

# Bahrain Cloud Transformation: Cloud First in eGovernment

Harikrishnan Sugumaran <sup>1</sup> and Dr. Khalid Ahmed Al-Mutawha<sup>2</sup>

IT Governance Architect<sup>1</sup> and Director of EA & IT<sup>2</sup>

Information eGovernment Authority, Kingdom of Bahrain

## Abstract

In Information and Communications Technology (ICT), we are having been talking about how ICT is supporting innovation, driving change and transforming the way we work. This is as true for the both public and private sector. The Kingdom of Bahrain understand very well that the customers expect government services to be responsive to their needs and available where and when they want them. Key to realizing this vision is the effective use of ICT by government, including the adoption of cloud services.

To do this, government agencies/ entities to think and act smarter when it comes to investing in ICT. The availability of cloud services offers an opportunity for government to deliver services more efficiently, as well as providing services that are more responsive to business and community needs. A lot of exclusive features such as high functionality and low cost have made cloud computing a valuable technology. These remarkable features give users and companies, countless opportunities to reach their goals spending minimum cost and time.

Kingdom of Bahrain aims is to drive a greater take up of cloud services by government agencies by adopting a '**cloud first**' approach. Agencies/ entities now must adopt cloud where it is fit for purpose, provides adequate protection of data and delivers value for money.

## Keywords

Bahrain Cloud Transformation, Cloud Computing, Bahrain Cloud, Bahrain Cloud First Policy, Bahrain Cloud First, eGovernment and Cloud Computing, Cloud Benefits, Cloud Challenges;

## Introduction

Kingdom of Bahrain **VISION 2030** and Information eGovernment Authority strategy has led to the creation of common ICT infrastructure such as Government Data Networks (GDN), National Data Centres (NDCs) and Common Service Centres as well as development of guidelines and standards to ensure interoperability, standardization and integration of various services to provide a single face of the government to the people.

The Government Cloud is envisaged to be established initially on national data centre assets (adapted for the cloud through virtualization) and connected through existing network infrastructure such as the **GDNs**, as well as the internet. Based on demand

assessment and taking into account security related considerations, government may also engage the services of private cloud providers.

The Government Cloud will provide services to government departments, citizens and businesses through internet as well as mobile connectivity. In addition to accelerating the delivery of e-services to citizens and businesses, the government's cloud-based service delivery platform will also support a number of other objectives including increased standardization, interoperability and integration, a move towards an opex model, the pooling of scarce, under-utilized resources and the spread of best practices. It will also support on-going cost effectiveness and manageability.

The Kingdom of Bahrain's ***His Highness Shaikh Mohammed bin Mubarak Al Khalifa, Deputy Prime Minister, Chairman of the Supreme Committee for Information and Communication Technology (SCICT)*** has endorsed Cloud First approach and envisioned with cloud computing there is considerable scope of speeding up the development and roll out of e-Governance applications, enhancing agility in customizing and deploying ICT to meet specific business needs, while at the same time increasing government ICT efficiency (through re-use and economies of scale).

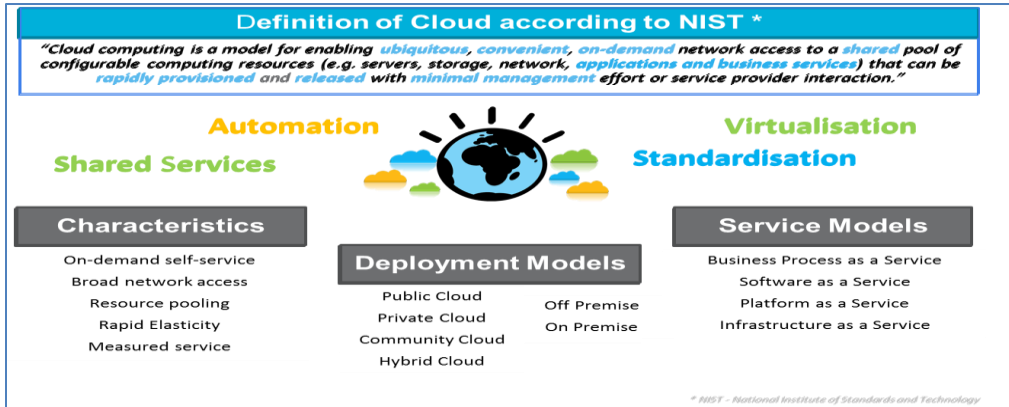
For realizing this vision and to establish the envisaged cloud computing platform, a well-defined adoption strategy and roadmap are critical.

## **Overview and Definition of Cloud Computing**

There are many different definitions for cloud computing. The Kingdom of Bahrain government has adopted the **National Institute of Standards and Technology (NIST)** definition that defines cloud computing as:

***“A model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources (e.g. networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction.”***

This section provides a brief overview of the essential characteristics of cloud computing together with the cloud service and deployment models. It is recommended that agencies familiarize themselves with the NIST definitions to ensure that they are able to identify and understand the risks associated with different cloud service and deployment models.



## Essential Characteristics

The following provides an overview of the five essential characteristics for cloud computing as defined by NIST:

- **On-Demand Self-Service** – customers are able to provision resources (e.g. a virtual server or email account) without any interaction with the service provider’s.
- **Broad Network Access** – customers are able to access resources over networks such as the Internet using a ubiquitous client (e.g. a web browser) from a range of client devices (e.g. smartphones, tablets, laptops).
- **Resource Pooling** – the service provider’s computing resources are pooled to serve multiple customers. Typically, virtualization technologies are used to facilitate multi-tenancy and enable computing resources to be dynamically assigned and reallocated based on customer demand.
- **Rapid Elasticity** – resources can be quickly provisioned and released, sometimes automatically, based on demand. Customers can easily increase or decrease their use of a cloud service to meet their current needs.
- **Measured Service** – customers pay only for the resources they actually use within the service. Typically, the service provider will supply customers with a dashboard so that they can track their usage.

## Deployment Models:

- **Public cloud** - The cloud infrastructure is provisioned for open use by the general public. It may be owned, managed, and operated by a business, academic, or government organization, or some combination of them. It exists on the premises of the cloud provider.
- **Private cloud** - The cloud infrastructure is provisioned for exclusive use by a single organization comprising multiple consumers (e.g., business units). It may be owned, managed, and operated by the organization, a third party, or some combination of them, and it may exist on or off premises.
- **Community cloud** - The cloud infrastructure is provisioned for exclusive use by a specific community of consumers from organizations that have shared concerns (e.g., mission, security requirements, policy, and compliance considerations). It may be owned, managed, and operated by one or more of the organizations in the community, a third party, or some combination of them, and it may exist on or off premises.

- **Hybrid cloud** - The cloud infrastructure is a composition of two or more distinct cloud infrastructures (private, community, or public) that remain unique entities, but are bound together by standardized or proprietary technology that enables data and application portability (e.g. cloud bursting for load balancing between clouds).

### Service Models:

- **Business Process as a Service (BPaaS)** - The capability provided to the consumer is any type of horizontal or vertical business process that's delivered based on the cloud services model. These cloud services — which include Software as a Service (SaaS), Platform as a Service (PaaS), and Infrastructure as a Service (IaaS) — are therefore dependent on related services.
- **Software as a Service (SaaS)** - The capability provided to the consumer is to use the provider's applications running on a cloud infrastructure. The applications are accessible from various client devices through either a thin client interface, such as a web browser (e.g., web-based email), or a program interface. The consumer does not manage or control the underlying cloud infrastructure including network, servers, operating systems, storage, or even individual application capabilities, with the possible exception of limited user-specific application configuration settings.
- **Platform as a Service (PaaS)** - The capability provided to the consumer is to deploy onto the cloud infrastructure consumer-created or acquired applications created using programming languages, libraries, services, and tools supported by the provider. The consumer does not manage or control the underlying cloud infrastructure including network, servers, operating systems, or storage, but has control over the deployed applications and possibly configuration settings for the application-hosting environment.
- **Infrastructure as a Service (IaaS)** - The capability provided to the consumer is to provision processing, storage, networks, and other fundamental computing resources where the consumer is able to deploy and run arbitrary software, which can include operating systems and applications. The consumer does not manage or control the underlying cloud infrastructure but has control over operating systems, storage, and deployed applications; and possibly limited control of select networking components (e.g., host firewalls).

## eGovernment and Cloud Computing

Governments throughout the world are promoting services in the best possible way to perform daily activities, especially in government's offices that have direct interaction with citizens. The use of the latest technologies is critical to reduce required time for the processing processes and in order to improve interaction with citizens through providing efficient and effective services. E-government can change the provided services to citizens, Provide access to information for citizens, and enable them to participate in the economic and social opportunities So that they can make a better life for themselves and future generations. Today, the use of ICT in order to improve efficiency and effectiveness, transparency and comparability of financial and information exchanges within the government, between the government and its subordinate organizations, between government and citizens, and between

government and the private sector, is called "E-government". E-government provides the government processes such as digitization of government records, automation of tax collection, receive community feedback, information dissemination collection of data / information, etc. with the use of modern information and communications technologies such as the Internet, local and global network, Mobile, etc. 24 hours a day.

