THE IMPLEMENTATION OF GOVERNMENT CLOUD FOR THE SERVICES UNDER E-GOVERNANCE IN THE KSA

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***ABSTRACT*:** *Revolution in e-government services fostered many developing countries in the world to automate their system for delivering better services to their citizens electronically. To automate the system, it is required to explore the options for these services. In recent years, many governments in the world have adopted cloud services that have promised their consumer's several proven benefits such as cost reduction, managing data, immediate scalability, enhancing public service delivery, resource sharing, and expanding communication channels. To adopt cloud services, there is a need to go for an extensive policy-making program. It is required to draw a roadmap, form committees and subcommittees to achieve the desired goal. Every committee and subcommittee will go through the various processes to analyze at the micro-level and provide an appropriate and robust solution for the desired goal. In each committee and subcommittees, it is required to include people from various fields such as the technology side, the government side, domain experts, and people different very much aware of the various processes, implementation of processes in services, and impact of services implementation. As the Kingdom of Saudi Arabia (KSA) government adopting a "Cloud First" policy [19] in their electronic services, it is necessary to explore the involvement of cloud technology in the e-governance program [3]. To achieve the desired target, it is necessary to build a cloud community that fosters a cloud culture and creates a government-owned cloud to unify government efforts in this field and facilitate access of global cloud service providers to attract investments and develop the final data regulations. There is a need to develop own government cloud naming like "SGC" Saudi Government Cloud. SGC will be responsible to host all kind of electronic services that is required to the government, its organizations, public sectors, and their vendors. In this paper, we have reviewed the government-owned cloud services benefits and recommended the KSA government should own its cloud as "SGC". SGC will have a major impact on the KSA e-Governance program in the near future. This paper explores the several issues, challenges, and impacts involved in the creation of SGC.*

Keywords: Cloud; SGC; Software as a Service (SaaS); Platform as a Service (PaaS); Infrastructure as a Service (IaaS)

1.

2. INTRODUCTION

To integrate cloud for fulfilling the dream of digitalizing everything related to government and its related services. In the future, the digital landscape of the world will increase many times. As per December 17, 2020, InfoWorld Report [20] based on Deloitte's projections and Gartner projects, significant changes in the cloud market have been noticed. In 2021, the cloud market is predicted to grow very fast as compared to the previous years including cloud application (SaaS), platforms (PaaS), and infrastructure (IaaS). In 2021, the global cloud market is predicted to grow to $117.7 billion by the end of 2021 and it will grow around $500 billion, by 2023. In 2021 public cloud providers will shift an increasing share of their workloads to intelligent-edge platforms to deliver the low latencies required by these applications. By the end of 2021, approximately 90 % of industrial enterprises will use edge computing, according to Frost & Sullivan projections. The annual growth of the cloud market indicates significant changes in 2021. The government-to-government and government to citizen move will have a great impact on our economic and social lifestyle. To realize the impact of services a country or government will require huge investments in its required infrastructure. Cloud fulfills this requirement and narrows the gap. There is a need to understand and collect the information for the average utilization of its infrastructure to a worldwide and specific country. In some countries, the average utilization of infrastructure is more than 50% but, in some countries, the average utilization of infrastructure is less than 50% and even it is near to 10% to 20% [2, 6, 7]. The government and organization strategies and vision should accelerate the delivery of electronics services and the organization and government to optimize ICT and infrastructure spending of the government. There is a need to study and identify the area of existing infrastructure how much they are utilized. One of the most important models of the cloud is the government to citizen (G2C) model. G2C model requires a huge number of people and it's treated as a very challenging task to get a feasible size of required infrastructure for the sizing of the people. In a traditional system, there is no way to find out the exact analysis that shows how many people will use a particular service. It shows that scalability management is a big issue in the traditional system. Scalability is not an issue in cloud-based services, usage of particular services can increase or decreased on-demand.

