



e- GCloud: Next Wave of E-Government

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Abstract

This research delves into the developments, in cloud computing and their significance for e government. It introduces an approach to e government advancement known as "Electronic Governmental Cloud (e-GCloud)" aimed at addressing identified issues and meeting the requirements of cloud computing. The study will conduct a review of existing literature and online sources analyzing studies and articles on the evolving landscape of cloud computing to elucidate its role in e government applications. It aims to outline the deployment strategy for cloud computing in e government settings and propose a novel governmental framework called "e- GCloud" designed as an exclusive private cloud community for national governments use. Additionally, this research, evaluates factors influencing the integration of cloud computing into e government systems by drawing insights from senior government officials and IT personnel within governmental entities. The results suggest that e-GCloud outperforms in applications due, to its enhanced flexibility, resource availability and prompt responsiveness.

Keywords: Cloud Computing; E-Government, Cloud Gov; Sharing Information; Virtual Technology; Governmental Cloud

1. Introduction

Cloud computing (CC) is leading the IT industry now because of its innovative approach to resource deployment and allocation. Cloud service providers bill customers based on their resource consumption offering pricing plans. This enables businesses to expand rapidly and efficiently through the availability of IT services such, as computing power and storage. Moreover cloud computing fosters innovation by facilitating global team collaboration and reducing barriers to entry for enterprises. The sector is experiencing a shift, towards cost scalable IT infrastructure as an increasing number of organizations opt for cloud-based solutions [1].

Consequently, cloud-computing environment is not compatible with the current e-government application environment. Hence, to improve security, trust, and privacy issues, a partial transition procedure is crucially necessary to migrate the e-government platform to the cloud-computing platform [2]. The transition must be managed with precision and systematic attention. To capitalize on cloud technology benefits, several nations in Europe and Southeast Asia, like South Korea, have embraced or intend to adopt it [3, 4].

As a result, the present environment for e-government applications does not align with that of cloud computing. Hence, to significantly enhance aspects of security, trustworthiness, and privacy protection; an essential phased approach is imperative for shifting the e-government framework onto the cloud infrastructure. This transition requires meticulous and methodical execution. In an effort to benefit from cloud computing, a number of European and Southeast Asian nations, including South Korea, have either already adopted it or plan to do so [4, 5, 6].

In this study, we propose a novel e-government development paradigm called the "Electronic Governmental Cloud" (e-G Cloud), which attempts to satisfy cloud computing requirements while avoiding the previously discussed issues. We will also describe the function of cloud computing in e-government applications by

conducting literature review and web research to look into various papers and studies relevant to cloud computing trends. Put differently, cloud computing allows for the dynamic and elastic on-demand provisioning of IT resources, such as processing power and data storage, to a multitude of users through a network of disparate devices. This paper presents a new paradigm of government termed "e-GCloud" and specifies the prevalent cloud computing deployment methodology in e-government. This is a reference to a communal or private cloud created especially for use by the federal government.

Finally, this paper organized into the number of sections: Section 2 explains study borders of the research. Section 3 reviews the prior research, whereas, Section 4 explains the specifications and environment of e-GCloud model. The results of the experiment and practical haven shown in Section 5. Section 6 discusses in details the obtained results. The Research limitations and future work have been presented in Section 7. Finally, Section 8 summarizes the conclusions.

2. Study Borders

This section explains in detail the purpose of the study, the problem statement, the significance of the study, and the methodology.

A. Problem Statement

The exponential growth of cloud computing brings forth opportunities as well as challenges for e-government endeavours. This study aims to look into the latest advancements in cloud computing and how they affect e-government. It points to the emergence of Electronic Governmental Cloud (e-G Cloud) model, which has been crafted from the ground up to encapsulate the wide range of demands of cloud computing and also to address some of the major problems previously identified in prior research. This study is to look at the articles that have been written concerning the cloud computing trends and further clarify the importance of this in e-government application development through a comprehensive literature review and online research. The paper particularly focuses on cloud computing deployment strategy, which is extremely popular in the e-government context [6, 7, 8], discussing its practical complications and the possible implications it might have. In addition, the research project introduces "e-GCloud", the first and unique type of government architecture that national governments can use to have their own personal cloud community with the ultimate data control (governance), safety and privacy. Along with the IT personnel and the top government management, the research conducts analysis on determining which factors power the integration mechanisms between electronic governance systems and cloud computing. While studying those specific components, the present study strives to propose concrete strategies to enhance e-government services, promote effectiveness, increases openness towards the citizens and thereby adoption of citizen-cantered governance.

B. Study Objectives

1. To devise a new approach to e-government development known as the "Electronic Governmental Cloud (e-G Cloud)" that aims to fulfil cloud computing requirements and resolve concerns raised in previous publications.
2. To determine function of computing in e-government applications and to look at previous research on the developments in cloud computing, a thorough examination of the literature and online research is needed.
3. To highlight prominent cloud computing deployment method used in the field of e-government.
4. To leverage IT staff and top government managers' responses to categorize and gauge the critical components that affects the integration of cloud computing into e-government systems.