Realization of E-government projects is done aimed at achieving different goals and these goals are meant to observe the following principles:

- improve and increase providing governmental services
- empower citizens through access to information and the government's ability to interact and collaborate
- achieving greater transparency and accountability of government
- Improvement of internal relationship between the government and the citizens' electronic delivery

Many countries have attempted to implement e-government to realize their goals with the principles mentioned above.

It shows that governments provide more advanced e-service delivery, better access to information, more efficient management and improved interactions with peoples, primarily as a result of increasing use by the public sector of information and communications technology.

In the previous two sections the concept of cloud computing and e-government have been discussed, now with the understanding achieved from cloud computing the implementation of e-government challenges and benefits of this technology will be examined.

### **E-Government over the concept of Cloud Computing**

Cloud computing can be a choice of interest for a government with a view to become e-government and to be effective and proactive regarding to the change that happens in the area of Information technology. E-government is a process of reform in the way how governments work, share information, engage citizens and deliver services to external and internal clients while the government and clients that they serve benefit from this way of working.

Many governments worked on projects to adopt the concept of cloud computing, for example: Australia, USA where administration started a project related to cloud computing for identifying services that can use cloud computing, United Kingdom where a project for adopting cloud computing was started with the objective to reduce its administrative costs, Canada, New Zealand, Japan which that work on project for various ministries to share platforms and infrastructure. In Europe, countries that are among the leaders in adopting cloud computing for e-governance working are France, Sweden and Spain.

E-government realized through the concept of cloud computing offers an effective way of sharing information to the citizens and businesses, helps budget management and decision makers, reduces its efforts of providing services and effectively utilizes

resources provided by its services. The government's ministries, interested in the environmental pollution and involved in the "Go green" projects, collaborate with each other through cloud computing, using a common infrastructure, platform and applications and delivering cost-effective services to the public. All of these efforts can drive the growth of the economy and government productivity.

E-government's services provided over the concept of cloud computing need to be automated. E-government's services fall into the following categories:

- **Government to Government (G2G):** Interaction between government organizations, departments and ministries with the intention to exchange information, to collaborate, to deliver services and so on. Typically, when some services from this category are provided, the level of message passing across government organizations, departments and ministries is really high.
- **Government to Enterprise (G2E):** Services that belong to this category are delivered to the enterprises. Enterprises need to react according to the policies implemented in those services and those services are controlled by the government. The high level of law enforcement is one of the main characteristics for the G2E services.
- **Government to Business (G2B):** Government provides services for the businesses over creating and managing contracts for business working.
- **Government to Citizens (G2C):** Government provides innumerable services from this category for the citizens. In this category, different government's departments offer various services for the citizens.

With the e-government adoption of cloud computing, all government's services are virtualized. Because e-Government requires 24/7 hours infrastructure availability, with cloud computing this can be achieved. Also cloud computing application offers unlimited supply of data storage, CPU, memory and bandwidth.

## Benefits of using Cloud for eGovernment

Cloud computing technologies have many benefits in different parts of e-government. These benefits are not limited to the contents discussed in this section.

### A. Rapid Elasticity

Cloud computing is designed to provide services with unlimited scalability which is regarded as one of its basic features. Customers have access to a huge pool of virtual resources which allows them to respond to unpredictable periods of peak load with an efficient, flexible and cost-effective method. Therefore, performance and economic stability is balanced. In addition, cloud computing resources can be purchased automatically in any quantity at any time.

### B. Protection, Care and Technical Support

Cloud computing service providers are hosts to applications and purchased servers. They are also responsible for updating software and provide technical support. The beauty of Cloud is appearing here to solve problems of e-government especially for small government department's outskirts of cities because employment of trained troops is not economical and also Professionals preferring not to work in such remote areas. Moreover, in the cloud technology it is not necessary to update the software applications over a single computer. This work will lead to save cost and time, and requires less trained personnel for developing countries and will increase system efficiency (by preventing maintenance errors) and its effectiveness.

### C. Cost and Efficiency

The service models of cloud computing have focused to provide economical services to companies and Government agencies. It creates an opportunity to change from costs of investment to operating costs by reducing the cost of purchasing very expensive systems and employ professional employees to manage and maintain. Hence one of the major barriers of having a huge and expensive technology infrastructure will be reduced and new opportunities for investment in developing countries will increase further.

#### **D. Auditing and Logging**

Traceability any change to contains of information is necessary in e-government services. Corruption in government agencies can be controlled with using information technology services and by responsibilities of service providers. Auditing process, security audits should be performed periodically to ensure system security. Cloud can help in analyzing huge volumes of data and detecting any fraud. This can help to build defense mechanisms to enhance the security, therefore applications are made available and reliable.

#### **E. Disaster Recovery**

This is really a critical issue for the survival of many organizations to ensure whether have the ability to survive at events Caused by their IT infrastructure or not. Disaster recovery programs in clouds provide more options than traditional disaster recovery model for organizations to restore information very quickly and effectively. At this type of disaster recovery costs and recovery time are reduced. Governments can store a backup of the server using the cloud as a backup for disaster recovery, daily basis and also can store it off-site using a third party storage service provider that has the ability to save in a different location.

#### **F. Reporting and intelligently**

Data Center (CPU, storage, network, etc.), the peak load, Consumption level, Use of energy along with time, are some factors That monitoring and reporting are necessary for better resource utilization. This minimizes costs and scheduling. Profiling data makes various services provided by the government visible. Cloud provides the Best Smart Infrastructure Business in comparison with previous methods because it has its extent and functionality. Applications can extract large amounts of real time and reliable data to make the best decisions for providing better services.

#### **G. Policies Management**

E-government applications have to implement Policies raised by the government facing citizens. These policies should be implemented Along with infrastructures and data centers to improve the daily performance. Cloud architecture is helping to implement this policy in a data center. Security-related policies deploy applications, etc. Can be designed and implemented in the data center.

#### **H. Systems Integration and Software LEGACY**

Not only applications and offered services are transferred to the cloud, it also integrates with cloud-based applications. Powers of IT are data correlation across applications and messages transmit in different systems to provide faster services to end users. Cloud is built based on the principles of SOA and can provide excellent solutions to integrate various applications. Also, applications can be seamlessly easily transferred into cloud.

#### **I. Old technologies and Migrating to New Technologies**

Transition from an old technology to a new one is always challenging. Using different versions of software, programs and security packages, is one of the nuances in the data center's security maintain in e-government. E-government applications due to existence of Security and adaptability, Can manage the proposed policies using cloud. Different types of e-government applications are simply integrated. Cloud architecture provides ability to run different versions of software at same time. After testing these applications they can enter the production phase.

## **J. Green technology**

The use of ICT systems in the public sector has created a negative impact on the eco So that rate of carbon dioxide increases and requires more power consumption. Cloud computing is relatively good in energy consumption and provides eco-systems through virtual services. Using Virtual Services, power consumption of an ordinary PC is reduced to 90%. Nowadays much attention has been paid to the effects of data centers. Power consumption and e-waste in the air can bring environmental hazards. This could be one reason for the government's move towards cloud. Cloud rather than building new facilities, provides the possibility of centralizing the existing facilities.

## **K. Security**

The cloud computing which is presented after technologies such as service-oriented architecture brings not only the benefits of these technologies, but it is trying to fix their flaws as well. To implement e-government, one of the major challenges of governments, was security issue particularly data security which before cloud computing created many problems including disruption of servers or data centers, lack of access to certain services at certain times of year, such as voting and election days for governments and users but Implementation of cloud computing includes advanced security technologies. Having a pool of resources enables cloud providers to concentrate on all of the security resources in order to secure the environment. Also, the automation within the cloud along with focused security resources creates advanced security features. Nevertheless, no system can fully ensure the security.

## **Challenges in eGovernment and cloud computing**

An effective eGovernment system should be Reliable, economical and easy maintenance. The government can use the powers and abilities of cloud to cover some communication gaps, especially relation to those of the citizens who reside in remote areas. Cloud can also be used to increase collaboration between different organizations within the government, reduce data redundancy and track and monitor the effectiveness of government plans. Sharing the computational resources between the central government and the states will lead to a reduction in infrastructure costs. Transparency in government can quickly be achieved through the adoption of cloud. Cloud has a lot of potential in this section and its benefits will come not only to themselves but also to the millions of people.