Due to its promising and prominent benefits, the cloud is a better solution for this kind of problem and requirement [5, 8]. It is always challenging for the traditional use of infrastructure. It is a classical challenge for the over-sizing and underutilization of resources. In case, an organization or a

country has invested in the infrastructure of worth 10 million but organization or country may not require that level of infrastructure today but the organization or country may require after 2-4 years. Nowadays, a country or an organization may require capacity worth 1 million but to avoid resources, crunch or face downtimes in the coming 2 to 4 years a country or organization started buying infrastructure that costs 3 to 5 times more. In the peak time utilization of resources and availability of resources is also required to maintain. A country or organization is needed to maintain buffer capacity too. To maintain and provide high availability of services for all time including peak hours and other hours, an oversized infrastructure is required and needs to deploy. To maintain this governance model G2C requires high availability. This kind of potential is available in cloud computing. Cloud transforms the way like how IT is consumed. How will it be managed without interruption and loss of services and data? Cloud computing improves the costing mechanism. Cloud provides innovative solutions on demand and always be updated according to the market requirements. The scalability feature of cloud computing will help the country or organization to go up and down on-demand. There is a need to learn from other organizations in various countries like the U.S.A., UK, South Korea, India, the European Union, Australia, and Singapore [3, 7, 9]. These countries are using cloud services for a better and reliable option to improve government services. By adopting CC services, a government or an organization can eliminate redundancy, increase agility, and provide information and communication technology (ICT) services at a cheaper cost [2, 5, 8]. Cloud services will be beneficial for both the country and the organization. To maximizes the benefits; the government or organization should engage in the formation of cloud computing. The government or organization's cloud can be used by government ministries, departments, vendors, and agencies at the center and governorate levels. It will leverage manual or traditional services to the delivery of e-services with the help of the cloud. There must be a clear-cut objective of government and organizations to adopt cloud computing. It should help in optimum utilization of infrastructure, to accelerate the application development, and program deployment of the related organization or government. It should be able to replicate the applications successfully across the related stakeholders. In this process, there is a need to take care that there should not be the duplication of work and effort and there should not be any expense on the duplicate or existing and available items. There should be a common standard for all important applications with high availability. On the concentration of these kinds, an initiative is required to proceed with a strategic plan and implement various models and related components. As per the e-governance perspective, it is required for propagation and proliferation of cloud in an organization or related stakeholder as various ministries and government departments. There is a need to concentrate on policymaking for cloud usage. These will be the initial step that will provide large-scale adaptation of cloud platform by the stakeholder. To achieve this initiative, the stakeholder must come to a common understanding and constitute a kind of task force or committee or council for the strategic direction and roadmap. This body will recommend the national or organizational cloud for leveraging the existing or new infrastructure. This body should come up with a framework for the implementation of cloud services in the organization and country. This body should assemble all inputs and data provided by the various subcommittees or related working bodies. They should compile all the inputs and data with the subsequent industry consultations. The outcome should comprise the formation and implementation of a cloud computing environment at national and governorate levels. Cloud provides all kinds of applications on a sharable basis at the national and governorate level. It acts as a common repository of cloud-based infrastructure resources.

3. E-GOVERNANCE AND CLOUD

In the roadmap, these are the feature services that should include in the cloud initiative. These services are part of the cloud. They cover most of the areas of infrastructure required for a system.

Fig. 1. Cloud services offering

It can be seen from Fig. 1, which represents the services offering from a cloud environment and its various levels of components. Each component in the figure represents a service that will accommodate as per need and business case. For the implementation of e-governance in an efficient way, a cloud is a leading option and solution. In the case of a particular country like KSA, there are huge scopes to implement e-governance programs in various areas of the country at the central level as well as at the governorate level. At the central level areas are banking, taxes, stock exchange, land records, passport, visa, immigration, health, education, civil aviation, energy, railway, road transportation, judiciary, military and defense, police, environment, meteorological and forecast department, etc. [1, 2, 5, 6]. Various e-governance delivery models can be implemented with the help of the cloud platform. Fig. 2 represents the classical cloud model of e-governance here beneficiary and requestor are citizens or business organizations or private, or public sector organizations.