C. Significance of the Study

The research is ground breaking because it looks into the tendencies, known as cloud computing and e-government, that are two very up and coming branches with tremendous influence in the modern governance. The chief objective of this study is to unveil the most important trends in technologic development that can improve the services provided to the public. This is done by exploring the newest advancements in the form of cloud computing and evaluating its implementation in e-governance. Through the e-G Cloud model, we implement a fresh and unique method that, by the assistance of cloud technology, tackles the existing challenges of the e-governance system. Such a paradigm has the greatest potential of completely overhauling the provision of the public services, making them more efficient and inclusive and protecting them from the malicious actors through modern technology using a broad literature review including the online. The purpose of this research is to more enrich our knowledge about the role played by cloud computing in e-government applications in particular. The purpose of this study is the identification of critical influencing factors that affect the adoption and application of cloud technology in government organizations; to do this through examination of published studies on cloud computing

trends. Additionally, it will offer insightful information to IT professionals and policymakers participating in e-government projects by outlining the most popular cloud computing deployment technique in the e-government sector. The introduction of the "e-GCloud" architecture, which serves as a private cloud community for the national government, offers a tailored solution to meet the specific requirements and preferences of government agencies. Concluding, by identifying and assessing central components influencing the integration of cloud computing into e-government systems, this study will help IT personnel and government management in making informed decisions. Employing insights from IT specialists and senior government managers, the study endeavors to offer a comprehensive understanding of both the opportunities and challenges. Overall, this study has major consequences for e-government's future, facilitates understanding, and offers recommendations to enhance creativity, and efficiency in the provision of public services.

D. Methodology

E-government refers to the electronic dissemination of government services and documentation through the utilization of Information and Communication Technologies (ICTs), predominantly internet connected computers. Cloud computing is now a widely discussed topic about the future of information technology, particularly e-government, as it has become a revolutionary reality in the sector [9, 10]. This implies that computer resources will be converted from goods to services, and cloud computing service providers. These facts demonstrate how beneficial cloud computing is for e-government initiatives. Two significant problems that lead to the failure of e-government projects are the expense of the infrastructure required for e-government and the inefficiency of HR, these issues can be counter by cloud computing, which also offers cost savings, expert management, and full use of all resources and apps [11, 12]. As a result, the study suggests a new, safe, and developmental framework model for planning the integration of cloud computing into e-government and the deployment of cloud computing inside the e-government application matrix. Examining the effects of cloud computing and E-government based design science methodology, survey, and acquired results utilizing an experimental cloud environment is the primary goal of this work.

In general, this study adheres to the design science process' recommended steps mentioned below to methodically arrive at an impartial and workable solution pertaining to the article's topic.

1. Creating the search procedure.
2. Gathering information (literature review).
3. Examining and extracting problems from the information.
4. Setting up the cloud infrastructure.
5. Developing an E-government cloud-computing model.
6. Outlining the obtained results.

The establishment process for the search protocol focused on a set of keywords like cloud computing, e-government, and cloud technologies. Then, select relevant data about cloud computing adoption in e-government that was carried out based on SCOPUS, Clarivate, PubMed, Springer, Emerald, and IEEE Explorer through (2019–2023). Table 1 summarizes the results of common scientific publishing databases associated with search filters.

Table 1: Relevant results from Scientific publishing Database.

Search Categories	DB	Relevant results	Period time
Journal-Articles	SCOPUS	133	2019-2023
Journal-Articles	Clarivate	18	2019-2023
Journal-Articles	PubMed	12	2019-2023
BOOK Chapter	Springer	75	2019-2023
Conferences	IEEE Explorer	123	2019-2023
Books	Emerald	8	2019-2023

E. Why e-G Cloud

Cloud computing provides significant solutions for the challenges faced by e-government such as scalability, cost savings, and efficient management of resources and applications. Nonetheless, the absence of an organizational model during the transition to cloud computing for e-government can lead to various research problems [10]:

1. The first step is to examine the requirements of cloud computing technology for e-government and understand the current state of e-government that necessitates the adoption of cloud computing to prevent failures.

2. The e-government application environment has to be adjusted to ensure compatibility with the cloud-computing environment.
3. The migration process from e-government to cloud computing should be considered the security concerns. While not all services may migrate to the cloud, it is most important to understand how to segregate the services within the e-Gov application and services with cloud without disrupting its functionality.
4. Define the security model by establishing a Service Level Agreement (SLA) and defining a security model for accessing data.
5. This study aims to solve above problems by creation of a novel development model that provides effective solutions.

3. Existing Studies

This section surveys the up-to date research in the field of integration between cloud computing and e-government. For example, Mohammed et al. [12], presented the paper entitled "Cloud Computing Adoption Model for E-government Implementation". The central aim of this study was to develop a framework for the implementation of cloud computing in e-government initiatives. The intended aims were to decompose the factors being determinants of cloud adoption in the public sector, make a constructive cloud adoption readiness assessment model and then empirically validate the proposed model. The researcher concentrated on factors like organizational preparedness, perceived risks, benefits, and compliance with the regulatory norms. The authors deployed a mixed approach, combining the survey data analysis, expert interviews, and literature review in order to assess and verify the assumed adoption model. Research demonstrated that the issues of organizational readiness, perceived benefits, and compliance with the regulations are the main drivers of the cloud adoption decisions in e-government sector. The necessity of considering these is to guarantee the good acceptance and implementation of cloud computing by local administrations.

Kh. E. Ali, Sh. A. Mazen and E.E. Hassanein [13] illustrated the challenges and features of cloud computing adoption in e-government, consequently, this study proposed a new hybrid model for adapting process in order to overcome such obstacles. Local Governmental Cloud "LGC", Regional Governmental Cloud "RGC" and Wide Governmental Cloud "WGC" are main three patterns of adoption process. This model specify the entity connection methodology to each of three clouds and what type of relation between them. In this study, the authors explained in details the migration steps from the e-government environment to the cloud environment, and achieve the readiness assessment for this stage. Finally, this project valid the adoption process by implementation a lot of cloud services one e-government model.