E-government automatically provides an integrated management with cloud computing by solving resolution problems and helps to reduce the budget based on the actual use of the data. The cloud architecture can help the government to reduce repetitive operations and increase the effective use of resources, in the global arena. These matters in their turn have an effective aid to create a green government, reduce pollution and waste management. Currently companies and small businesses are using the benefits of cloud based on pay-as-you-use service model which is available in a wide scale. Effective challenges in e-government are classified into three groups that include social, economic and political barriers. These barriers limit the scope of policymakers' activity for effective use of new technologies. There are number of technical challenges such as data scaling, auditing and logging, replication and migration, disaster recovery, management policies, system integration, legacy software, Obsoleted technologies and migration to new technologies. Cloud computing is appropriate to respond to these challenges. Cloud Database provides on-demand and high scalability. Which holds a large number of records that is the basic need in government. Cloud provides the ability



to audit event, Login and report information about the tenant and based on program which recognizes fraud and corruption in government agencies. This can help in creating mechanisms for security increasement. There for reliable and accessible applications can be created. Facilitate proliferation and migration of applications is possible with virtualization technologies in the cloud which is useful in disaster recovery and reduction of time to establishment new softwares. Cloud provides tools and technology which simples and Eases the disaster recovery.

## Bahrain Cloud First

The Bahraini Government is committed to modernizing government information and communication technologies (ICTs) and will lead by example in using cloud computing services to reduce costs, increase security, increase productivity, and develop excellent citizen services to adopt a Cloud-First approach with the aim of:

- Reducing the cost of government ICT by eliminating duplication of solutions and fragmentation in the technology environment, and leveraging the efficiencies of on-demand provisioning of ICT services;
- Increasing security by using accredited platforms;
- Increasing productivity and agility, and thus improving citizen services.

***“Government entities / departments first evaluate the option of using the government Cloud for implementation of all new projects funded by the government. Existing applications, services and projects be evaluated to assess whether they should migrate to the government Cloud.”***

In order to achieve this, all government agencies of the Kingdom of Bahrain will evaluate cloud-based services when undertaking all ICT procurements. The decision on the appropriate ICT delivery model will be based on an assessment of each application, incorporating fitment of purpose, cost benefit analysis and achieving value for money over the life of the investment. This assessment is best achieved by using any of the well-established tools available in the market, either from the identified cloud service provider and/or a non-attached third party.

## Objectives

Kingdom of Bahrain’s objectives in adopting a cloud computing strategy is as follows:

- Optimum utilization of infrastructure
- Speeding up the development and deployment of eGov applications
- Easy replication of successful applications across government departments to avoid duplication of effort and cost in development of similar applications
- Develop training to transition staff from administrator roles to cloud and DevOps engineering roles
- Lead staff transition process and create an empowered, service focused culture
- Migrate existing app workloads with a goal of x% of existing compute from on premise data centers to the public cloud
- Establish operational toolsets and processes to ensure operational effectiveness, awareness, and partnership with service teams

## Key Drivers / Purpose of Policy

This policy provides guidance to all government entities in the Kingdom of Bahrain, as the Kingdom moves towards a common operating environment for all government entities, leading to:

- **Reduction** in cost for both hardware and platforms. Outsourcing government services to cloud computing results in immediate reductions of large capital outlays for infrastructure and maintenance costs. Up to date, best of class solutions also become immediately available to government agencies through cloud provisioning.
- **Improved manageability and productivity of ICT solutions.** Government ICT resiliency and security is improved and made consistent with upgrades to both hardware and software being managed by the service provider.
- **Better integration between services.** More effective collaboration is enabled as agencies are more easily able to share resources across institutions, improving efficiency, and enabling creativity in delivering public services.
- **Operational continuity and business recovery.** With centralized and redundant data storage and backups, business recovery and data retrieval during times of crisis becomes faster and more cost effective.
- **Greater budget control.** A ‘pay for what you use’ model means that government agencies can purchase as much or as little resource as needed, and only when needed. Cloud scalability results in systems usage being dialed up or down as it is required. Transparency of the utility-based pricing structure means that spending caps and alerts can be implemented to further assist in budget control.
- **Greater agility.** Cloud computing streamlines development, support and hosting of ICT solutions, resulting in improved service performance and faster deployment of services. It reduces the amounts of ICT infrastructure required to be built and owned by government agencies, shifting the focus from management of infrastructure to delivery of services.

## Cloud First Policy Principles

This policy is based on the following driving principles:

- ICT at entity level must focus on functional excellence and delivering higher business value
- ICT Infrastructure is one key candidate for national level consolidation and optimization
- Standardized infrastructure management enables
  - optimization of infrastructure cost
  - Improvement in service quality
  - improved security
  - efficient business continuity
- Promote holistic “**cloud first**” approach while respecting the Kingdom of Bahrain and every ministries roles, legislation, and mandates.

The following rationale of this principle applies to:

- To reduce redundancy and associated complexity across the ministries and agencies
- To design IT infrastructure with a "one or integrated government" approach, to facilitate changes in government business processes in an easier and quicker way

- Enable cost optimization and risk reduction across government through leveraging common platform and information systems for cross-government service delivery

## Assessing Cloud Suitability: The Cloud Buyer’s Decision Tree (Informative)

Cloud computing can bring business benefits to across government organizations. It is, however, not always the right solution, and there are several forms of cloud computing, which have different advantages in different situations.

Is cloud computing right for you? If it is, should you be considering BPaaS, IaaS, PaaS, or SaaS? Should you use public, private, community, or hybrid cloud?

If you determine that cloud computing is not a good fit, you should review the following solution considerations.

- If you have custom or specialized hardware or operating system, but off-the-shelf applications, then no form of cloud computing is likely to be a good fit for your requirements. Nor is BPO or infrastructure outsourcing.
- You might, however, consider outsourcing data center operations, IT management, governance, middleware, and data storage. Outsourced application management could work for you if you can use a standard application development platform.
- You might also consider hardware appliances and virtualization.

Outsourcing (including BPO) can deliver some of the commercial and organizational benefits of cloud computing, including reduced capital expenditure (CAPEX) and access to large pools of expertise for specialist tasks. Hardware appliances and virtualization can deliver some of the technical benefits, including the ability to deploy additional resources when needed, and more effective resource utilization.

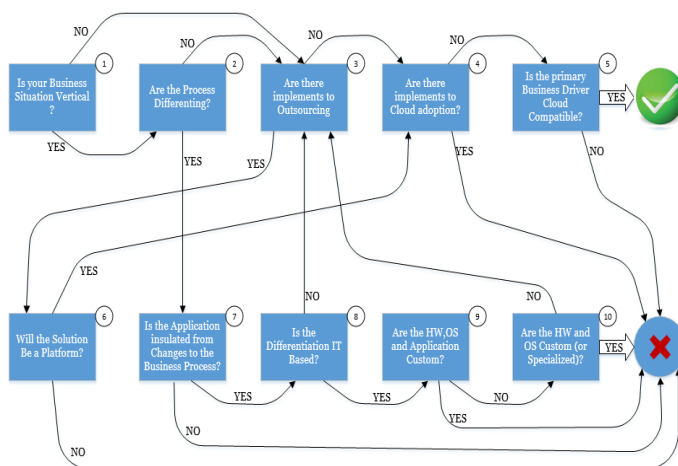


Figure 1 : Deciding on Cloud Solution

solution, may emerge when you develop a detailed architecture

[Appendix A](#) section which presents a decision tree that helps you to determine whether cloud computing belongs in your vision. It makes the connection between the business use and the enabling cloud technology.

It is an aid to decision-making, not a definitive algorithm. Further considerations, either for or against a cloud

## Benefits of Cloud Architecture & Considerations (Informative)

### Traditional IT Compared to Cloud Computing

The following table shows some of the characteristics of traditional IT compared to Cloud-Computing.

Traditional IT	Cloud Computing
<ul style="list-style-type: none"> <li>• Hardware is hosted on the premises of the organization and/or managed hosted.</li> </ul>	<ul style="list-style-type: none"> <li>• Hardware and/or software is hosted off-premise (public or hybrid) or on-premise as a private Cloud service.</li> </ul>
<ul style="list-style-type: none"> <li>• Hardware and software is provisioned for peak demand.</li> </ul>	<ul style="list-style-type: none"> <li>• Services are provisioned and used based on actual demand, providing this elasticity as a managed service.</li> </ul>
<ul style="list-style-type: none"> <li>• Service management monitoring is used to generate forecasts of demand usage and current SLA performance.</li> </ul>	<ul style="list-style-type: none"> <li>• Services are typically focused on short-term “burst” demand to gain cost savings over provisioning and owning the assets.</li> </ul>
<ul style="list-style-type: none"> <li>• Chargebacks and compensations are used to adjust usage and payments.</li> </ul>	<ul style="list-style-type: none"> <li>• Statistical automated scaling is used to optimize the shared virtual assets.</li> </ul>
<ul style="list-style-type: none"> <li>• Under-provisioning and over-provisioning of capacity can result from unforeseen demand changes.</li> </ul>	<ul style="list-style-type: none"> <li>• Risk is transferred from the buyer to the seller/provider of the Cloud service.</li> </ul>
<ul style="list-style-type: none"> <li>• Business invests in ownership of assets that can be enhanced and extended through IT programs and development.</li> </ul>	<ul style="list-style-type: none"> <li>• Cloud sellers and providers seek to grow amortized economies of scale through increasing the numbers of users of the shared resources.</li> </ul>
<ul style="list-style-type: none"> <li>• Changes to IT involve migration and divestment/investment issues and programs.</li> </ul>	<ul style="list-style-type: none"> <li>• The IT infrastructure and operation are masked from the service user. Cloud is more than just SaaS.</li> </ul>

**Table 1 : Traditional IT vs Cloud Computing**

In a traditional architecture, the services offered are bound to a physical machine. One has to maintain the redundancy in terms of the physical services. This model

increases the cost of deployment and becomes expensive to maintain as number of services increase.

