of items out of the 73 items measuring the constructs have loadings that were less than 0.7, representing poor loading contrary to the requirement of the model factor loading of 0.7.

Nonetheless, all of the remaining items indicated a factor of 0.7 or higher, fulfilling the criteria [177]. As a result, the model needs to be updated for the items that failed the indicator reliability test. Regarding the indicator items with external loadings below the threshold of 0.7, the PLS algorithm was repeated. According to the proposal by Hair et al. [180], it is essential to remove a specific item if this can improve the AVE and CR values. Therefore, in the PLS algorithm Table 6, data showed that deleting all 10 items increased the CR and AVE values. Finally, the nine poor items with external loadings of less than 0.70 were removed, leaving the remaining items above the threshold.

Table 6. Data showing deleting items.

Construct	Item Code	Loadings	Construct	Item Code	Loadings
Relative Advantage	RA1	0.805	Technology readiness	TER3	0.759
	RA2	0.810		TER4	0.730
	RA3	0.919	Top management Support	TOP1	0.890
	RA4	0.889		TOP2	0.932
	RA5	0.830		TOP3	0.910
Compatibility	COMP1	0.820		TOP4	0.897
	COMP3	0.880	Return on Investment	ROI1	0.860
	COMP4	0.820		ROI2	0.767
	COMP5	0.843		ROI3	0.741
Complexity	COMX1	0.776		ROI4	0.838
	COMX3	0.850	Transparency	TRA2	0.819
	COMX4	0.901		TRA3	0.861
	COMX5	0.910		TRA4	0.770
Trialability	TRL1	0.795		TRA5	0.720
	TRL2	0.840	Government laws and regulation	GLR1	0.805
	TRL3	0.902		GLR3	0.780
	TRL4	0.890		GLR4	0.830
Observability	OBS1	0.770		GLR5	0.871
	OBS2	0.791	Service Level Agreement (SLA)	SLA2	0.891
	OBS3	0.840		SLA3	0.770
	OBS4	0.830		SLA5	0.842
Security	SEC1	0.883		SLA6	0.869
	SEC2	0.859	Trust	TRU1	0.878
	SEC3	0.830		TRU2	0.875
	SEC4	0.920		TRU3	0.850
Availability	AVA1	0.890		TRU4	0.910
	AVA3	0.930	Intention to adopt cloud	ICC1	0.851
	AVA4	0.793		ICC2	0.813
Technology readiness	TER1	0.750		ICC3	0.801
	TER2	0.765			

Factor Analysis

To confirm that the questionnaire items in this study met the study's purpose and intention and to test the research model, an exploratory factor analysis was conducted through outer factor loading before evaluating the external model. Each indicator should be evaluated based on its factor loading exceeding 0.6–0.7 and being higher than other indicators [40], this in light of previous study [80,181].

8.3. Internal Consistency Reliability

The reliability of the constructs' internal consistency is assessed based on the criteria of composite reliability (p.). This type of reliability is normally based on composite reliability, where an estimate for the construct's internal consistency is examined [179]. This kind of reliability does not guarantee that all indicators are in the same way reliable. This is the suitability of PLS-SEM, which brings out a priority in indicators as per their reliability during the estimation of the model [179]. In an exploratory study, the values between 0.60 and 0.70 and values between 0.70 and 0.90 in advanced studies are acceptable. On the other hand, values below 0.60 lack some reliability. Lesser reliabilities indicator may indicate the indicator's inadequate measurement of a construct [179]. It is valuable that there is a joint measurement of all constructs adequately. Therefore, this is assessed by construct reliability, where indicators are allotted to a similar construct. This reveals a stronger mutual association. In accordance with the above discussion and referring to Table 7, the Cronbach's alpha and *p* values for all constructs met the acceptable threshold, which is greater than 0.

Table 7. Reliability of internal consistency.

Construct	Cronbach's Alpha	Composite Reliability	Items
Relative advantage	0.904	0.929	5
Compatibility	0.839	0.888	5
Complexity	0.840	0.885	5
Trial ability	0.802	0.821	4
Observability	0.825	0.880	5
Security	0.919	0.940	4
Availability	0.820	0.880	4
Technology readiness	0.896	0.942	5
Top management support	0.928	0.948	5
Return on Investment	0.772	0.890	4
Transparency	0.838	0.889	4
Government laws and regulation	0.843	0.893	5
Service Level–Agreement	0.871	0.910	5
Trust	0.902	0.932	6
Intention to adopt cloud	0.801	0.873	6

8.4. Convergent Validity

The constructs' convergent validity is performed by assessing the AVE values for each construct. In view of the advice by Hair et al. [179], this study used the acceptable threshold value of 0.5 for AVE. The AVE values of all constructs, as shown in Table 8, have exceeded the least value of 0.5, which implies that the convergent validity of the proposed measurement model is not affected.

Table 8. Convergent validity.