Al-Ruithe and Benkhelifa [14] take stock and divide the obstacles and the success factors in the implementation of the cloud data governance strategies. The paper had the goal of finding the barriers and the facilitators of strategy implementation for cloud data governance. The analysis of variables involved the most significant contributors and obstacles mainly from secondary research and expert interviews. The procedure included the following: categorizing of obstacles and critical success criteria in a systemic way by a comprehensive literature and professional reviews. In the end, the study highlighted the critical issues underpinning the cloud data governance world and emphasized that getting to the success would be hard but vital and thus the need to beating obstacles and taking advantage of growth factors are of immense value.

Khan et al. [15] contributed the research tilted as "Technological leapfrogging e-leadership by cloud computing" in order to discussed the benefits of the cloud computing technology for speeding up e-governance development in the third world countries. In the scope of the project, we get to see how cloud computing may have a role in e-government development, identify and focus on the most significant factors driving this tech leapfrogging and assess the strategy that is being used in order to develop these elements. Most likely, the structural framework that was chosen for this evaluation includes service accessibility, data security, scalability, and cost-effectiveness. A case study approach that includes literature studies and a combination of empirical and analytical approaches was used in the methodology to highlight the ability of cloud computing in e-government. Probably the learned will highlight the changing impact of cloud service on the quality of e-government services, costs and efficiency of the delivery process. For this reason, government officials and lawmakers will explore how to adopt this technology to work in a wide range of both private and public sector systems over the years to come.

Mistry and Jalal [16], carried out a research paper to demonstrate empirically the existence of e-government and corruption link. The goal of the study was to explore whether any correlation exists between the decrease of corruption and the rate of adoption of e-government measures. The factors studied were the tendencies towards corruption in several nations and the degree of development of e governance. Simply, researchers conducted quantitative analysis involving a large number of countries on a specific period with such methodologies as regression analysis. The study that has been conducted contends that there is a significant connection between the

perceived corruption and degree of e-government development. It shows that the e-government initiative may be of benefit to countries that adopt these initiatives by reducing corruption in the country, -which may also have a positive influence on improving the governance and remake the image of the country to the outer world.

Carter and Bélanger [17] predicted how e-government services are used. Essentially, the task of the researchers is to describe the independent factors that foster the citizens' appropriate levels of confidence, innovativeness, and acceptance. The approached survey focused on different features including public trust, future innovation, perceived value, perceived ease of use and the interest to go with government online services. The authors employed a survey-based method to collect information from a sample of citizens that reflected its overall outlook. Consequently, the findings brought to light the importance of this combo of public confidence in government services, perceived innovation, and perceived utility as the input in the acceptance and usage of e-government services. The research stated that to apply e-government services among citizens, constructing trust, having innovative thinking and ensuring the perceived usefulness are the most important factors.

Alfadli I. [18] presented the base for cloud computing that meets e-commerce in Saudi Arabia requirements, as it is reported in the Journal of Computer Science. This document suggests cloud-computing framework that face specific requirements and obstacles in electronic commerce industry in Saudi Arabia. The goals are to itemize the indispensable constituents of the cloud-computing model, analyse its practicality and effectiveness, and outline strategies that should be adopted for its implementation. Among the variables that will be evaluated we will include the scalability, security, affordability, and performance of the suggested cloud model. The way this study is put together involves the use of case studies, questionnaires, and an interview with e-commerce stakeholders together with the relevant literature. At the end of this paper, the results of the study are summed up and the advantages of the suggested cloud-computing paradigm for the Saudi e-commerce environment are emphasized with regard to directions for further research.

Generally, all authors have discovered two-steps approach for migrating E-Government to the Cloud Computing model from the above existing studies. The first phase is preparing E-Government for the upcoming transition, while the second phase involves a comprehensive analysis of Cloud Government. Our study highlights that the incorporation of cloud computing into E-Government can revolutionize public service delivery, improving efficiency, effectiveness, and accessibility. After conducting a thorough analysis of eight studies, a total of eight factors were established to accurately demonstrate the viability of each study such as cost-effectiveness, security, user services, cloud processing structure, regulating framework, user approval, reliability model, and productivity. Table 2 presents the analysis of existing studies in this part with respect to eight defined criteria.

Table 2: Comparison criteria for Existing cloud computing with E-gov.

Ref	Cost-effectiveness	Security	User services	Cloud Processing structure	Governing framework	User approval	Reliability Model	Productivity Model
Mohammed et al	✓	×	✓	✓	✓	✓	✓	✓
Kh. E. Ali et al.	✓	×	×	✓	✓	✓	×	×
Al-Ruithe and Benkhelifa	✓	×	✓	×	✓	×	✓	✓
Khan et al.	✓	×	✓	✓	✓	×	✓	×
Mistry and Jalal	✓	×	✓	✓	×	✓	✓	✓
Carter and Bélanger	✓	×	✓	×	✓	✓	×	✓
Alfadli	✓	×	✓	×	✓	✓	✓	×

4. e-G Cloud Specifications

The e-G Cloud model designed based on the analysis of previous models of adopting of cloud computing in e-government. The problem analysis of transition of e-government to the cloud computing collected from the theoretical context have been mentioned in Section 4. The architecture of e-G Cloud refers to the design-structure of cloud-based on infrastructure used e-government services, see figure 1. The e-G Cloud model provides high-

performance, scalable, and secure services by combination between “hardware, software” and networking technologies. Moreover, e-G Cloud architecture typically includes multiple layers have been listed as follows:-

- Application layer: it is responsible on providing the user interface.
- Data layer: it is responsible on manage-store (databases, data warehouses, and data management tools).
- Infrastructure layer: it involves the physical and the virtual resources.