Cloud computing offers:

- On-demand self-sufficient service
- Ubiquitous network access
- Location independent resource
- Rapid elasticity

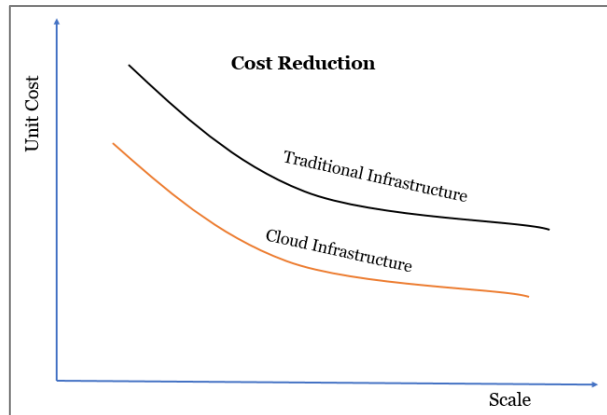


Figure 2: Reducing Cost Compare to Traditional IT

Cloud is making rapid inroads because of the following advantages:

- Can reduce IT labor cost by 50% in configuration, operations, management and monitoring
- Can improve capital utilization by 75%, significantly reducing license costs
- Reduce provisioning cycle times from weeks to minutes
- Can reduce end user IT support costs by up to 40%

In a traditional infrastructure there will be one instance of application per physical server and has an average utilization of 10%. Cloud not only automates the maintenance and manual operations, but also raises the utilization rate by 50% and offers full virtualization.

### Cloud Economics

A large portion of cloud architecture savings are associated with labor reductions derived through automation enabled by a service management system. With cloud, the services are visualized, in such a way that the services can be moved from physical server to other based on the policies. In addition to servers, cloud architectures provide access, storage and backup services that can be utilized by the unified eGovernance infrastructure.

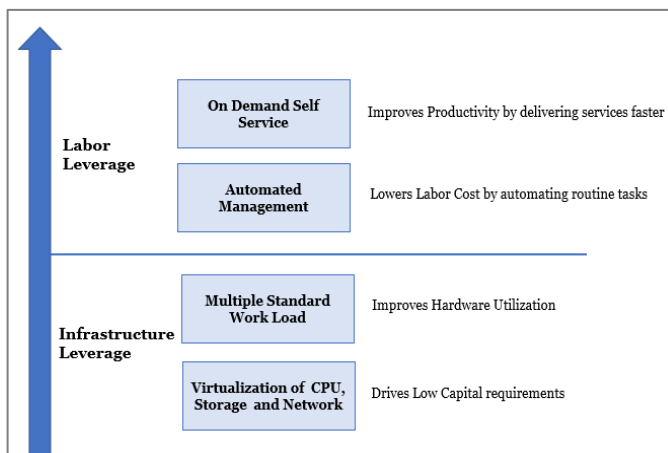


Figure 3 :Cloud Economics

Infrastructure leverage and centralized management offers good benefits. The major factors that drive cost reduction are shown in Figure 3.

## Service Management

A service management system provides the visibility, control and automation needed for delivery in both public and private implementations. Cloud unlocks the following benefits compared to a traditional infrastructure.

- **Simplified user interaction with IT:** Its user friendly self-interface accelerates time to value. The service catalog enables standards which drive consistent service delivery and provides enhanced transparency and accountability.
- **Provisioning enables policies to lower cost:** The automated provisioning and de-provisioning speeds service delivery. The provisioning of policies allows release and reuse of assets. Its centralized identity and across control policies provides fast and affordable adherence to security compliance.
- **Increase system administrator productivity:** The productivity increase is attributed from its move from management silos to a service management system
- **Improve service delivery to the citizens in their constituencies:** Provides improved informational services to citizens.
- **Automate virtual infrastructure for peak performance:** Virtual infrastructure will accelerate provisioning time by 50 to 70%. It manages virtual machine from a central location and monitors the performance of these machines and their hosts. We can have live migration of applications from one virtual host to the other. It also enables dynamic policy-based allocation of IT resources with automated load balancing and eliminates the repetitive configuration and maintenance tasks.
- **Reduce costs:** We can reduce costs by consolidating hardware and increase server utilization. Server utilization can go up from 5-15% up to 80% based on workloads. We can measure the performance and availability of critical virtual server resources, correlate events and understand the impact of problems on the eGovernance by saving on power consumption. And also analyze costs, budget, plan, track, allocate and invoice by department, user and many additional criteria by efficient management of resource & assets.

Service catalog drives standards by standardizing on hardware, software, platforms and storage. During deployment, one can get an environment when needed with an outstanding user experience's standard services avoid unexpected problems as well.

## Considerations

This section provides considerations that are significant in the development of Cloud Architecture for the enterprise /organization.

### *Security Considerations*

Cloud has extended enterprise boundaries and the security of enterprise information/data is one of the primary issues surrounding cloud adoption. Security boundaries are extended from a self-managed environment to an external and somewhat untrusted environment of the cloud. Some of the security considerations are:

- Ability to secure intellectual property and capital assets
- Evolve the security capabilities to support cloud deployment

- Effectively manage confidential information and apply regulatory policy requirements (records management)
- Define an approach for how to enable policy-based service delivery
- Considerations for Identity, Entitlement, and Access Management (IEM) and/or Role-Based Access Control (RBAC) for the enterprise.

### ***Business Considerations***

Some of the strategic business objectives for consideration include:

- Allow the CIO to focus on business information and applications providing direct business value to all stakeholders, rather than supporting platform and infrastructure
- Reduce or eliminate continuously evolving IT infrastructure investments
- Efficient management of business processes
- Seamless collaboration and integration capabilities with partners, suppliers, and back-office
- Standardization of business processes for consistent and cost-effective use (standardized capabilities consumed by all applications; hide implementation complexity of core business capabilities)

### **Business Excellence**

The following business objectives are targeted by enterprises in order to capitalize on the cloud computing IT delivery model to achieve business excellence:

- Rapid business service enablement
- Cost-effective and standardized service models (standard process, tools, and technology)
- Built-in self-service accessibility capabilities
- Lower total cost of ownership

Gain higher cash flow since capital expenditures on Cloud Services are typically lower as they are based on the pay-as-you-go pricing model. At the same time, there are challenges/considerations that need to be resolved to achieve target business agility. Some of those challenges are:

- How business capabilities, both existing and new, are to be assembled quickly
- Cloud Services change management

### **Business Capability Assessment**

Provide a mechanism to evaluate and address business requirements as to what needs to be processed internally and what services can be processed externally.

### **Portability and Interoperability**

Portability and interoperability aspects to ensure disparate services, perhaps provided by multiple Cloud Service Providers, can seamlessly interact.

## **Contractual, Legal, and Regulatory Considerations**

The enterprise cloud enables consistent enforcement of various applicable regulatory, auditing, and compliance-related business requirements. The cloud offers services capabilities that define, integrate, and align compliance activities of enterprise governance bodies in order to apply consistent adherence to compliance with applicable laws and regulations.

### ***Technical Considerations***

Enterprises are attempting to evolve current business solutions to take advantage of dynamic allocation of resources with Cloud Services and the use of an SOA approach to modularize business solutions including application overhaul and consolidation.

The following are some of the technical considerations to ensure that an enterprise is prepared to take advantage of the cloud.

### **Common Framework for Applications**

Where appropriate, consider an application framework that enables standardized Cloud Services capabilities to create, execute, and manage enterprise cloud business solutions. A common application framework provides an effective mechanism to manage interactions and collaborations with Cloud Service Providers.

### **Robust Integration Capabilities**

Ensure that the service capability that serves as a seamless connector from one cloud environment to another (e.g., private cloud environment to external/public cloud environment). A cloud connection service ensures secure connectivity when traversing different network boundaries seamlessly, and enables performance improvement capabilities (e.g., compression).

