

Concepts, Challenges and Opportunities of Cloud Computing for Market Analysts

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Abstract – The clouds of information technology are commonly referred to as “Cloud Computing”. Cloud computing is the next big thing after the internet and it will revolutionize the way IT services are provided. Cloud computing is a general term for anything that involves delivering hosted services over the internet. This article explains what is cloud computing, why do you need to know about it, what are the risks, what are the benefits, how will it impact businesses, how will it impact

auditors, should business analysts use cloud computing, what are the challenges and opportunities for enterprises and for business analysts.

Keywords : Cloud Computing, Hosted Services.

I. Introduction

Business Analysts deal with data/information in myriad forms for assurance reviews, analysis and decision-making. The location of digital data can be tacked to computers and servers either at identified offices of clients or vendors. However, of late, there is increasing talk of data being stored on the “cloud” and usage of cloud computing which leads to new areas of concern from perspective of risk, security and controls. Enterprises are increasingly using cloud computing due to business benefits it offers. As with any deployment of IT by enterprises, cloud computing offers both challenges and opportunities to business analyst. The challenges are

in terms of the inherent risks of accessing data on the cloud and the impact on the way services are provided. The opportunities are the way in which cloud itself can be used to deliver services of assurance/consulting to clients. It is imperative that business analyst understand concepts of cloud computing, service offerings, deployment models and the related risks and controls for two purposes :

1. Impact on services provided to clients by accessing relevant data at clients offices or remotely;
2. Impact on how services are/will be provided within their own offices using cloud computing.

II. MARKET SURVEYS

Is cloud computing real or hype? The answer is: it is somewhere in between. We have to go beyond the hype created by the vendors and look at the reality of how it can add value to the enterprise while mitigating the relevant risks. As per Gartner research, every new IT usage moves through different phases from conception to obsolescence. Thus, the peak of inflated expectations leads to the trough of disillusionment which is followed by the slope of

enlightenment and the plateau of productivity. Currently, cloud computing is in the peak phase so you can expect to find lot of hype. However, it is expected to transition into the enlightenment or growth phase shortly. A sample of findings from latest surveys and study made by consultancy and market research firms highlights the importance and projected growth of cloud computing.

a. Global Scenario

1. Cloud services revenue to touch \$ 149 billion in 2014. \$55 billion forecasted worldwide revenue from public IT cloud services alone.
2. Cloud services cost less than traditional outsourced services, with savings ranging from 20% to 50% depending on the type of service offered.
3. 30% is the rate at which cloud computing will grow in 2011, or more than five times the rate of IT industry as a whole.
4. 2.3 million (Net) new jobs will be created by cloud on a cumulative basis from 2010-2015.
5. The impact of cloud computing will be very high on the nearly \$60 billion outsourcing sector, whose mantra is cost savings. This sector has little choice but to

include cloud computing as part of their service portfolio.

b. Indian Scenario

1. India is ahead of US in cloud adoption. Top cloud users today are Brazil (27%), Germany (27%), India (26%), US (23%).
2. Cloud computing market in India is expected to cross \$1.08 billion by 2015, from \$110 million in 2010.
3. Of the projected \$4.5 billion total cloud computing market in India by 2015, private cloud will account for \$3.5 billion.
4. Cloud computing will generate about 100, 1XXI additional jobs and save about 50% of cost of IT operations for Indian enterprises.
5. The CEO and MD of India's second largest software exporter says: "India needs a policy framework for the new service that enables companies to share IT infrastructure and cut costs. Efforts are on for such a policy and the confederation of India Industry (CII) will submit a draft paper to the government. The opportunities are huge for India for providing citizen services and the right regulatory frame work will accelerate the growth. Some of the issues like data privacy and

security should be addressed properly, which is possible only with a regulatory framework. Regulatory framework would give confidence that the service providers will provided the service securely and reliably. Our company has already appointed 2000 experts to work on this new service."

6. India's No. 3 outsourcing firm looks at cloud computing as a "game changer". It is building data centers in India and is implementing private clouds in partnership with other IT firms.
7. The cloud has the potential to transform business ecosystems that are relatively under-penetrated by IT due to high capital requirement, such as government, healthcare and education.