Construct	AVE
Relative advantage	0.725
Compatibility	0.676
Complexity	0.610
Trial ability	0.540
Observability	0.648
Security	0.809
Availability	0.648
Technology readiness	0.848
Top management support	0.824
Return on Investment	0.630
Transparency	0.668
Government laws and regulation	0.686
Service Level Agreement (SLA).	0.712
Trust	0.763
Intention to adopt cloud	0.632

8.5. Discriminant Validity

The discriminant validity of the measurement model used in this study was applied in accordance with the Hulland et al. [182], theory. A discriminant validity for the proposed measurement model of the study is said to have been achieved if the square root of the AVE value is larger than the correlations between the calculated measure and all other measures in the model. As a result, the discriminant validity of each factor was evaluated.

The findings showed that the square root of each AVE was greater than the off-diagonal elements in its associated row and column. Cross-loading values and criteria assessment values are shown in Table 9 by the bolded values. As shown in [179], the square roots and other values of the AVE represent the intercorrelations between the constructs [183]. This indicates that the criterion is met.

Table 9. Discriminant validity (Fornell–Larcker's Standard).

Construct	RA	COM	COMX	TRI	OBS	SEC	AVA	TOP	TER	ROI	TRS	GLR	SLA	TRU	ICC
RA1	0.856														
COMP1	0.382	0.841													
COMX1	0.306	0.422	0.896												
TRL1	0.393	0.312	0.241	0.940											
OBS1	0.311	0.378	−0.234	−0.142	0.810										
SEC	0.419	0.517	0.311	0.352	0.333	0.835									
AVA	−0.109	0.143	0.242	0.218	−0.084	0.410	0.962								
TER	0259	0.312	0.492	0.206	0.214	0.098	0.281	0.752							
TOP	0.318	0.388	0.462	0.268	0.220	0.114	0.479	0.501	0.905						
ROI	0.289	0.594	0.365	0.448	0.274	0.203	0.303	0.470	0.432	0.804					
TRA	0.381	0.389	0.264	0.355	0.414	0.485	0.416	0.236	0.587	0.237	0.794				
GLR	0.328	0.321	0.269	0.277	0.293	0.132	0.238	0.402	0.403	0.339	0.350	0.822			
SLA	0.275	0.423	0.264	0.180	0.052	0.342	0.369	0.229	0.664	0.582	0.427	0.393	0.845		
TRU	0.356	0.272	0.181	−0.302	0.108	0.195	0.155	0.453	0.278	0.504	0.231	0.283	0.246	0.878	
ICC	0.462	0.22	0.542	0.195	0.480	0.604	0.445	0.268	0.466	0.374	0.534	0.279	0.270	0.580	0.830

To detect any lack of discriminant validity, the heterotrait–monotrait ratio of correlation (HTMT) was also evaluated. As recommended, all HTMT values were below 0.90 [184]. Referring to Table 10, the discriminant validity and HTMT were attained in this case due to the low correlation between the various constructs. Thus, all of the changes in the measurement model have been made which can be utilized to test the hypotheses of the study and run the structural model with the satisfaction and confidence of discriminant validity.

Table 10. (HTMT) evaluation.

Construct	RA	COM	COMX	TRI	OBS	SEC	AVA	TOP	TER	ROI	TRS	GLR	SLA	TRU	ICC
1 RA															
2 COMP	0.71														
3 COMPX	0.76	0.61													
4 TRL	0.68	0.54	0.75												
5 OBS	0.45	0.40	0.48	0.68											
6 SEC	0.59	0.46	0.63	0.60	0.79										
7 AVA	0.57	0.50	0.62	0.48	0.33	0.83									
8 TER	0.51	0.43	0.37	0.39	0.55	0.31	0.71								
9 TOP	0.56	0.49	0.59	0.66	0.74	0.43	0.40	0.81							
10 ROI	0.57	0.60	0.58	0.40	0.71	0.60	0.50	0.57	0.74						
11 TRA	0.65	0.48	0.44	0.46	0.67	0.55	0.32	0.42	0.59	0.83					
12 GLR	0.52	0.48	0.47	0.43	0.76	0.62	0.40	0.56	0.60	0.82	0.73				
13 SLA	0.71	0.59	0.68	0.68	0.68	0.59	0.48	0.47	0.75	0.73	0.80	0.78			
14 TRU	0.55	0.63	0.61	0.73	0.58	0.46	0.68	0.40	0.67	0.51	0.46	0.51	0.71		
15 ICC	0.51	0.43	0.68	0.78	0.45	0.40	0.50	0.57	0.58	0.40	0.50	0.62	0.48	0.82	

9. Discussion and Conclusions

Cloud computing (CC) offers government opportunities for better resource development. Several previous studies support this conclusion [8,185] and allocation, which makes it the best solution for several developing countries such as Libya. However, governments hesitate to adopt them because, in developing countries such as Libya in which cloud technology is relatively new, there are challenges such as cost, trust, transparency, and insufficient IT infrastructure, which supports the findings by [51,131]. Furthermore, there are several challenges and circumstances, and building a model for cloud computing adoption solely relies on the bases of concrete scientific ideology and going through a lot of evaluations and validations by specialized IT professionals. Thus, the decision of e-government departments to employ new technologies and adopt e-services may be influenced by a number of factors and should be investigated before applying this technology. This outcome is supported by several prior studies [65,99].