Accordingly, in order to protect the data from threats and other security attackers, the e-G Cloud architecture includes various security mechanisms and protocols like firewalls, intrusion detection systems, data encryption, and access control mechanisms.

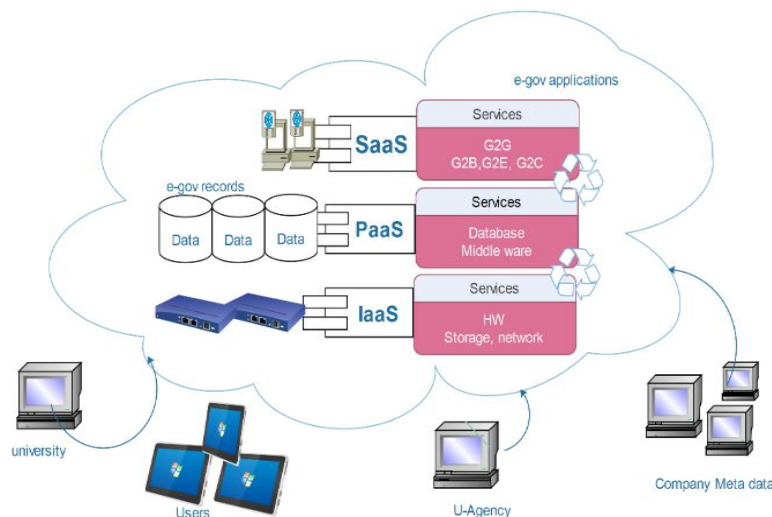


Figure 1. e-GCloud Main Building

Overall, the architecture of e-G Cloud aims to provide a highly reliable, scalable, and secure environment for delivering e-government services to citizens and other stakeholders. The e-GCloud has undergone testing and validation at the University of Fallujah's Deputy President for Administration Affairs Office and Computer Centre Laboratories. Regarding methodological work, writers gathered information from actual administrative office settings. The cloud computing architecture typically includes a range of supporting technologies and services such as load balancers, firewalls, identity, access management, data storage, and backup solutions. These components designed to work together to provide scalable, reliable, and secure computing environment. The e-G Cloud model have been obtained based Windows Server datacentre 2012, Hyper-V, System centre manager 2012 R2, and Oracle db [18, 19].

A. Practical Environment

The key components of the e-G Cloud model are presented in this section. The most crucial stages in creating a practical electronic government cloud model are the assessment, construction, and migration phases, the service classification phase, the integration phase, and the service legal permanence phase.

i. Assessment

The first phase of the e-G Cloud concept, in which the writer assesses traditional e-government methods based on particular scientific standards. Examined are a number of domains and measures, including information publication, interaction, and transactions. As explained in more detail in Section 3, surveys and expert interviews are used to identify these indicators. The phase's outcomes indicate the maturity level of e-government and shed light on whether it has moved into the new cloud government age or are still in the transaction phase.

ii. Construction and Migration

Rebuilding and reconfiguring service applications in accordance with Service Oriented Architecture (SOA) are the next stage when it is verified that traditional e-government has made the transition to the transaction state in the first phase [20, 21]. In order to comply with SOA principles, applications must be rebuilt as separate entities and services. As a result, the procedure guarantees that each service added or removed from the application is simple and has no negative effects. This increased flexibility comes in very handy when moving e-government

apps to the cloud. In SOA environment, the reconfiguration of applications must progress through specified scientific phases, including re-analysis, re-design, and re-implementation. This structured approach results in the development of new, adaptable applications that can be easily segmented or integrated into services based on demand. Because of this phase, e-government classification becomes more straightforward.

iii. Service Classification

In the Services Classification phase, various service types are classified, including static, dynamic, inquiry, interactive, procedural, expensive, inexpensive, confidential (privacy-focused), and less confidential services. The decision on which service types will transition to cloud computing and which ones will not depends on e-government feasibility, cost-benefit analysis, security assessment, and political considerations. Due to divergent privacy and security concerns among nations, e-government typically avoids migrating all its services to the cloud. The outcomes of this phase will specify which service classes will undergo cloud migration and which ones will remain unchanged.

iv. Integration

Following the completion of the classification phase and the identification of e-Government services slated for migration to cloud computing, the subsequent step is the Integration Phase. The Integration Phase commences once the determination is made regarding which services will be transferred to the cloud environment. In this phase, with the objective of reducing costs and eliminating redundancies in cloud computing, the authors consolidate applications that are constructed with a service-oriented design and incorporate a built-in software-as-a-service layer. So, in order to build an optimal transmission between local e-Gov applications and new place at cloud environment with Minimum Acceptable Level of customization for security and running requirements, this phase focuses on creating a single integrated functioning SOA and decreasing redundancy. The consolidation and focal point of aggregation will enhance the qualitative optimization of the utilized applications, thereby, delivering a meaningful service to the end user.

v. Service Legal Permanence

The final level of the e-GCloud model is the Service Legal agreement. this phase broaching about the cloud computing security issues such as data ownership, confidentiality, and suggest service legal Permanence (SLP) to prevent future political unrest from affecting cloud computing-based e-government [22] Accordingly this study suggests draft legal texts include the following points:

- Ownership of information.
- Explicit penalties for the unauthorized disclosure of official work.
- Adherence to the organizational structure of the Insinuation.
- Maintenance of a clear separation between e-G Cloud and any possible political concerns and conflicts.
- The government is legally authorized to replicate specific transaction services on local servers for backup purposes.