Analysis of findings above highlight that cloud computing is expected to be the next big wave in IT. This clearly establishes that cloud computing is emerging as the next big IT service for its pay-as-you-go model, which will eliminate capital intensive investment especially for the small and Medium Enterprises by minimizing investment in IT infrastructure. There is growing

recognition of the power of cloud computing by many CIOs who are looking to implement it in their own IT departments. However, with all the noise in the market about cloud computing, it is critical to remove the hype from the reality, identify the right strategy and know where to begin. There is no running away from cloud computing as it is increasingly becoming all-pervasive. Business Analyst needs to understand the services which can be delivered using the power of cloud computing so as to be empowered to explore how to convert challenges of the cloud to opportunities for themselves and their clients.

III. KEY CONCEPTS OF CLOUD COMPUTING

Let us understand the key concepts, features of cloud computing, cloud, access, cloud services and cloud participants. The key features of cloud computing are :

- Access to cloud network through any device using broad network access.
- Model of pooling of resources to serve multiple customers using a multi-tenant model, with different physical and virtual resources dynamically assigned and reassigned as per demand.
- Capability to scale up quickly and rapidly by buying more capacity in any quantity at any time.
- Measured serviced which automatically control and optimize resource use by leveraging a metering capability based on storage, processing, bandwidth and active user accounts where resource usage is monitored, controlled and reported with transparency.

Definition : The National Institute of Standards and Technology (NSIT) and the cloud security Alliance define cloud computing as a “Model for enabling 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”. Gartner defines cloud computing as: “A style of

computing where massively scalable, IT-enabled capabilities are provided as a service across the internet to multiple external customers”.

Cloud computing refers to both the applications delivered as services over the internet and the hardware and systems software in the data centers that provide those services. It facilitates sharing of technological resources, software and digital information across multiple platforms, clients and users on internet.

In simple terms, cloud computing refers to computing power in all its totality or specified components (infrastructure, platform or service) being offered in the cloud as a utility out users, to be paid by the meter on consumption basis, just as we pay for utilities such as electricity, gas and water based on usage. Cloud computing is an ‘on demand model’ for allocation and consumption of computing as utility which offers immediacy, elasticity and is generally multi-tenanted.

Cloud, cloud services and access: The “cloud” in cloud computing is defined as the set of hardware, networks, storage, access to applications and business processes. Access to the cloud is generally provided via

multiple technologies (internet or other) using multiple devices remotely on real-time basis.

Cloud participants : The end user, who doesn’t have to know anything about the underlying technology of the cloud just as you need not know about the technology behind the cell phone to use it.

1. Enterprise management, who are responsible for the management of data or services living in a cloud.
2. The cloud service provider, who is responsible for IT assets and maintenance and providing the services as per service level agreement.

IV. HOW DOES CLOUD COMPUTING WORK?

Many of us who are using e-mail account with a web-based e-mail service provider like Gmail, Hotmail, Yahoo etc. are already cloud service users even without knowing it. You will notice that you are using a computer of any type which may be located anywhere, anytime to access your emails. The email programme is running on the server and all your emails including the software is stored on the cloud.

Although users don't need to have knowledge of, expertise in, or control over the technology infrastructure in the "cloud" that supports them, a conceptual understanding would be useful. From a technology perspective, in cloud computing, multiple servers are used as a single platform on a network under secured environment with access provided via any computer device to a range of applications and tools, thus reducing the cost of IT operations. Cloud computing is enabled by a number of existing technologies, such as virtualization, automation, and self-service portals. In cloud computing, services are provided over the internet by dynamically scalable and often virtualized resources.

The cloud computing system can be conceptually divided into two sections: the front end and the back end, which connect to each other through a network, usually the internet. The front end is the interface by the user for interaction by the user for interaction with the back end. The front end or user interface could be any device such as a desktop, laptop, computer terminal, mobile devices, smart phone, PDA, etc. and this could section of the system which is the

collection of servers connected on a public/private network.

The front end includes the client's computer or network and the application required to access the cloud computing system. It is not necessary that all cloud computing systems have the same user interface. Services like web-based e-mail programmes use existing web browsers like Google Chrome, Internet Explorer, Firefox, Safari, etc. At the back end are various computer, servers and data storage systems that create the "cloud" of computing services. Generally, each application is required to have its own dedicated server. A central server administers the system, monitoring traffic and user demands to ensure that all applications and the network access are running as required. The system follows a set of rules called protocols and uses a special kind of software called middleware which allows the networked computers to communicate with each other.