### **Network and Bandwidth**

The cloud solutions are tolerant of network failures and bandwidth inconsistency. The architecture needs to accommodate these new assumptions associated with built-in architectural enabling mechanisms to efficiently communicate/exchange information consistently in an enterprise.

### **Distributed Environment (Global Applications versus Local Applications)**

The inherent capabilities of utilizing standard network access in distributed applications may impose technical constraints that will require additional capabilities (e.g., caching and continuous synchronization of information) to support expected service response time. On the other hand, local/diversified applications may require some customization/coordination of Cloud Services and therefore have low potential to replicate without alterations. In either case, it would be ideal to describe a holistic enterprise cloud architectural strategy to avoid unintentionally creating silos.



## ***Operational Considerations***

Cloud computing is extending enterprises' trust boundaries for business operations to effectively achieve targeted business objectives. In order to optimize business relationships with extended enterprises that include heterogeneous Cloud Service Providers, the enterprise must efficiently manage business operations with its changed nature of IT delivery. Enterprises are now responsible for brokering cloud-specific solutions of Cloud Service Providers that meet the established policies on cost-effectiveness, solution viability, and business expectations related to IT performance. For example, the ability to rapidly provision IT services without spending large amounts of resources is one of the major practices that impacts business operations of an enterprise. The following summarizes the key business operational considerations.

### **Operational Excellence**

The target objectives for cloud operational excellence are to lower overall operational expenditure and operational optimization to achieve a sustainable and long-term improvement of an enterprise. Also, operational excellence effectively manages all aspects of enterprise governance that include application, data, SOA, corporate, and IT governance.

### **Cloud Services Operational Management**

The enterprise must adopt an IT strategy that not only builds internal clouds but also utilizes external clouds to enhance business agility and support:

- Operational support optimization
- Fully tested operational procedures
- Automated change and configuration control

### **Workforce Management**

Due to several internal and external factors, most enterprises are shrinking their IT capabilities. Enterprises would like to efficiently utilize their finite resources on innovation and engaging their strategic Cloud Services suppliers and partners to leverage available Cloud Services and expertise in order to meet business objectives. The focus of enterprises is now to train the workforce with these new realities that requires the workforce to become an IT enabler and orchestrator.

### **Problem and Error Resolution Management**

The enterprise manages any Cloud Service-related incidents and enables an effective mechanism to perform root cause analysis, store incidents-related information for further analysis, and provide an effective service to evolve Cloud Services so future incidents can be prevented.

### **Service-Level Agreements (SLAs)**

The enterprise provides the capabilities to meet expected Service-Level Agreements (SLAs). For example, it provides a mechanism to seamlessly handle network failure

and address performance-related SLAs. While engaging Cloud Service Providers, the enterprise must carefully negotiate SLAs to ensure that its requirements are explicit and fairly managed. A mechanism that provides opportunities/insights in real-time to make adjustments to SLAs with Cloud Service Providers during their active relationship period.

### **Licensing and Contract Management**

In order to reduce IT service costs, enterprises require efficient enablement of Cloud Services. Cloud Service Providers provide many options to optimize licenses and contracts needs associated with their Cloud Services offerings along with an expedited auto-provisioning process and flexibility to adjust Cloud Services to meet immediate business requirements.

### **Cloud Service Subscription and Life Cycle Management**

The externalization of IT is the movement of IT resources from direct enterprise control and ownership to one or more external service providers. This requires new operational capabilities to build relationships with external Cloud Service Providers to expedite Cloud Services provisioning to meet business needs, within effective pricing parameters. Cloud Service Providers will provide effective Cloud Services management through such capabilities as a self-service, quickly provisioned, show back-based IT consumption model.

### **Cloud In/Exit/Migration Strategy**

As enterprise boundaries continue to disappear, their ability to rapidly provision IT services without large capital expenditure is appealing to budget-minded executives. IT organizations are taking an “adopt and go” strategy to satisfy internal customer IT consumption requirements. For example, many IT organizations are utilizing Cloud Service Providers with effective life-cycle management (i.e., in/exit/migration of services) to support non-critical IT services (e.g., development and test applications). This requires an effective strategy to engage Cloud Service Providers in enabling cloud solutions, shifting Cloud Services from one Cloud Service Provider to another, and discontinuing Cloud Services of Cloud Service Providers when required.

### **Capacity and Services Monitoring**

The enterprise shall consider providing an integrated monitoring view and performance reporting capabilities in order to achieve better performance, accountability, and business results from its Cloud Services. Enable a real-time and efficient allocation of underlying resource workloads in order to provide optimal use of running Cloud Services.

### **International Reference: Cloud Initiatives (Informative)**

Cloud computing is used to help the E-governments in providing best possible services to its stockholders i.e. citizens and businesses, and to reduce the costs by reducing repetitive operations and increase the effective use of resources, in the global arena.

Some agencies in Australia seek for innovative ways to deliver government services and want to rationalize their ICT asset so they commenced small pilots to evaluate the potential of application, platforms and infrastructure cloud computing. The agencies are listed in Table 2.

In 2011 the UK government published its ICT strategy which covered the cloud computing and involved reducing ICT costs for governments, optimizing the use of data center infrastructure, and increasing public sector agility using GCloud(Government Cloud) Table 3.

While Kuwait cloud computing was established in 2006 and has achieved several projects involving data infrastructure which are needed to develop E-government that incorporates relevant official bodies. It established a data network that links over 56 governmental bodies, sharing electronic documents and data at a very high speed where the aim of using cloud computing is for easy data recalling and storage.

**Table 2 : Government Agencies of Australia with their pilots projects of cloud computing**

Agency	Implementation of Cloud Computing
Australian Maritime Safety Authority (AMSA)	AMSA implemented public cloud. This department adopted cloud computing of pilot-cloud based application on a vendor platform (Force.com).
Australian Government Information Management Office (AMIGO)	AMIGO adopted IaaS and PaaS cloud computing delivered models. The data sets on the data.gov.au were migrated onto the public Amazon cloud. The data.gov.au and govspace.gov.au websites were migrated onto a private cloud.
Department of Human Services (DHS)	DHC implemented public cloud and this department is only in the stage of the proof of concept.
Department of Immigration and Citizenship (DIAC)	DIAC implemented hybrid cloud and important issue was centrality versus distributed centers.
West Australian Department of Treasury and Finance (DTF)	DTF implemented private cloud. This was announced in August 2010.
West Australian Health (WA Health)	WA Health implemented private cloud. This was announced in August 2010.

**Table 3: UK G-Cloud Programme**

HM Government | G-Cloud

## G-Cloud vision

- Public Cloud First
- Multi-tenanted
- Commodity solutions
- Pay-as-you-go and friction free – easy in and easy out of contracts
- Rapid elasticity- up/down
- On-demand self-service
- Easily Accessible

“G-Cloud has shown itself to be a model for efficient public sector IT procurement, establishing a dynamic marketplace for cloud based IT services”  
Francis Maude  
Minister for Cabinet Office

HM Government | G-Cloud

## The G-Cloud Programme

- G-Cloud is the UK Government Programme to encourage adoption of cloud-based services
- G-Cloud covers the processes of buying, managing and using cloud services

How do we change the way we commission and use IT? How do we encourage the shift away from custom to commodity?

- Develop a marketplace
- Simplify how we buy & deliver services
- Provide access to a wider choice
- Encourage innovation
- Encourage change in culture

HM Government | G-Cloud

## G-Cloud Programme:

Our aim is to encourage the adoption of cloud based services across the Public Sector

- Phase 1 complete: 1<sup>st</sup> anniversary open and competitive marketplace
- 800+ suppliers and 7000+ services provide access to much wider choice
- We've made it a lot easier for suppliers to play the market for SMEs
- We've made it a lot easier for suppliers to play the market for SMEs
- We're getting the message out: we're changing the market for public sector IT
- Public Cloud First announced

Sales: £18.2m to end of Mar  
SME Vol: 80% vol of orders  
SME Sales: 70% of spend

HM Government | G-Cloud

## G-Cloud: the benefits

- Easy to buy**
  - No OJEU's or long procurements necessary
  - Compliant, self-service online CloudStore
- Transparency**
  - Services, prices & commercial terms all online
  - Driving competition – open marketplace
- Significant savings**
  - Elastic pay-as-you-go, up to 90% savings
  - No need to spend £m's to keep the "lights on"
- Agile & Responsive**
  - Reducing deployment time
  - Ability to meet changing user needs

## Recommendation

Considering the expressed subjects and benefits of cloud computing technology, this technology is currently the best option for eGovernment. Thus, the best option for developing countries that have not yet fully implemented eGovernment is leading government towards cloud architecture. This will reduce costs and increase the efficiency and user satisfaction. Also, the importance of benefits such as data integrity, acceleration of processes and the flexibility of cloud in government should not be ignored that these benefits can meet many challenges of governments to implement eGovernment.