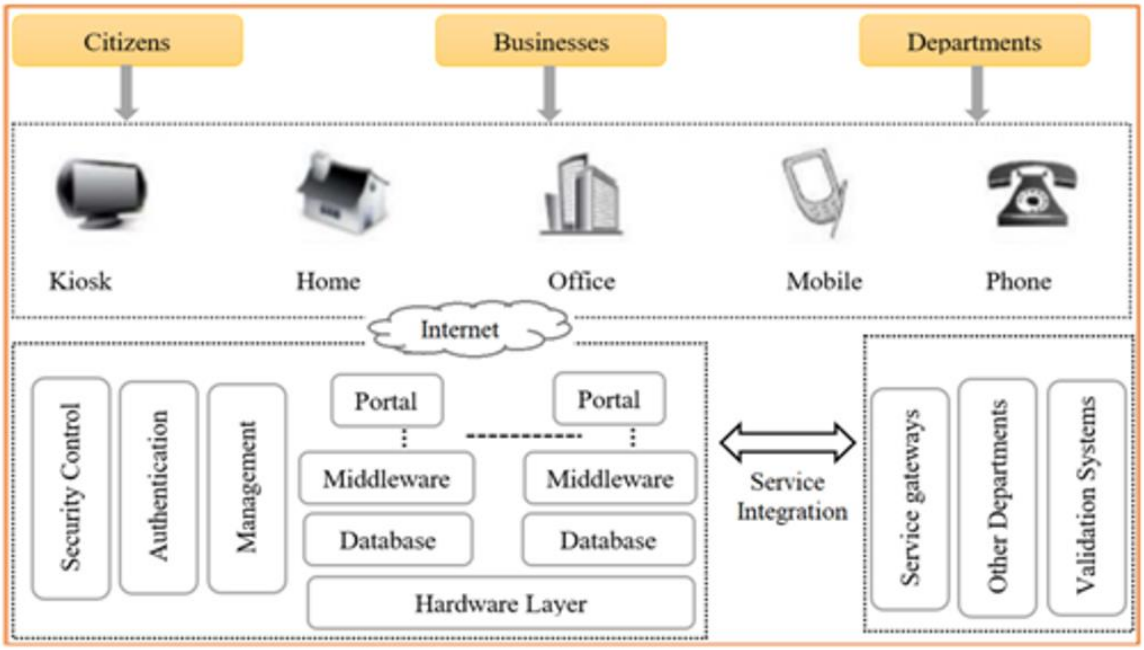

Fig. 2. Cloud Model for E-Governance

A. Government to Citizen (G2C)

The government provides services to fulfill the need of citizens. Citizen-related services can be implemented with the help of the cloud and can be used as e-services. Cloud will help connect the people directly without any mediator. Cloud provides various suggestions and feedback to improve the services. Generally, the motto of any government is to provide all available resources to its citizens. Many services start from human birth to till its death. In this duration, a citizen has multiple roles in society, and to fulfill its role in society conveniently required support from the government at many levels. They go to government offices here and there and waste lots of time and resources. To maximize the utilization of time and resources, there is a need for the government to provide the services to its citizens with the help of various departments under a single umbrella.

B. Government to Government (G2G)

There should interaction and coordination among the government organization, departments, and authorities. Cloud platforms can play a vital role in the interaction of various government departments with common needs and demands. It will reduce the effort of the government department and agencies by providing an optimum solution for their routine work. The cloud platform will be helpful in the approval and notification process when multiple departments of government are engaged in a common and specific task.

C. Government to Employee (G2G)

Cloud can help in the implementation of online services for the government employees for their various needs like life service benefit, settlement of remunerations, reimbursement of various perks, applying for a better opportunity, scope for better future growth, and option for further study, etc.

D. Government to Business (G2B)

The cloud platform will help to provide online services with high availability for any business organization. It can provide online licenses and permits. People or person that wants to start a business can complete all kind of necessary procedure as per their demand.

These government models are shown in Fig. 3.

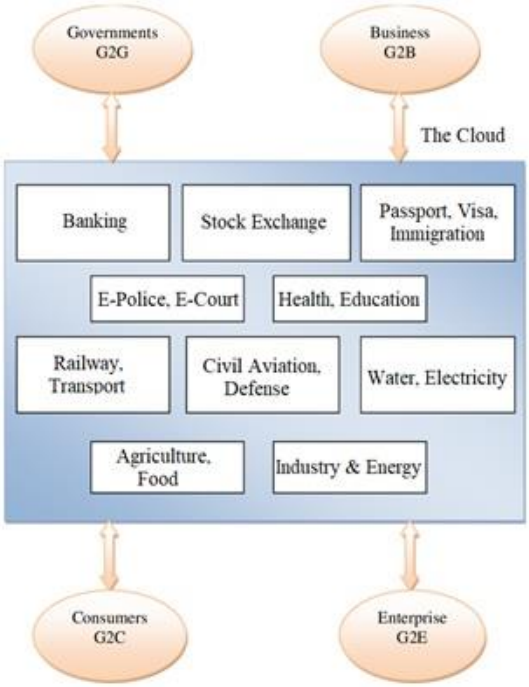

Fig. 3. Cloud Models and its services under E-Governance

4. EDUCATION SYSTEM IN KSA UNDER CLOUD PLATFORM(ANALYSIS)

To provide the various services to their citizens, the government needs to set up a huge level of infrastructure across the nation. It is required to build multiple governorate levels of the hub to connect with the centralized system and

the governorate to connect at the more local level like district headquarter and villages. It will engage a high level of resources for the implementation of this kind of infrastructure. Proper communication and standardization are required to implement this kind of infrastructure to avoid redundancy. Fig.4 represents the setups of many data centers at the governorate and district level. These infrastructures will help to run the services of the cloud smoothly and securely at the end level.