V. BENEFITS OF CLOUD COMPUTING

It is a key enabler and is a critical part of business/service of most of the enterprises. Cloud computing builds on power of internal IT and enables

enterprises to have access to continuous real-time data flow, anytime on any platform for providing access to computer resources not only across the enterprises, but also to the external customers or vendors as required. The internal/external user can log in to their applications from anywhere: office, customer location, and factory or anywhere in the world. By using appropriate security, the data is safe from external threats such as fire/theft flood which may affect your office. The end result is “everything is available remote.” The office computers can be just “dumb terminals,” which provide basic interface for the user to access applications/data on the cloud.

Cloud computing provides opportunity for enterprises to reinvent their IT deployment and accelerate their business initiatives and offer new services at lower cost by enabling them to focus on their core competence and outsource responsibility for IT infrastructure to specialized vendors. This enables enterprises to convert capital expenditure to operating expenses.

Some of the key benefits of cloud computing are:

- **Cost reduction** : Enterprises can invest only on the front end computers/devices and the internal network and use the cloud for the backend. This reduces cost of investing on the servers and relevant software. Enterprise will then have to incur only the operational expenses of using the cloud as per usage.
- **Rapid deployment** : Major time/cost is required for investing and making the back end computer servers work as required. In a cloud computing environment, the cloud service vendor provides this from their standard offering and the users can start using applications by connecting to them on the cloud.
- **Availability/resilience** : Enterprises are not dependent on their internal servers and the inherent risks and instead can use the service of cloud providers who have the infrastructure and bandwidth to accommodate business requirement for high speed access, storage and applications. These specialized vendors have redundancy built into the system which makes availability and business

continuity planning more effective.

- Scalability : The cloud service providers with their inherent capacity can offer increased flexibility and scalability for evolving. IT needs as required by enterprises. They have surplus capacity which can be procured on demand and at short notice.
- Efficiency: Regular operational maintenance of the servers is done by the service provider on a timely basis which increases the overall efficiency of the system.

VI. RISKS OF CLOUD COMPUTING

Implementing cloud computing has immense rewards but as with any IT implementation, it has inherent risks too. Hence, it is important to balance the risks with the return and implement appropriate risk mitigation strategy. In addition to risks of IT, cloud computing has additional risks primarily on account of dependence on the internet and data being and transmitted on the cloud. Further, there is greater dependence on third parties (cloud service provider) which is aggravated on account of increased risks of vulnerabilities in external interfaces and aggregated data

centers, immaturity of the service providers and the increased reliance on independent assurance processes.

The unique and dynamic nature of cloud computing results in new risks relating to location of the processing facility, ability to process the required volume of data, data movement across national boundaries, sharing of facilities with competitors, potential data leakage and legal issues (liability, ownership, etc.) due to differing laws in hosting countries which may put the enterprise data at risk.

The risk mitigation strategy has to be commensurate with the risks and would include the following: choosing a reputed service provider, establishing clear responsibility for ownership of data in all its stages, controlling access to data and its movement, ensuring availability by insisting on appropriate resilience measures. The service level agreement has to include key clauses relating to levels of service availability, security availability, data protection and data migration in case of termination of the service.

VII. DEPLOYMENT MODELS

The basic deployment models of cloud computing are : public clouds, private clouds, hybrid clouds and community clouds. Each of these is briefly described here:

Public Cloud: The public cloud is made available to the general public or a large industry group. It is owned by an organization that sells cloud services and is sold to the public from a mega-scale infrastructure (e.g. Amazon, Google). The data may be stored in unknown locations and may not be easily retrievable. The key benefits of using a public cloud service are: easy and inexpensive set-up because hardware, application and bandwidth costs are covered by the provider, scalability to meet needs, payment on usage. Enterprises using public cloud can focus on their core business, rather than be concerned about scalability of infrastructure. Solving peak business demands for performance can be readily met by using cloud computing, thus translating into more reliable backup, more satisfied customers, increased scalability and better margins.