But significant challenge that perhaps governments are harassment to use cloud computing is laws and service level agreements because the countries laws are very different from each other. And in case government rent the service from cloud service provider in another country, it should accept not only the laws of the country of origin but also the laws of the country that is in the data transfer path if there is one. Thus, the need to create new laws and regulations between countries is required in data transfer field, to use of services provided by service providers to be possible for governments all over the world. In this regard, and according to the developed countries and some developing countries are separately executing the eGovernment projects and have less participation in this field together. The developing countries with cooperating and using each other's experience to form a committee to investigate the cloud computing's depth and applications in eGovernment and laws related to data transfer is proposed. To be able to provide needs and necessary platforms to the development and implementation of eGovernment and e-services with the achievements of the committee in a short time and instead of using separate operating

teams for each country, the creation of such a committee can reduce many of the costs of research including financial and time in this field. And this cooperation will lead to participation of other countries in the future and the result of this cooperation will be creation of more coherent and consistent e-government with the minimum technical and legal problems and therefore reception and participation of people will be followed for Extensive use of e-government services. It seems that participation is key to success, especially in this period of time to create the e-government based on cloud computing. However, special attention should be given to providing infrastructures, Telecommunications and communications equipment for increasing internet's bandwidth for realization of the e-government by using cloud computing.

## Conclusion

When discussing public sector adoption of innovative technologies, the Kingdom of Bahrain's unique cultural, economic, and political landscape sets it apart from other jurisdictions. Indeed, unique legislative and regulatory frameworks, competitive economies and legacy systems all come in to play when faced with the decision to invest in and implement new IT service models. Cloud computing represents a catharsis to important policy decisions in the Kingdom of Bahrain. Governments will need to decide how best to serve their people by pooling resources, investing in infrastructure and developing technology-neutral laws, regulations and policies in relation to data protection, cloud, data classification and cloud first initiatives, which will invigorate economies and meet the increasing demand for streamlined and efficient services.

Late adopters of cloud platforms have the advantage of cherry picking from the best-of-breed cloud frameworks. This is now, more than ever, very true for governments in the Kingdom of Bahrain, who have an appetite for innovation and a need to build integrated, responsive and efficient government services for a fast-growing population with high expectations of their governments and the services they provide. Cloud-based solutions will certainly be a part of this transformation.

Governments in the region can follow like the lead of the UK, Australia, Singapore and enable such technology by (1) endorsing the use of cloud-based solutions, (2) suitable cloud governance and operating model (3) proper cloud business model for cloud solution (4) creating a rigorous data classification framework for properly allocating IT resources and leveraging cloud services where appropriate, and (5) implementing security and privacy requirements based on international standards that allow for the use of qualified cloud services.

## References and Citations

National Institute of Standards and Technology (NIST), US Federal Cloud Computing Initiative RFQ (GSA). U.S. government (2009)

Layne, K. and Lee, J. “Developing fully functional e-government: a four stage model”. Government Information Quarterly, vol.18, 2001, p. 122.

Kuldeep Vats, Shravan Sharma, Amit Rathee, “A Review of Cloud Computing and E-Governance”, International Journal of Advanced Research in Computer Science and Software Engineering, Vol2, Issue 2, 2012.

A. Tripathi, B. Parihar, “E-governance challenges and cloud benefit”, VSRD International Journal of CS & IT Vol. 1 (1), 2011, pp. 29-35.

Gopala Krishna Behara, Vishnu Vardhan Varre and Madhusudhana Rao, “Service Oriented Architecture for E-Governance”, 2009, www.bptrends.com.

Thomas B. Riley and William Sheridan, “Electronic Government in Developing and Developed Countries: The Basics By Thomas B. Riley and William Sheridan,” Commonwealth Centre for e-Governance, Ottawa, Canada, October 2006

Borko Furht, Armando Escalante. Handbook of Cloud Computing. New York: Springer, 2010.

Eric A. Marks, Bob Lozano. Executive's Guide to Cloud Computing. Hoboken, New Jersey: John Wiley and Sons, 2010, PP. 40 – 102.

Wojciech Cellary, Sergiusz Strykowski. “E-Government Based on Cloud Computing and Service-Oriented Architecture” International Conference on Theory and Practice of Electronic Governance, 2009, PP. 5-10.

A. Tripathi, B. Parihar, “E-governance challenges and cloud benefit”, 2011 IEEE International Conference on Computer Science and Automation Engineering, 2011, Publisher: IEEE, pp.: 351-354

Toby Velte, Anthony Velte, Toby J. Velte, Robert C. Elsenpeter. Cloud Computing: A Practical Approach. New York: McGraw Hill Professional, 2010, PP.274

Australia Government Cloud Computing Policy Version 2.0, Year 2012, <http://www.finance.gov.au/files/2012/04/Australian-Government-Cloud-Computing-Policy-Version-2.0.pdf>

Australia New South Wales Government cloud services policy and guidelines <http://www.finance.nsw.gov.au/content/dfs-c2013-4-nsw-government-cloud-services-policy-and-guidelines>

United Kingdom Government Cloud guidance of templates and legal documents <https://www.gov.uk/guidance/g-cloud-templates-and-legal-documents>

Australian Academy of Technological Science and Engineering (ATSE), Cloud Computing: Opportunities and Challenges for Australia, page 1-3, 13-15, 2010

Australian Government, Department of Finance and Deregulation, Cloud Computing Strategic Direction Paper, Opportunities and applicability for use by the Australian Government, Version 1.0, page 5-10, 22, 31, April 2011

Australian Government, Department of Finance and Deregulation, Cloud Computing Strategic Direction Paper, Opportunities and Applicability for Use by the Australian Government, Version 1.0, Page 5-10, 22, 31, April 2011.

UK Cabinet Office (2011) Government ICT Strategy  
<http://www.cabinetoffice.gov.uk/content/government-ict-strategy>

Dr. Vasudeva Varma, White paper, Cloud Computing for E-Governance, International Institute of Information Technology, Cloud Computing Group, Web:  
<http://www.iiit.ac.in/~vasu>

Nicola Westmore, Deputy Programme Director, UK's G-Cloud Project, 13 May 2013, HM Government G-Cloud, <http://gcloud.civilservice.gov.uk> 5

The Open Group, Cloud Computing for Business – Establishing your Cloud Vision,  
[http://www.opengroup.org/cloud/cloud\\_for\\_business/p3.htm#X\\_The\\_Example\\_Project](http://www.opengroup.org/cloud/cloud_for_business/p3.htm#X_The_Example_Project)

The Open Group, Building Return on Investment from Cloud Computing,  
[http://www.opengroup.org/cloud/wp\\_cloud\\_roi/p2.htm](http://www.opengroup.org/cloud/wp_cloud_roi/p2.htm)

The Open Group, Cloud for Business, Assessing Cloud Suitability, The Cloud Buyer Decision Tree, [http://www.opengroup.org/cloud/cloud\\_for\\_business/p3.htm](http://www.opengroup.org/cloud/cloud_for_business/p3.htm)

The Open Group, Cloud for Business, Assessing Cloud Suitability, The Cloud Buyer Decision Tree, [http://www.opengroup.org/cloud/cloud\\_for\\_business/p3.htm](http://www.opengroup.org/cloud/cloud_for_business/p3.htm)

The Open Group, Architectural Considerations for an Enterprise Cloud Ecosystem,  
[http://www.opengroup.org/cloud/cloud\\_ecosystem\\_rm/p4.htm](http://www.opengroup.org/cloud/cloud_ecosystem_rm/p4.htm)

## Authors



**Harikrishnan Sugumaran, ToGAF®, ITIL®, COBIT®.**

Is an IT governance architect with the Information and eGovernment Authority in the Kingdom of Bahrain. He is a practicing architect and business technology leader with more than 21 years of professional experience, spanning management consulting, strategic planning, business and enterprise architecture, governance architecture, and technology advisory, across diverse industry segment and geographic locations.



**Khalid Al-Mutawah, Ph.D.**

Is the C-Level Executive as a director of Enterprise Architecture and IT at the Information and eGovernment Authority in the Kingdom of Bahrain. His focus is on covering IT architectures and infrastructures and using the benefits of IT to solve business problems throughout the process of cost and risk management.



## Appendix A (Informative)

This section presents a decision tree that helps you to determine whether cloud computing belongs in your vision. It makes the connection between the business use and the enabling cloud technology (referred from The Open Group).

*It is an aid to decision-making, not a definitive algorithm. Further considerations, either for or against a cloud solution, may emerge when you develop a detailed architecture.*

### Assessment Considerations

There are ten key questions, whose answers will help you to determine whether to use cloud computing, whether a public or private cloud is appropriate, and whether IaaS, PaaS, or SaaS cloud offerings would best meet your business and technical requirements. They are shown as a complete set in the figure below.