B. Experimental Environment

The setting-up and configuring of a cloud computing system for testing and experimentation is referred to as the cloud computing experimental environment. Researchers, developers, and IT professionals to analyse and test the performance, scalability, dependability, and security of cloud-based applications and services usually use this environment. The experimental environment of e-G Cloud typically involves the following components (see figure 2):

- Virtual Machines (VMs): There are two virtual machines; these are the computing resources that are provisioned on-demand in the cloud. To replicate various contexts and scenarios, virtual machines (VMs) can be created with varying operating systems, software packages, and network configurations.
- Cloud Services: Software as a Service (SaaS), these are the services provided by the cloud provider, such as storage, messaging, database, and compute services. Cloud-based apps can be developed and implemented using these services.
- Networking: The bandwidth transforms of the host server utilization arrived to 144 Kbps. This includes the configuration of virtual networks, subnets, and security groups to enable communication between VMs and cloud services.
- Monitoring and Management Tools: The physical server selected to be the host for the cloud environment (which have processor type Intel(R) Xeon(R) CPU E3-1225 V5@4.30GHZ, memory with size 24GB, and hard disc size 2TB) and The cloud environment has been built depending on MSCM 2012 R2 (MSCM) and

Hyper-V hypervisor. These are used to monitor the performance and health of the cloud environment, and to manage the configuration and deployment of resources.

- Users: 45 participants online worked on the cloud network centre.

To set up an experimental environment of e-GCloud, a cloud provider, create an account, and configure the required resources using the provider's management console or APIs should be provided. Thus, client used the e-GCloud template application. This applications working based VM-oracle database and utilize HR system of university of Fallujah. Applications working based VM-oracle database and utilize HR system of university of Fallujah.

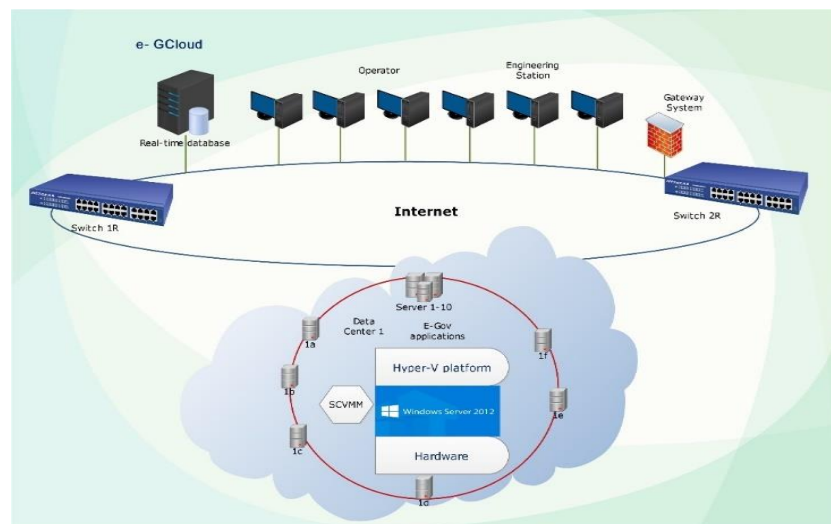


Figure 2. Experimental Environment of e-G Cloud

5. Results

Within the e-GCloud architecture, the experimental role consists of presenting the results of the system's real-world application and operation in a controlled setting. This entails analysing the e-G Cloud infrastructure's scalability, performance, and dependability in addition to its capacity to fulfil the specified goals and specifications. Metrics like system uptime, response times, resource use, and user satisfaction levels are examples of outcomes from the experimental role that might be obtained, offering concrete proof of the e-G Cloud's efficacy in securely and efficiently delivering government services.

A. Experimental Result

The experimental results obtained from implementing the human resources system (HR) in both the conventional desktop environment and the cloud-computing environment. Authors defined criteria for evaluating, restructuring, transforming, and modelling the application. These criteria take into account things like long-term efficacy, high-quality service, and regulatory barriers that prevent the widespread use of virtualized governance. Additionally, we consolidated all the services provided into a unified computing service pool. Therefore, Figure 3 (3.a, 3.b) shows the obtained results regarding to mentioned scenarios, (i) implementing E-Gov applications on traditional, (ii) Adopting of E-Gov applications in cloud environment. Also, compute the performance utilization before setup HR system with two scenarios in order to present holistically analysis for adoption resources cost.