Private cloud : A private cloud is managed by the enterprise it serves or third party and is operated solely for that enterprise. It may be deployed

on-premise or off-premise. It offers cloud services with minimum risk, but may not provide the scalability and agility of public cloud services. Private cloud offers the benefit of cloud by improving IT responsiveness to business needs, reduces costs, and provides elasticity, dynamic computing or storage capacity. With a private cloud, a business service that needs additional computation or storage resources can dynamically procure it. The benefit of a private cloud is that it enables an enterprise to manage the infras but this comes at the cost of IT department creating a secure, scalable, compliant cloud. Managing a private cloud requires effective monitoring of operating expenditure and balancing it with the benefits.

Hybrid cloud : The hybrid cloud is maintained by both internal and external providers. It is a composition of in-house infrastructure and/or reaching out to multiple clouds. Hybrid clouds have to maintain their unique identity, but are bound together by standardized or proprietary technology that enables data and application portability. The hybrid cloud aggregates the risk of merging different deployment models and the classification and labeling of

data will be beneficial to the security manager to ensure that data are assigned to the correct cloud type.

Community cloud : The community clouds may be shared by several enterprises and supports a specific community that has a shared mission or interest. This may be managed by the enterprises or a third party and may reside on or off premise.

The risk is that data may be stored with the data of competitors.

VIII. SERVICE MODELS

Currently, there are three dominant cloud computing service models: Infrastructure as a Service (IaaS), Software as a Service (SaaS) and Platform as a service (PaaS). The service models are dynamically changing as cloud providers come out with new offerings focused on being competitive, increase market share, each with the aim to becoming one-stop shop as feasible.

The service models are explained below:

Infrastructure as a Service : This model of services typically includes the core IT Infrastructure Services such as operating systems, data storage, web servers, and edge

caching services. This model provides the capability to provision processing, storage, networks and other fundamental computing resources by offering the customer the ability to deploy and run arbitrary software, which can include operating systems and applications.

The primary difference between this approach and traditional outsourcing is that with cloud computing, access to the infrastructure is through the public or private networks and the assignment and payment for resources is based on usage. In 2011, a big trend in IaaS is the move to automation – a converged infrastructure. IaaS by providing required technology infrastructure saves its customers the cost of buying hardware and the system software to run the hardware.

Platform as a service (Paas): This model provides the application building blocks which may include: workflow, document management, data service, APIs, fabric, proprietary development languages. This model provides the capability to deploy onto the cloud infrastructure customer-created or acquired applications created using programming languages and tools supported by the provider. PaaS enables independent software

vendors (ISVs) to develop, deploy, and manage applications without incurring upfront cost for buying the platform hardware or software. PaaS platform has evolved from software as a service (SaaS) and infrastructure as a service (IaaS).

Software as a Service (SaaS): This model provides complete applications which are sold on a subscription model for a specific period : Examples of software provided through SaaS model are CRM, ERP, e-mail, Calendar, Internet File Stores, Spam filters, etc. This model provides the capability to use the provider's applications running on cloud infrastructure. The applications are accessible from various client devices through a thin client interface such as a web browser (e.g. web-based e-mail). SaaS saves customers the cost of buying licenses and running programmes on their own computers.

Enterprises have to select the right service model based on their specific requirement. The selection has to be done considering various factors such as cost benefit analysis, relevant risks, security and controls and the criticality of the data and services. Typically, enterprises would choose the model which offers them the best

savings with the required security as appropriate to the criticality of the services provided. Quite often, the non-critical services/applications are the first to be migrated both as a test case and also considering the lower risks.

IX. IMPACT OF CLOUD COMPUTING ON BUSINESS ANALYSTS

Cloud computing offers business analysts with new ways of providing services to clients. As with any IT, we need not be confounded by the technology as there is absolutely nothing mystical or overly complicated about this model. IT has and continues to change the way services are provided to the clients. This can be gauged from the fact that IT has become imperative on account of compliance services which require use of IT and the client data which is available only in digital format. For example, balance sheet audit of a branch which has implemented core banking solution requires auditors to access data of branch using the network.

The data of the branch is not available at the branch but at the data centre. Auditors need to learn how to conduct the audit of data in a digital

format which is accessible on the network. Similarly, auditing data on the cloud requires providing assurance as per the scope and objectives by understanding business process which is rendered on the cloud. This requires understanding of the information architecture of how data is generated, transmitted, accessed and stored on the clouds and how the relevant risks are mitigated by implementing appropriate controls.