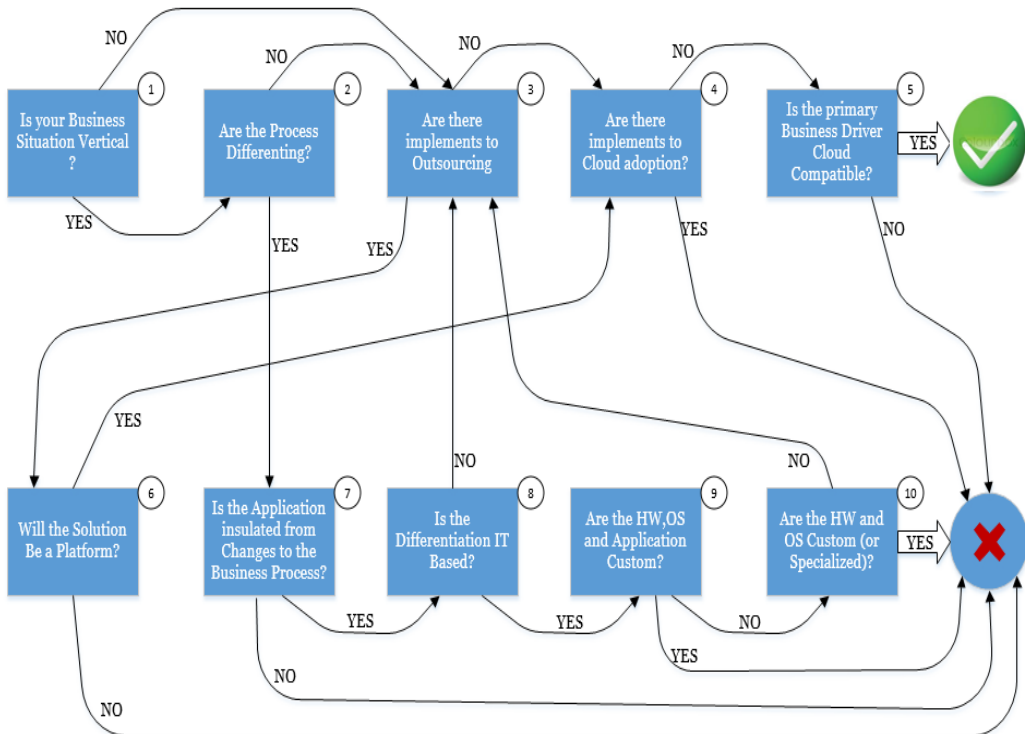


Figure 4: Deciding on your Cloud Solution

They are presented as a simple sequence. Your decision process may be more complex and iterative. Answering a question may require you to explore aspects of your business that you had not previously considered, and perhaps to re-evaluate your objectives for using cloud computing. You may find that you need to go back to a question that you answered previously, and re-consider your answer in the light of your later ideas. But thinking about these questions, in the order presented here, will help you to organize

your consideration of cloud computing, and lead you to a better solution for your enterprise.

### Question 1: Is your Business Situation Vertical?

Is your business scope a vertical or horizontal business process in the industry domain of operation?

Decision	Definition	Next Decision	Objective
Yes: Vertical	You are looking at a single business process or a small number of business processes with consistent requirements that can be considered as a single set. ('Vertical' in this context does not refer to "industry vertical" or "geo vertical".)	Go to Question 2.	Determine which layers of the computing environment shown in the NIST Cloud Service Models figure should be outsourced; and – whether outsourced or in-house – for which layers should cloud solutions be considered.
No: Horizontal	You are looking at business processes with multiple sets of requirements that must be considered separately.	Go to Question 3.	Determine how much of each solution layer should be outsourced or in-house, and for which of those decisions should cloud solutions be considered.

**Question 1: Vertical or Horizontal Business Situation**

### Question 2: Are the Processes Differentiating?

Is the business process a key differentiator for the business? Are the business drivers and performance of this process critical to the competitiveness and cost-effective operation of the enterprise?

Decision	Definition	Next Decision	Objective
Yes: Differentiating	Processes which are integral to the competitive advantage of the business.	Go to Question 7.	Keep competitors from adopting.
No: Non-differentiating	Business-as-usual or external compliance processes which are not significant contributors to competitive advantage.	Go to Question 3.	Keep investments to the minimum required and/or market parity.

**Question 2: Differentiating or Non-Differentiating Business Process**

### Question 3: Are there Impediments to Outsourcing?

Are there any barriers that may prevent some or all of the layers of the solution from being outsourced?

Common impediments to outsourcing include:

- Specification of in-house service cannot be matched externally
- Labor contracts
- Long-term leases
- Switching costs
- Fixed assets with depreciation value
- Immature business architecture
- Business culture
- Geographic location sovereignty rules
- Industry regulation
- Compliance audit rules
- Community relations

Decision	Definition	Next Decision	Objective
Yes: Impediments to Outsourcing	Your business situation includes one or more of the Impediments to Outsourcing, such as long-term labor contracts and enterprise licenses; aspects of your business environment would impede an outsourcing solution; and these impediments cannot be overcome.	Public Cloud is not a good fit. Go to Question 6.	Determine whether a private PaaS (cloud) is a good fit.
No: No Impediments to Outsourcing	Your business situation does not include any nsuperable Impediments to Outsourcing; your business environment does not have aspects which would impede an outsourcing solution, or the impediments can be overcome.	Go to Question 4.	Avoid pursuing a public cloud or other form of outsourcing solution without first having addressed the impediments to doing so.

**Question 3 :Reviewing Impediments to Outsourcing**

### Question 4: Are there Impediments to Cloud Adoption?

Are there barriers to cloud adoption because of issues in hosting the service in a cloud environment that may be detrimental to the business drivers and ROI goals?

Most of the impediments to be considered for outsourcing apply also to cloud adoption. Only additional constraints specific to cloud are listed in this section.

Typical barriers include:

- Custom resources, no major changes planned
- Standard resources, but not adaptable to one-to-many; transformation not practical
- Policy restrictions on resource sharing or on control of configuration changes
- Flat requirements profile, no fractional resources
- Too few potential subscribers (not attractive market to providers)
- Entry costs too high
- SLA performance is not acceptable
- The Recovery Point Objective (RPO) and Recovery Time Objective (RTO) performance is not acceptable

These impediments can apply to SaaS, Paas, or IaaS, and to public, private, community, or hybrid cloud solutions.

Decision	Definition	Next Decision	Objective
Yes: Impediments to Cloud	Your business situation includes one or more of the Impediments to Cloud Adoption, such as a functionally adequate legacy application on fully depreciated custom hardware; and these impediments cannot be overcome.	Cloud is not a good fit.	Avoid pursuing a cloud solution where this is not appropriate.
No: No Impediments to Cloud	Your business situation does not include any of the Impediments to Cloud Adoption; or it includes impediments but they can be overcome.	Go to Question 5.	Avoid pursuing a cloud solution without first having addressed any impediments to doing so.

**Question 4: Reviewing Impediments to Cloud Adoption**

### **Question 5: Is the Primary Business Driver Cloud-Compatible?**

Though there may not be any operational barriers to cloud adoption, if the business objectives are not aligned with the inherent strengths and characteristics of cloud solutions, then non-cloud solutions will be a better fit for the business situation.

Cloud-compatible business drivers may include:

- Reduce medium and/or long-term TCO
- Improve cash flow
- Shift from CAPEX to OPEX
- Improve QoS or SLAs
- Access to functionality or domain expertise
- Scale labor or fixed asset capacity up or down
- Become a cloud provider

Cloud-incompatible business drivers may include:

- Cut short-term costs
- Shift from OPEX to CAPEX (public cloud incompatible)
- Increase capacity without need for third-party financing
- Change tax situation (recognize depreciation, job creation incentives, etc.)
- Shift fixed assets (potentially including leases) or labor to provider

Decision	Definition	Next Decision	Objective
Yes: Driver is on Compatible List	Cloud strengths match business objectives.	Cloud is a good fit. Review the previously selected Decision Nodes and the Solution Considerations to determine which type of cloud solution is the best fit.	Ensure strategic as well as tactical fit.
No: Driver is on Incompatible List	Cloud strengths do not match business objectives.	Cloud is not a good fit. You may wish to consider outsourcing.	Avoid pursuing a suboptimal IT enablement strategy.

**Question 5: Review the Primary Business Driver**

If you determine that cloud computing is a good fit, you should review the following solution considerations.

You should consider all forms of cloud computing if:

- The business process is not a key differentiator for your business.
- The differentiation is not IT-based and the applications are insulated from changes to the business process.
- You have standard hardware, operating system, and applications.

If the business process is a key differentiator for your business, and the differentiation is IT-based, then PaaS or IaaS may fit, and:

- If you have standard hardware and operating system, and custom applications, then SaaS is unlikely to meet your needs.
- If the business process definition is de-coupled from the application, consider SaaS.
- If the business process definition is not de-coupled from the application, is it time to overhaul the business process, and could the definition be abstracted during that overhaul? If yes, then consider SaaS; if no, then SaaS is not for you.