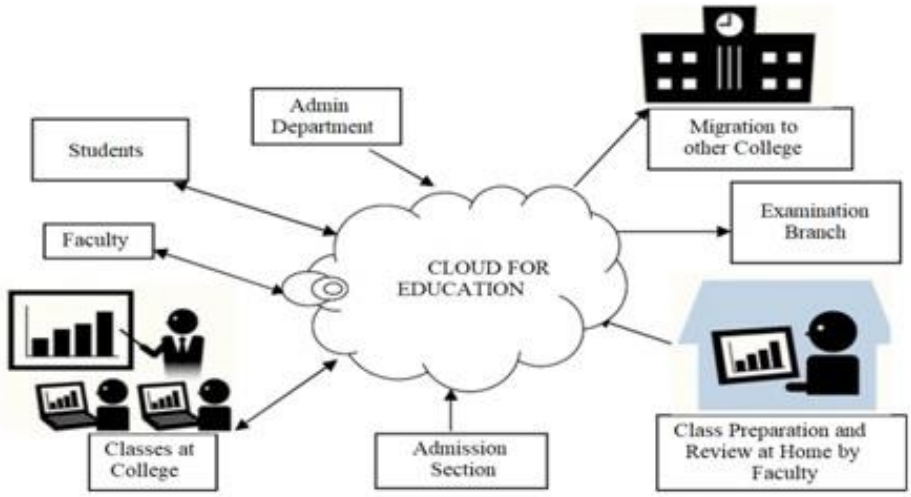

Fig. 4. Cloud in Education System

MeghRaj, is an official cloud for the government of India, provides a variety of services to users [1, 2]. The strategic aims and initiatives are to hosting government applications and required services on the cloud platform. A common and integrated platform can further enable native government and its local and governing bodies to adopt e-governance with the cloud computing model for interpreting enhanced citizen services, without the requirement of setting up any type of substantial IT infrastructure. It provides an opportunity for a country's information technology services sector by opening up a new opportunity of facilitating cloud-based services to global organizations ranging from "software as a service" that is based on catalog services.

We have conducted a study on many units of the two Universities of KSA namely, Majmaah University and Northern Border University. In this study, we have included people from various departments such as IT, finance, administration, academic staff, and technology expert people. In this study, we have included their opinion and feedback to collect the data for our research. From the IT department, we have collected the data related to various levels of licensing. Department has provided data for the product using the under-licensing category and freeware category. IT department also provides the data related to their operation effort. We have received the feedback from the maintenance department that how they manage various available product which is used in various level of services in the University. The finance department has provided their data for the costing of the product used in the organization. Based on the department feedback, we have compiled the data and defined them as a unit to hide the actual cost due to the confidentiality and secrecy rules of the organization. We have talked to many people that are service providers and users. They have provided information and data about any specific products and environmental maintenance. These summarized data is available in Table I and Table II.

A. Cloud Platform Benefits for Educational Institutions

An organization or department can take the service of a web server under the cloud platform. Cloud can provide a variety of web servers. There is no need to purchase anything except a subscription to cloud access of web servers. It will provide a full level of the control panel to the user and enables the user to perform the required activity for the web server. It will be highly available and able to access from anywhere using the internet.

It can be seen from Table I, cost incurs for the traditional system to deploy in the web-server for an application or system. It is assuming 1 as 1 unit for calculation of the available data and geographical representation of these data.

Total Cost = Hosting\License cost + Operational cost + Maintenance cost + other cost (Miscellaneous)

Apache HTTP Server Total Cost = 3+2+1+1 = 7
Apache Tomcat Server Total Cost = 4+2+1+1 = 8
IBM HTTP Server Total Cost = 8+3+2+1 = 14
Internet Information Services (IIS) Total Cost = 5+2+1+1 = 9
Oracle HTTP Server Total Cost = 6+2+1+1 = 10
Oracle WebLogic Server Total Cost = 7+3+2+1 = 13

TABLE II. WEB SERVERS DISTINGUISH COSTING.