The purpose of this paper is to propose a theoretical model for investigate the factors influencing the initial CC adoption in the Libyan e-government. To the best of our knowledge, this is one the first research studies to address cloud computing phenomenon in developing countries and Middle Eastern countries in particular, such as the Libya e-government context [186]. The research also addresses the related issues in order to understand the adoption of cloud computing services in the government sectors from a holistic view. Additionally, an instrument to assess the impact of those factors on the decisions to employ cloud computing was developed. The development of the instrument went through various stages to ensure its validity and reliability.

First, the measurements were created using prior research on cloud computing and the studies on the proposed model structures. Second, the content validity of the instrument was evaluated by six academic staff and researchers on information systems. Based on the feedback of these experts, the measurements were adjusted. Third, real data were gathered from 38 respondents for pilot research. Following an analysis of the data, some items were removed in order to raise the related scales' reliability to a level that was deemed acceptable [187]. The content validity of the scale's measures was further ensured by factor analysis. The developed instrument can be used to investigate how the mentioned criteria affect the decisions of government agencies to employ cloud computing to provide e-government services.

The results of this pilot study offer preliminary validation of the model constructs and measurement tools used to analyze the factors that impact the intention of decision-makers to implement cloud computing. For some model constructs, the reliability coefficient was determined based on the Cronbach's alpha value greater than 0.80, exceeding the minimum required value of 0.70 indication value [179]. The AVE and CR values are used to establish the convergences and discriminant validity for each construct. The values of AVE and CR for all structures are based on the recommended minimum threshold after a few bad misfit items were removed, as reported in several previous studies [188].

Therefore, all of the proposed model's constructs were suitable for the validation of the final model in the full study. A final instrument was developed for full-scaled study in response to the feedback and recommendations by the respondents to the questionnaire and academic researchers, based on the analysis provided above. The validation report of the survey questionnaire on intentions to implement cloud technology is also proposed in order to create intentions for cloud computing adoption for the Libyan e-government. Thus, the findings of this studies demonstrate that the instrument is valid and reliable based on the specified standards and may be regarded as a suitable measuring instrument to obtain the required data for full-scale studies, with [189] supporting our findings.

The first phase of evaluating the relevant factors that impact the stakeholders' intent to adopt the cloud computing is the development and validation of the models and instruments. The primary objective of the study is to use the instruments that were employed to carry out the research on the core studies that used the pre-selected target groups of IT professionals, CTOs, and CIOs who may be considering cloud computing deployment and who are the decision-makers in the Libyan government sector. Each model's constructs impacting on the adoption of cloud computing in the Libyan e-government sector will be investigated. By applying partial least squares structural equation modeling to check the proposed hypotheses, their importance in the model can be established (PLS-SEM).

Future studies on CC adoption in situations such as this will make use of a final validated model. Moreover, future research on the adoption of cloud computing in further sectors, including educational institutions, public services, small and medium-sized businesses, and manufacturing industries in Libya and elsewhere, can also make use of the model. To analyze CC adoption and other technology-specific sectors in the e-government sector in Libya and other developing countries, the results of the comprehensive study will help establish a context-specific model [17]. The results of the study will also support the body of CC literature through appropriate empirical facts and give sector decision-makers the information they need to make certain decisions. Furthermore, the results from the proposed study will be important for IT-based experts who are the main service providers, who have relevant data and information that can be used for any project in CC because they are validated by scientific research studies. Finally, the study is also intended to add to the body of knowledge on the most effective IT-based adoption strategies that are appropriate for developing countries.

The aim of this pilot study is to be able to find the most important factors that will motivate the Libyan government to use cloud computing technology and, therefore, presents an integrated model. This model considers different factors from various studies, including some new factors that were not yet considered in the literature to determine how they influenced cloud computing adoption. To sum up, the developed instrument can be used to investigate how the mentioned criteria affect the decisions of government agencies to employ cloud computing to provide e-government services in future study.

10. Future Research and Limitations

There are several limitations to this study that suggest future directions. Since data were collected from only one country, our research only presents the state of Libya. Therefore, this research suggests that future research can utilize a sample taken from similar countries as a basis for validation of the model or its implementation in different cultures and geographical settings in order to provide a more detailed understanding of cloud computing adoption and use, especially among under developing nations in turbulent environments. A second research model can be developed by incorporating other relevant constructs under the four key dimensions that have been taken into consideration during the development of the research model. The third aspect of this study concerns the adoption of cloud computing in e-government from the perspective of IT professionals; future research can focus on the adoption process from the perspective of employees and cloud providers. Last but not least, this study explored only organizational intention to embrace cloud technology in the context of e-government. A high potential for future research lies in assessing the success of this prevalent technology.

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