For example, an SaaS or IaaS solution could be appropriate for a differentiating, IT-supported – or possibly even IT-based – business process if the differentiation is commoditization. There is a well-known PC supplier whose supply chain processes differentiate it from other suppliers. That differentiation is primarily due to the leverage that it has over its suppliers due to the size and frequency of its purchases rather than due to a proprietary supply chain process or IT configuration. Even with the ability to replicate that company's Supply Chain Management (SCM) processes and

IT enablement, potential entrants to its market face formidable barriers. So, theoretically, an SaaS solution and perhaps even a BPO solution would be an appropriate choice for enabling that company's SCM processes.

The proliferating online universities in India provide another example of the considerations involved. Should the Indian government force the market to be more efficient by requiring the use of a government-subsidized SaaS or IaaS solution? While consolidation on a cloud solution might be more efficient from a government standpoint, it might not be attractive to the participating universities. But if a university is differentiating its online courses on the basis of content alone, if the courses' resource consumption profile is not complementary to the rest of the university's IT portfolio, and if the government subsidized solution meets that university's QoS and financial requirements, including relief for switching costs, then consolidation would likely be very attractive. So the government must decide whether the consolidation benefits outweigh the costs (including the set-up costs and the unallocated fixed costs prior to reaching break-even), and the risks (including the risk that fewer than the break-even number of universities will make use of the cloud solution).

### Question 6: Will the Solution be a Platform?

Is your objective to transform the solution layers below the business processes and applications into a standard, shared configuration for delivering all of the company's IT services?

These layers typically include middleware, operating system, hardware, and data center infrastructure. The middleware may include an Enterprise Services Bus (ESB) to support a Service-Oriented Architecture (SOA).

Decision	Definition	Next Decision	Objective
Yes: Middleware and HW & OS	An IT platform is comprised of the Middleware and Hardware and Operating System Solution Stack Layers. The Data Center Infrastructure may also be included.	Go to Question 4.	Determine whether private PaaS or IaaS plus a platform is a good fit. (Public cloud has already been ruled out.)
No: HW & OS and/or Data Center	Horizontal HW & OS solutions include server farms, storage pools, and on-demand infrastructure. A data center includes network, physical plant, and a Network Operations Center (NOC).	Cloud is not a good fit, but other solutions such as virtualization, appliances, and out-tasking may be a good fit. Review the Solution Considerations.	Increase the yield of in-house IT infrastructure resources.

#### Question 6: Platform or Non-Platform Solution

If you determine that cloud is not a good fit, you should review the following solution considerations.

If you have standard hardware, operating system, and applications, then any form of outsourcing may meet your needs, and you might use virtualization or hardware appliances.

If you have standard hardware and operating system, but custom applications, then application outsourcing and BPO are unlikely to meet your needs, but outsourcing of data center, IT management, governance, or data storage could be a good fit. Also, you might use virtualization or hardware appliances.

When considering these options, review Question 5 because similar considerations are likely to apply to compatibility of business drivers.

### Question 7: Is the Application Insulated from Changes to the Business Process?

Can the business process architecture be customized without impacting the underlying standard application configuration and its shared IT management timeline? Can the IT configuration be customized without impacting the execution of the business process with shared resources (especially labor) and using a standard process definition?

Decision	Definition	Next Decision	Objective
Yes: Application is Insulated	Business process definition is abstracted from the enabling application such that a business person with no knowledge of the application can modify the definition of the business process without impacting the ability of the application administrator to manage and maintain the application efficiently.	Go to Question 8.	With insulation, delivery of the IT layers can be somewhat independent of delivery of the business process layer.
No: Application is not Insulated	A change to the business process definition requires a change to the	Outsourcing (including public cloud) is probably not a good fit, and by itself this	Avoid inhibiting changes to the differentiation; changes to a cloud solution are made at the provider's convenience – whether the

<b>Decision</b>	<b>Definition</b>	<b>Next Decision</b>	<b>Objective</b>
	application, and <i>vice versa</i> .	situation cannot support private cloud. Review the Solution Considerations.	provider is internal or external. Insulation and control of change management may not be applicable to a process differentiated purely on scale (i.e., differentiation through commoditization). Private PaaS could be a good fit if the benefits of a common shared IT platform for this differentiating process and several non-differentiating processes, outweighs the benefits of enabling those non-differentiating processes with a public cloud or non-cloud outsourcing solution.

**Question 7: Reviewing Application Insulation**

If you determined that the application is not insulated from the business process, you should review the following solution considerations.

Although it is unlikely that cloud is a good fit, there are some situations where it might be appropriate.

If the application is insulated from the infrastructure, you could consider running it on a public or private cloud IaaS or PaaS.

Even if it is not well insulated, you could consider putting the application on a private IaaS or PaaS if this solution makes sense for your application portfolio as a whole.

To consider these options, go to Question 4.

**Question 8: Is the Differentiation IT-Based?**

Is IT is a key enabler of differentiation for the business process?

<b>Decision</b>	<b>Definition</b>	<b>Next Decision</b>	<b>Objective</b>
Yes: Differentiation is IT-based	IT is integral to the differentiation.	Go to Question 9.	Improve IT enablement without enabling competitors to replicate the IT architecture on which the differentiation is based.



No: Differentiation is not IT-based	IT merely supports the differentiating business process.	Business Process Outsourcing (BPO) is not a good fit. Go to Question 3.	Improve IT enablement without enabling competitors to replicate the business process architecture.
-------------------------------------	----------------------------------------------------------	-------------------------------------------------------------------------	----------------------------------------------------------------------------------------------------

**Question 8: IT-Based or Non-IT-Based Differentiation**

**Question 9: Are the Hardware, Operating System, and Application Custom-Made?**

If the hardware, operating system, and applications layers are all custom-made, then cloud solutions are not a good fit. If only the hardware and operating system have custom elements, or only the applications have custom elements, then cloud might be a good fit.

Mission control weapons systems, and business intelligence systems, are examples of systems where hardware, operating system, and applications layers may all have custom-made elements.

<b>Decision</b>	<b>Definition</b>	<b>Next Decision</b>	<b>Objective</b>
Yes: Custom HW & OS and Application	The IT configuration must be managed on a unique timeline.	Cloud and most forms of outsourcing are not a good fit. See the Solution Considerations.	Legacy IT solutions are often custom, so until a major transformation activity can be justified, cloud is not a good fit.
No: HW & OS and/or Application are Standard	Either the HW & OS or the Application layer is standard (off-the-shelf).	Go to Question 10.	Investigate the standard IT layer for cloud fit.

**Question 9: Reviewing Custom-Made Elements in Hardware, Operating System, and Applications**

If you determine that cloud computing is not a good fit, you should review the following solution considerations.

If you have custom or specialized hardware or operating system, and custom or specialized applications, then public cloud – whether SaaS, PaaS, or IaaS – is unlikely to be a good fit. Nor is either private IaaS or PaaS, unless there are a number of business processes in the overall portfolio that have complementary resource consumption profiles to this process, can be enabled with the same IT resources, and cannot be enabled more effectively with alternatives.

Infrastructure outsourcing, application outsourcing, and BPO are unlikely to meet your needs. However, you might consider outsourcing data center operations, IT management, governance, and data storage.

You might also consider hardware appliances and virtualization.

## Question 10: Are the Hardware and Operating System Custom-Made or Specialized?

If these IT layers are standard, you may have a good candidate for a cloud solution.

Examples of custom or specialized hardware and operating systems include those designed for fault tolerance or real-time performance, those including special memory (e.g., supercomputers), and those including cell processors.

Decision	Definition	Next Decision	Objective
Yes: Custom or Specialized HW & OS, Tailored Application	The HW or OS is specialized, while the Application configuration fully or nearly matches the most typical configuration of that application.	Cloud and most forms of outsourcing are not a good fit. See the Solution Considerations.	Re-evaluate the requirements necessitating custom HW or OS. If the technology is early stage then, as it matures, look for providers to start to support it.
No: Standard HW & OS, Custom Application	The HW & OS but not the Application are configured in a typical fashion.	Go to Question 3.	Rule out cloud solutions for the Application layer.

### Question 10: Reviewing Custom-Made Elements in Hardware and Operating System

If you determine that cloud computing is not a good fit, you should review the following solution considerations.

If you have custom or specialized hardware or operating system, but off-the-shelf applications, then no form of cloud computing is likely to be a good fit for your requirements. Nor is BPO or infrastructure outsourcing.

You might, however, consider outsourcing data center operations, IT management, governance, middleware, and data storage. Outsourced application management could work for you if you can use a standard application development platform.

You might also consider hardware appliances and virtualization.