S. No.	*Server Name*	*Developed By*	*SW License*	*Host\License*	*Operational*	*Maintenance*	*Other*	*Cloud*
1	Apache HTTP	Apache SW Foundation	Apache	3	2	1	1	1
2	Apache Tomcat	Apache SW Foundation	Apache	4	2	1	1	1
3	IBM HTTP	IBM	Non-Free Prop	8	3	2	1	2
4	IIS	Microsoft	Non-Free Prop	5	2	1	1	1
5	Oracle HTTP	Oracle Corp	Non-Free Prop	6	2	1	1	1
6	Oracle WebLogic	Oracle Corp (Formerly BEAS)	Non-Free Prop	7	3	2	1	2

TABLE III. WEB SERVERS TRADITIONAL AND CLOUD COSTING

S.No	*Web Server Name*	*Traditional or Legacy System Cost*	*Cloud Cost*
1	Apache HTTP	7	1
2	Apache Tomcat	8	1
3	IBM HTTP	14	2
4	IIS	9	1
5	Oracle HTTP	10	1
6	Oracle WebLogic	13	2

It can be seen from Table II that there is a huge cost reduction in the cloud system compared to traditional or legacy systems. Right now, it has been taken only one example of a web server as data and this is the primary and important component of the web application for hosting and running a simple web-based application. So, by analyzing the above important web servers that run independently on many platforms have cost variation as per their company and provider. It is shown that the cost of an Apache HTTP server is reduced from 70% to 10%. When Apache HTTP is used in the traditional system then it is costing almost 70% on the parameter of 100 while once that system moved in the cloud environment then it is reduced to 10% on the scale of 100. Similarly, by moving some other web servers like IIS. It is displaying its cost reduction can be possible from 90% to around 10%. From this study, a significant reduction has been noticed and can impact on overall costing of the system. So, it is displaying a significant change in cost by moving web servers from the traditional environment to the cloud system. Similarly, there is a chance of a huge reduction of cost for other web servers that are mainly used in the deployment of the web application for the organizations. Fig. 5 represents the costing graph of Web Servers.

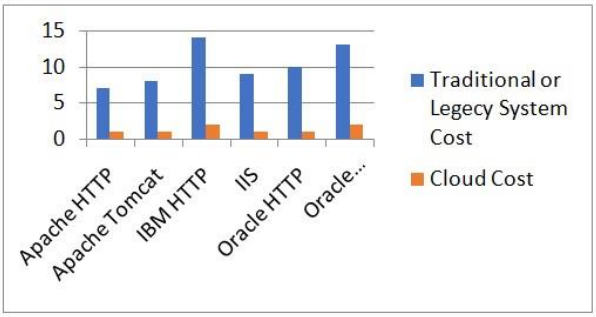

Fig. 5. Costing Graph of Web Servers

To run the traditional or legacy system there is a need for the different environments as per the roles and credential level of the user. Production, Quality (QA), Staging, and Development are the environments that will provide the application and system to the user as per their roles. In the traditional system, it is required to maintain every level of the environment with the full support of related software. That software includes languages, framework, web server, application server, and database server, etc. All items are different entities for the hosting on the same system or on different systems. It costs the organization in terms of managing resources and timing estimation.

TABLE IV. COSTING OF DIFFERENT APPLICATION ENVIRONMENTS

Environment Server	*Traditional\ Legacy Cost*	*Cloud Cost*
Production	10	2
QA	6	1
Staging	3	1
Development	2	1

The maintenance of the servers as per the provider organization for the different web servers is a critical job. Their maintenance in many environments is an important factor for any IT organization. These IT organizations maintain their environment as per the need of the business demand. The production environment of the organization is more critical compared to the QA environment. There are different kinds of facilities and factors involved in the maintenance service of these environments. So as per their criticality, their overall operational cost and total cost vary. A production environment needs more high availability as compared to the development environment. So, once an organization moves its environment from the traditional system to the cloud, its cost will be reduced. From Table III, it can be seen from the table that the overall cost of the production environment in the traditional system is reduced from 50% to 10% in the cloud system on a scale of 100. Other environments are less important than the production environment but there is a reasonable change in their cost as per their environments. So, To compare overall cost and for large infrastructure level setup of an organization. It will impact on complete costing of the project and system. Fig. 6 represents the costing graph of different application environments.