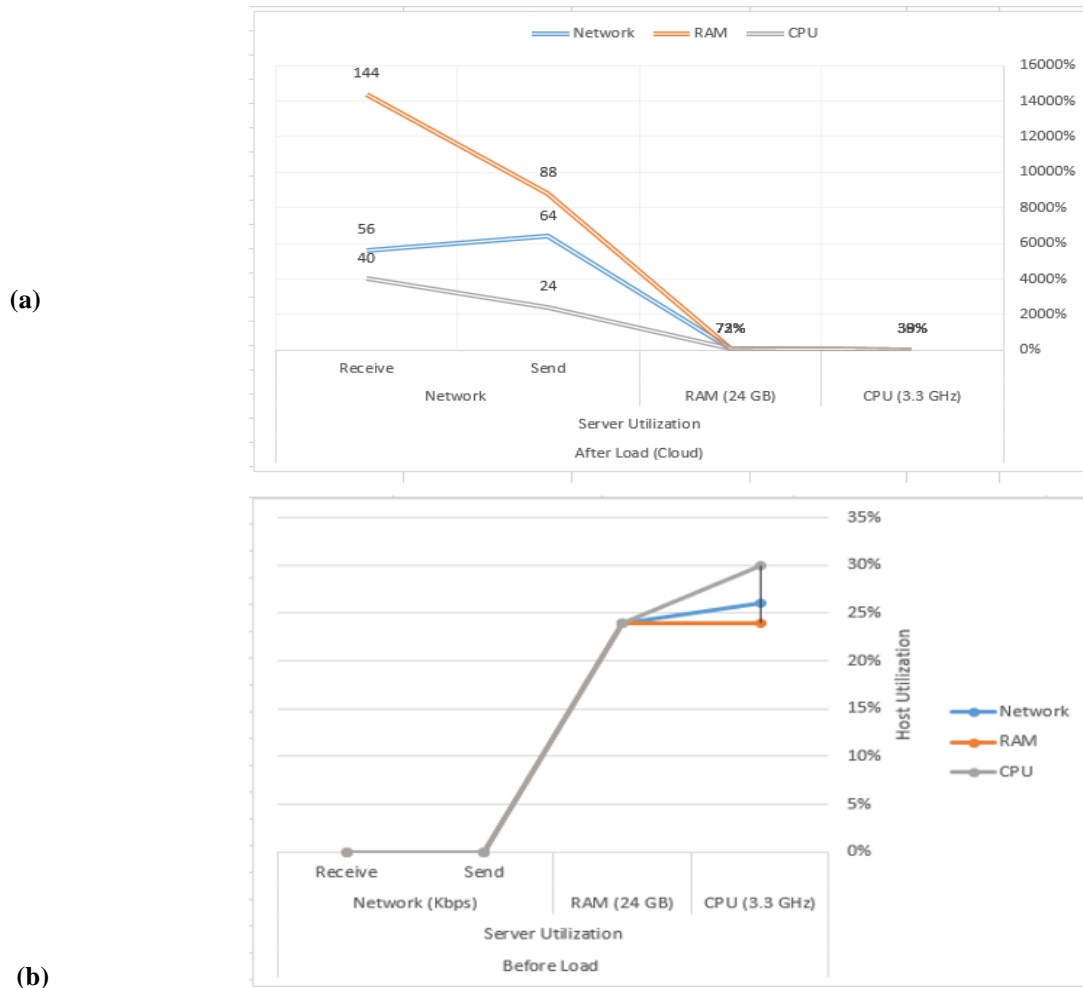
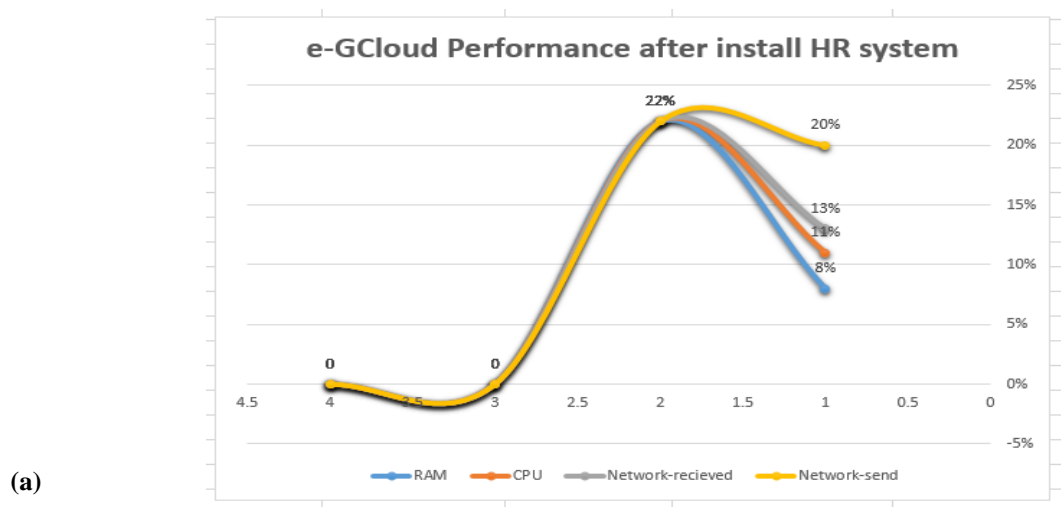


Figure 3. Host Utilization through traditional work: (a) without E-Gov. Implementation and (b) with e-Gov. Implementation

Consequently, Figure 4 (4.a, 4.b) show the results regarding to the adopting of E-Gov applications in cloud environment, so, we measure the utilization before implementation and after for E-Gov. applications.



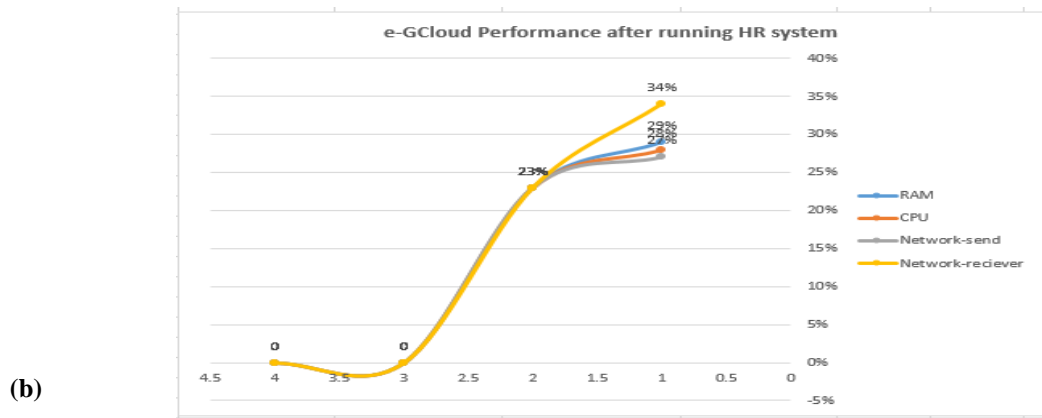


Figure 4. Host utilization through cloudy work: (a) without E-Gov. Implementation and (b) with e-Gov. Implementation