Cloud computing and related cloud services generate new ways of thinking about IT computing architecture and service delivery models. With cloud, everything becomes a service thus enabling enterprises to create new initiatives without a huge IT investment. It transforms capital expenditure to operating expenses payable based on use. Cloud computing offers new and unique business benefits which are expected to change the way businesses collaborate, compete, operate and deliver services. Hence, the number of enterprises who use cloud computing will keep increasing in the near future.

Given below are list of sample questions which can be used as a basic checklist to evaluate the current

competencies and identifying areas where business analyst or auditors need to add to their skill-sets to be able to use the cloud model internally within their office to deliver services and also to provide assurance on cloud services of their clients.

Assurance issues for cloud: How are the key aspects of value and risk to the information which is being outsourced to the cloud provider considered by the enterprise?

- What business continuity and disaster recovery measures are in place in the cloud infrastructure? Does the cloud provider have a backup in place? Is this appropriate for the enterprise?
- What are the risks of migrating services to cloud and have these been appropriately mitigated?
- How will enterprise ensure that knowledge of the business process is retained and versioned, in case there is need to switch cloud provider in future?

Business issues for cloud

- What services can be offered using cloud computing what are the risks?
- Based on the risks and control, how do you determine and

implement the right cloud computing strategy for our enterprise?

- Have you computed the cost benefit analysis of offering the services via the cloud?
- Which services should you outsource versus build internally?
- Which cloud delivery model is appropriate for the enterprise?
- How do you ensure the quality, timeliness and availability of the services managed?
- How do you protect IT investments now and in the future?
- How do you manage the cloud environment?
- How do you ensure privacy, security and availability of the data?

Steps for identifying cloud model

- Identify new applications that could run in a public cloud.
- Identify existing applications that could run in a public cloud.
- Identify legacy applications that are likely to need to remain in your data centre.
- Considering your enterprise's need for privacy or to support legacy applications, decide

whether you need to use a private cloud.

- Identify appropriate cloud vendors.

Key issues to be resolved with the cloud service provider:

Once appropriate cloud model and vendors have been identified, the following questions need to be answered for each of the cloud service providers for selecting the right vendor:

- Where will your data be stored?
- What type of security and controls are implemented by vendor to protect your confidential and sensitive data?
- What type of redundancy and back up measures does the vendor have and are they appropriate to meet your requirements?
- What is the vendor's data retention policy and does this meet your compliance requirements?
- Who will have ownership of that data and do you always have ownership of your data?
- In what format is the data stored and is the format in a commonly accepted standard and not a proprietary format?

- What counter measures do the vendors have to prevent data loss or corruption?
- What is the risk mitigation strategy in the event of loss of data? Who is responsible and are you adequately protected?
- What is the dispute resolution mechanism and is it agreeable and enforceable by you?
- What is the financial stability of the vendor and who or which are their primary funding sources?
- Is the vendor well established and can provide proper references?
- What is the support structure provided by the vendor?

X. CONCLUSION

Business Analyst will be increasingly required to consult on IT problems for clients. The cloud computing architecture will continue to evolve to permit additional layers of services to be offered. Cloud service offerings will no doubt grow not just in number but also in variety. Although it is unlikely that cloud computing will completely will completely replace in-house IT, but it is expected to grow to more than 30% of the market in the very near future.

The most critical aspects about the cloud services for enterprises will be in deciding which applications to put in the cloud and which to keep closer to home based on cost benefit analysis and risk. Enterprises will require advice and assurance on business, compliance, security aspects of the cloud environment. Business analyst with good understanding of cloud computing can play a more proactive role for their clients in riding the cloud wave and also enhance the quality of their service offerings using the cloud computing model.

XI. REFERENCES

- (1). www.cloudsecurityalliance.org/
- (2). www.nist.gov/itl/cloud/index.cfm
- (3). www.opencloudconsortium.org/
- (4). www.opencloudmanifesto.org/
- (5). www.cloud-standards.org/wiki/
- (6). www.howstuffworks.com
- (7). www.cloudcomputing.systems.com/
- (8) www.microsoft.com/cloud
- (9) www.isaca.org/cloud
- (10) www.cloudsecurity.org/
- (11) www.cloudaudit.org/

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