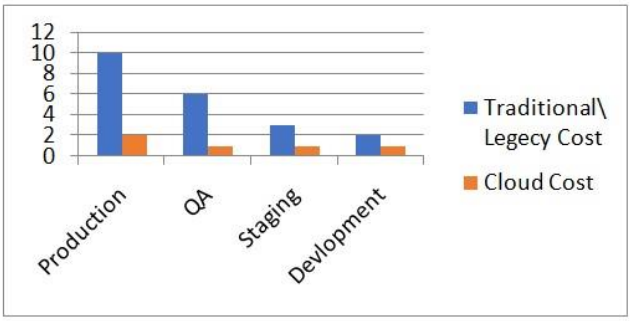

Fig. 6. Costing Graph of Different Application Environments

A database server is one of the most important parts of any application and system. If the database server gets impacts, then it impacted all the services related to the application and system. It should be highly available to maintain the services of the application and the system. The cloud platform provides highly available services to the user. The infrastructure of cloud designs in such a way, that if any part is impacted with any kind of interruption, it is balanced by another infrastructure allocated by the cloud platform. All the services on the cloud are efficient and effective as per the user requirement.

In a Cloud environment, it is easy to manage the related items of an application in a single window. It has more accessibility and user-friendly. It is easy to customize and personalize the role of user, developer, and client, or customer. It is required to purchase the subscription of resources and it can personalize to use for a specific user. If we see the services of cloud offerings, then there is no need for any organization to arrange the infrastructure to run any kind of service. Even if any kind of service is offered by the Cloud environment, then an organization or individual can segregate its need partially or fully. There are so many areas and scope of implementation of cloud computing. Service in the education department system then we have Elementary level education, middle-level education, and higher-level education. Now, under the e-governance plan, for higher-level education, higher education institutions develop intellectual capital knowledge and innovation is necessary for the development of an individual nation and society. The higher educational institutions contribute to the development of social capital such as good governance, rules, democracy, and society. Areas of the higher educational institutions of e-governance projects – Interaction required among various related entities like faculty, school, student and department, etc. It is required integration between various related departments like the human resource department, finance department, infrastructure department, information technology department, operation department, academic department, and administration department, etc.

5. STATISTICAL ANALYSIS AND EVALUATION

The organizational structure of a university in KSA can be seen in Fig.7. As can be seen many offices under the umbrella of the Rector include expert and consultant office, supervisor office, rector's office, directorate office, finance controller office, and many more. Each office work culture and nature of the work is entirely different. The finance control office has a different nature of work as compared to the office of human resources or office of administration. There is communication between them and outside the department, they have a different form, letter, and notification to communicate and instruct each other. Some tasks may be done manually and some partially manual and some fully machine-based or automatic. To complete these tasks there is a huge investment in an entity used for tasks such as paper used for the form, letter, and notification. There is an option for various applications and software for computerized flow. The finance department is using software which is different from human resource and administration or any other department. They use different licensing software for related tasks or applications and systems. It is required to build an infrastructure from software to a network to the server and others. It required a huge investment in each area of these items to support the application or system that is used by these offices. Cloud provides great help in this area. There is a need to study what kind of services are required for the task and check in the cloud platform software as a service section.

If it is available, then you need to take the only subscription of that service for the needed time. There is a need for the classification of our required services at a macro level to segregate them with the available cloud services. Similarly, there are many deanships and departments also present at the university. A detailed and comprehensive study is required for understanding the need for various deanships and

departments. Once all the areas are identified, it is required to classify all the present areas. Now it should look in the cloud platform which service can replace the existing service.