As shown in the above figures, the results of a study on the use of cloud computing in e-government reveal the following:

- **Cost Savings:** e-GCloud help governments save money by removing the need for pricey gear and software as well as by offering a pay-as-you-go model for resource utilization.
- **Scalability:** e-GCloud can give governments the capacity to instantly scale up or down their computer resources as necessary to meet changing demands.
- **Improved Accessibility:** Since e-GCloud allows for access to information and services from any location with an internet connection, citizens may have better access to government information and services.
- **Enhanced Efficiency:** governments can improve their efficiency by simplifying their operations, reducing manual labor, and making the best use of their resources. Better efficiency and quicker service delivery may result from this.
- **Availability:** e-GCloud provides service based on sharing services aspect, so, resources should be available over time as an online mode.

B. Practical Result

The results of the fieldwork described in Phases A are expanded upon in this section. Accordingly, the Ministry of Higher Education and Scientific Research, which is in charge of overseeing the e-government project in Iraq, was presented with e-G Cloud as a case study. A wide range of experts, managers, system analysts, technical project managers, technical support specialists, and the programmed director for the development of government services were carefully selected for this project. Accordingly, figure 5 shows the outcomes of the electronic survey and interview.

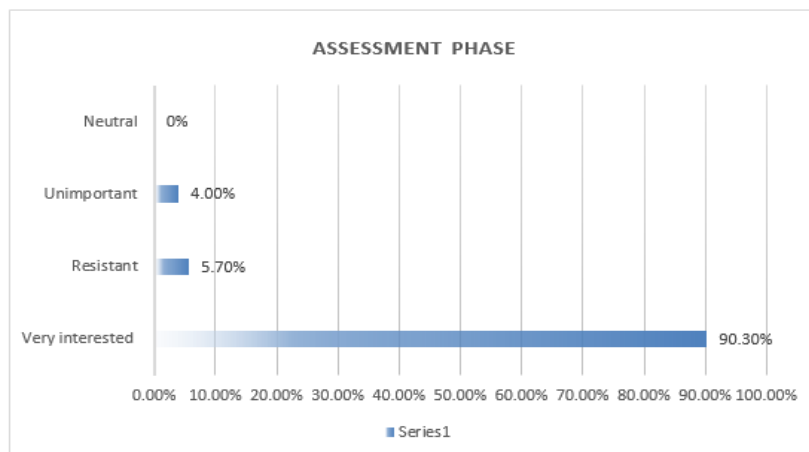


Figure 5. Assessment result report

90.3% of participants in the Assessment phase agreed that the phase was significant, whereas 5.7% disagreed, 4% said it was unimportant, and 0% said they had no opinion. When it came to the building and migration phase which involved rearranging service applications using a Service-Oriented Architecture (SOA) 80% of participants recognized its importance, 8% disagreed, 7% said it was irrelevant, and 5% said it was neutral (see Figure 6).

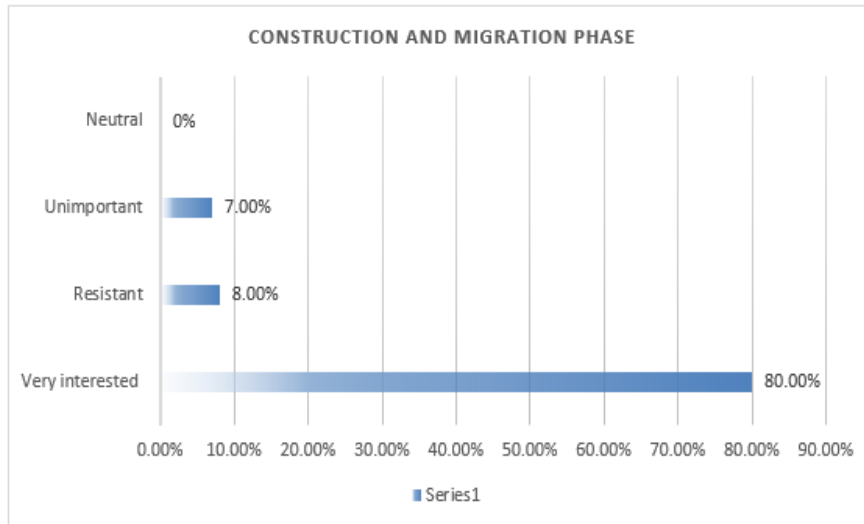


Figure 6. Construction and Migration result

In the Service Classification and Integration phases, 99% of participants affirmed the significance of these stages, while 1% displayed resistance, and there were no respondents who considered it unimportant or remained neutral, see figure 7.