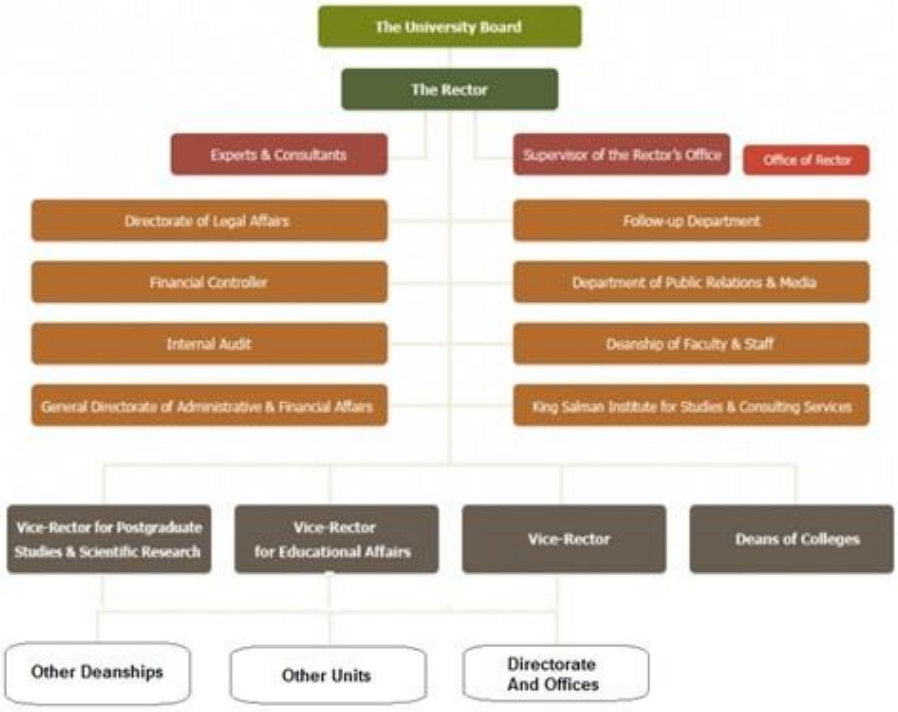

Fig. 7. KSA University Organizational Structure

TABLE V. SUMMARIZES THE COST COMPARISON AMONG MANUAL COST, AUTOMATIC COST, AND CLOUD COST.

S. No.	*Offices*	*Number of Units*	*Manual Cost*	*Automatic Cost*	*Cloud Cost*
1	Rectors' Office	1	10	10	2
2	Rectors' Admin Office	5	15	10	4
3	Vice Rectors' Office	4	12	8	4
4	Admins' Office	3	9	6	3
5	Colleges	7	21	14	7
6	Deanships'	10	40	25	10
7	Others	3	6	4	2

Table IV, summarizes the cost comparison among Manual cost, Automatic cost, and Cloud cost. We consider the unit cost and hide the actual cost due to the secrecy of the organization.

It has been taken the university and their associated bodies and calculated their expenditure on manual services and automatic services. It has taken 1 unit as 1 cost value in the calculation. So, there are two types of costs reflecting to provide the services are one which will incur manual service and another on automated services which are supported by various software and application. Now if it analyzes in the cloud platform then it can see mostly services are available in various resources of the cloud platform. Let us assume that it is only matching available in 40-60 % in (SaaS) then it can go for a Platform as a service (PaaS) for remaining [8, 9, 10, 15]. This is still a cheaper and highly available service provided by a cloud. Here it can develop and customize services as per needs. There is a need for only subscriptions and use resources for this service. It can be accessed from anywhere using the internet. It will save a huge resource in terms of monetary, time, and human resources. There are multiple costs involved in the development, operation, and maintenance of services. In the cloud under one subscription, all the costs are included. There is no hidden cost. Even it is incurred when it is used. A lot of varieties of subscriptions available from the cloud side to attract the legacy system's client and customer. Fig. 8 represents the cost comparison among manual, automatic and cloud.

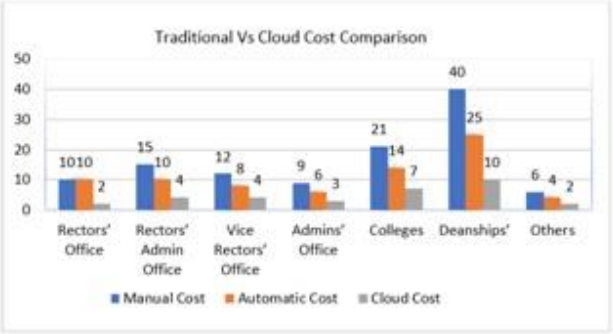

Fig. 8. Manual, Automatic, and Cloud Cost Comparison

The government of the KSA engages in an e-governance plan and transformation process that leads to its realization; to reduce costs, improve services, save time, increase effectiveness and efficiency across the organizations. As a result, the government of the KSA has already started the process of implementing an e-government strategy. 'YESSER' has been the umbrella organization and the overall controller of all procedures, activities, and all other issues and acts related to e-government implementation in the Kingdom [6, 10, 11, 15]. Cloud computing promises to significantly improve government functions, the services it provides to its citizens and institutions, and its cooperation with other government organizations and their agencies. The general claimed benefits of cloud computing include: cost efficiency, almost unlimited storage, backup and recovery, automatic software integration, ease of access to information, quick deployment, the easier scale of services, and delivery of new services. Despite recent considerable investments to develop its ICT infrastructure, it is still behind when it comes to the adoption of cloud computing.

Recently, the KSA government has established a special committee to develop the necessary regulations for the cloud paradigm, to facilitate its adoption across governmental organizations [4] [11]. This study will help to fill this gap in the literature by researching the impact of the key adoption issues in KSA (both beneficial and detrimental).

The findings will be helpful for decision-makers inside the country's organizations in terms of adopting cloud computing and it will also be useful for IT managers/CTOs/CIOs who may be considering cloud computing deployment in their business and organization.

Fig. 9 shows, a high-level understanding of the cloud implementation for the traditional and manual services under the policy of e-governance.

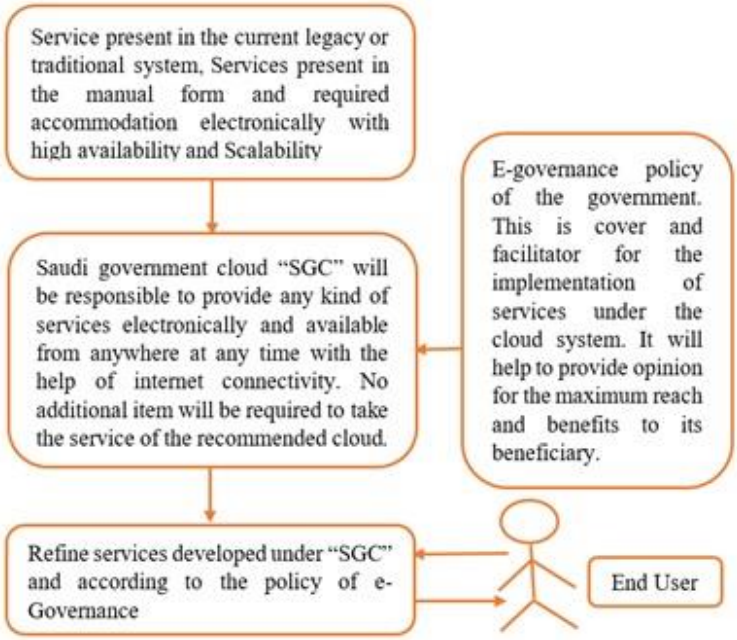

Fig. 9. Recommended Cloud System

6. CONCLUSION

In this paper, the authors have reviewed the present capacity of the cloud facility provided by the various agencies and recommended a national level of cloud platform i.e. Saudi Government Cloud "SGC". The authors also discussed and analyze the various services of government organizations. The e-governance program of government is to provide the various services of government-related organizations electronically with high availability and easily accessible from anywhere. We have recommended and presented an example to analyze the present government services under the traditional or legacy system. It is required to collect the nature and functioning of existing services and then properly assemble them. As we are collecting various kinds of data, there is a need to arrange those data as per the framework of the e-governance program of KSA and the services of the cloud platform. Data classification is very important because until and unless we are not able to classify and categorize

data, we cannot recognize which cloud services are required for the present traditional and legacy services. There is a need to make certain kinds of analytical tools under the guidance of e-governance and cloud which show that present services can be accommodated in this kind of cloud service and this policy of e-governance. The analytical results show the comparison of data from various electronic models and technology that are used to achieve traditional services and applications or systems in electronic format. It is analyzing the most important factor of a system costing and timing of a system. The Saudi government is currently under the reforming process and focusing on the vision 2030 [3]. It is required to open the working area at multiple fronts as we need to provide the classified data and information as per the Saudi Vision 2030. It is required to rationalize the related factor of the required services under the policy of e-governance. Finally, we summarize our paper in which the following recommendations must be taken to design the recommended cloud system given in Fig. 9.

1. Prepare a plan for the initiative of Saudi Government Cloud i.e. "SGC"
2. Prepare teams consisting of various subject matter experts, especially from the area of technology, cloud, and e-governance side.
3. Include the team to implement the "SGC".
4. Include the team to study the present existing services.
5. Classify the services and accommodate under the platform of "SGC" and according to a policy of e-governance.

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