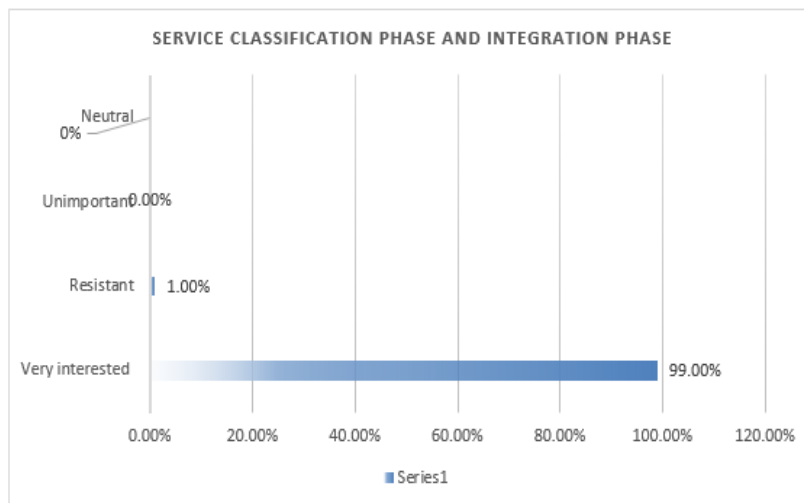


Figure 7. Service Classification phase and Integration phase

Finally, concerning the Legal Permanence of Services, all participants acknowledged the significance of the conditions and rules essential for establishing a resilient modern mode.

6. Discussion

The use of cloud computing into e-government endeavours holds the potential to improve public services' efficiency, affordability, adaptability, and accessibility. However, before governments can reap the alleged benefits of the cloud model, they need to address a few pressing issues. The main worry is the security and privacy of private citizen data and secret government data stored on cloud servers. Even with advanced cyber security

measures in place, the risk of unauthorised access and data breaches is increased when there is no physical control over cloud infrastructure. Large volumes of personal data about the names, whereabouts, finances, health, and other particulars of its citizens are managed by government agencies. Any breach in data privacy protection or improper use of this information might violate citizens' rights and damage public confidence. Sensitive data pertaining to diplomatic relations, national security, and policy choices, etc. is also stored in government clouds. While essential, robust encryption and access controls are not perfect. Risks can be reduced by enforceable security standards, frequent cyber-audits, multi-factor authentication procedures, sophisticated threat monitoring systems, and stringent contractual provisions outlining provider accountability. However, worries are still present about security that comes with a model that encourages widespread access to the public internet.

Furthermore, compliance and governance are constant challenges due to complex and constantly changing data protection, privacy, and other legal obligations. Every state and nation has laws governing the processing and storage of public and government data, particularly now that public cloud models permit cross-border data transfers. Governance is made difficult by the intricate web of compliance requirements, including the need for regular security certifications and the ability to adjust to new legislation.

Moreover, the open nature environment of cloud computing cause in an interoperability challenge, especially, when integrating the cloud platform service with a traditional monolithic structure. However, sustaining cloud systems remains challenging due to a lack of technical expertise. Building capacity through public-private partnerships is therefore essential. Governments are concerned about the risks associated with vendor lock-ins, lack of reversibility, and loss of direct control when outsourcing public ICT systems, despite the many advantages, such as savings and productivity improvements. These factors can be balanced by implementing in stages using thorough cost-benefit analyses and feasibility assessments. Data security and modernizing ICT for the public sector while upholding sovereign obligations to protect citizen rights remain paramount concerns. Although moving e-government to the cloud is essential, several obstacles include adoption, security, governance, interoperability, and loss of autonomy. The secret is to take a measured, cautious approach supported by laws and capacity building.

7. Limitations and Future work

In Iraq, where e-government endeavours are increasingly gaining traction, a significant research vacuum concerns the investigation and use of the e-G Cloud architecture, thorough research on the uptake and integration of cloud computing technologies that are especially suited to the nation's distinct socioeconomic and infrastructure context still needs to be completed. The area of unmet research need is how the e-G Cloud concept may be applied to the unique problems that Iraqi government agencies have namely their inadequate technological infrastructure, security issues, and resource limitations. Furthermore, there needs to be more empirical data regarding the possible advantages and disadvantages of e-G Cloud implementation in Iraqi environment (technically, human skills). To advance the next wave of e-government efforts and propel digital transformation in Iraq, further research is necessary into the viability, effectiveness, and implications of e-G Cloud adoption. Whereas the limitations are listed as follows:

- In regions with inadequate technical infrastructure, such as remote or marginalized areas with unreliable electricity and internet access, the prevalent adoption and execution of the e-G Cloud might encounter obstacles.
- Cloud Data Privacy concerns boost the government agencies to hesitant to embrace e-G Cloud solutions.
- Financial and budgetary limitations.
- Dependency of cloud services.
- Software Integrity between traditional environment and new platform environment.
- Data Storage precautions.
- Skills of employee and citizen.

8. Conclusions

This study strive to explain the importance and maturity of e-government development in Iraq, exploring the current e-government landscape in the country and drawing insights from e-government cases in South Korea. Numerous benefits emerge from such exploration including scalability, modifiability, on-demand service, pay-as-you-use, and ease of implementation. However, several concerns must be carefully considered when designing new phases, models, or frameworks, such as privacy, cost, security, customization, and integration. In addition, this study reveals a readiness of e-government for migration to the cloud, with various studies presenting step-based, component-based, or layered-based models. These models propose frameworks for adopting Cloud in e-government services and highlight the advantages of cloud integration. Nevertheless, it is noteworthy that all these

models remain conceptual and lack practical implementation. Therefore, there is an opportunity to conduct experimental studies or propose new theoretical models in order to bridge this gap. Finally, the results reveal that e-G Cloud proves more apt for new portal applications, offering heightened flexibility, resource availability, and rapid responsiveness.

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