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A Study on Challenges of Cloud Computing in Enterprise Perspective

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Abstract: It will analyze from a company's point of view the factors that need to be considered by an enterprise when making the decision of using Cloud Computing. Cloud Computing is the latest trend in IT. So the companies are moving towards Cloud Computing. On the other hand, other companies cannot take into consideration the idea of having their sensitive data outside their premises. These two cases represent companies that are just not very well informed. To analyze the positive and negative aspects of each of the following factors: integration with existing IT infrastructure and existing software, costs, return on investment, performances, security. Also, we will correlate all these factors with the company size and business area in order to identify if or what type of Cloud Computing solution is suitable for company's needs.

Keywords: Cloud Computing, IT (Information Technology), Enterprise, Security, Performance.

I. INTRODUCTION

The Cloud Computing was established in late of 2007, currently emerges as a hot topic due to its abilities to provide flexible dynamic IT infrastructures, Quality of Services guaranteed computing environments and configurable software services. In short period, Cloud Computing is completely real and will affect almost everyone. In this day and age, we have all become stakeholders in the computing movement, and we are all affected when major changes occur. Now, Cloud Computing is shifting that computing power back to hosts again. Only this time things are different, since those hosts have become abstract, and are spread all over the Internet and world. That is to say that computing power is being shifted to the "cloud". Such a shift to Cloud Computing would not have been possible until now.

Broadband connectivity now makes Cloud Computing a realistic possibility for larger companies, small businesses, and individual consumers. Now these users have chance to access the cloud, and they also have access now to applications and services. Few years ago they couldn't begin to access or afford applications and services.

Cloud Computing guarantee to deliver all the functionality of existing information technology services even as it dramatically reduces the upfront costs of computing that prevent many organizations from deploying many cutting-edge IT services. All such guarantee has led to superior expectations.

Gartner Research expects Cloud Computing to be a $150 billion business by 2014, and according to AMI partners, small and medium businesses are expected to spend over $100 billion on Cloud Computing by 2014.

The impetus for change right now is seen primarily from a costs perspective, as organizations increasingly discover that their considerable capital investments in information technology are often grossly underutilized.

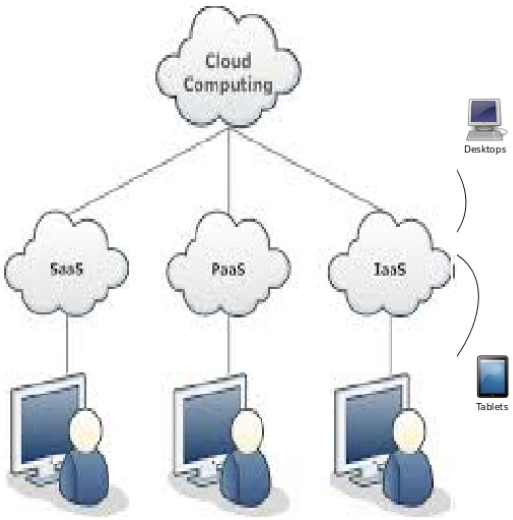

Fig-1 Cloud Computing Basic Structure

II. CLOUD COMPUTING OVERVIEW

A model for enabling everywhere, 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. Cloud Computing represents a convergence of two major trends in information technology.

a. IT efficiency, whereby the power of modern computers is utilized more efficiently through highly scalable hardware and software resources
b. Business agility, whereby IT can be used as a competitive tool through rapid deployment, parallel batch processing, use of compute-intensive business analytics and mobile interactive applications that respond in real time to user requirements.

Cloud Computing is a general term for delivering services to host over the Internet. These services are broadly

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divided into three categories: Infrastructure-as-a-Service (IaaS), Platform-as-a-Service (PaaS) and Software-as-a-Service (SaaS). This service has differentiated it from traditional hosting. It is sold on demand, typically by the minute or the hour; it is elastic -- a user can have as much or as little of a service as they want at any given time; and the service is fully managed by the provider (the consumer needs nothing but a personal computer and Internet access). Significant innovations in virtualization and distributed computing, as well as improved access to high-speed Internet and a weak economy, have accelerated interest in Cloud Computing.

A. *Service Models*

There are three service models in Cloud Computing. NIST defines as follows:

1) 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.

Example for SaaS Company:

- Athenahealth
- Concur Technologies
- E2open

2) 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.

Example for PaaS Company:

- Apprenda
- IBM
- Open shift

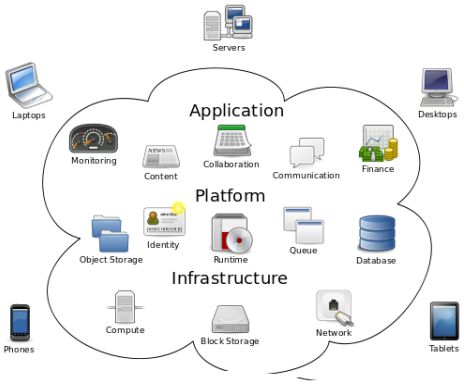

Fig-2 Cloud Computing

3) 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).

Example for IaaS Company:

- Amazon web service
- At & t
- Ca technologies

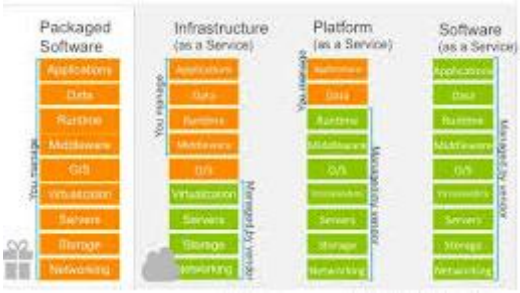

Fig-3 Cloud Service Models

B. *Deployment Models*

There are four deployment models in Cloud Computing.

1) 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.

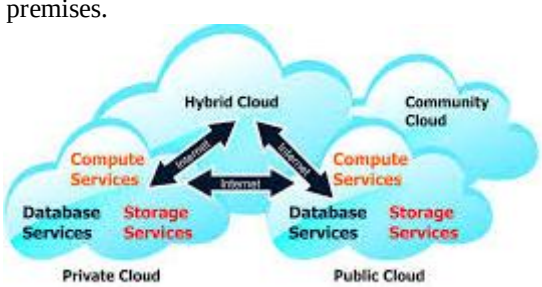

Fig-4 Types of Cloud Deployment Model

Examples of Private Cloud:

- Eucalyptus
- Ubuntu Enterprise Cloud - UEC (powered by Eucalyptus)
- Amazon VPC (Virtual Private Cloud)
- VMware Cloud Infrastructure Suite
- Microsoft ECI data center.

2) 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.

Examples of Public Cloud:

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- Google App Engine
- Microsoft Windows Azure
- IBM Smart Cloud
- Amazon EC2

3) 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).

Examples of Hybrid Cloud:

- Windows Azure (capable of Hybrid Cloud)
- VMware vCloud (Hybrid Cloud Services)

4) Community Cloud: The cloud infrastructure is shared by several organizations and supports a specific community that has shared concerns (e.g., mission, security requirements, policy, and compliance considerations). Government departments, universities, central banks etc. often find this type of cloud useful.
Examples of Community Cloud:

- Google Apps for Government
- Microsoft Government Community Cloud

C. Opportunities in Cloud Computing

Cloud computing presents an opportunity for business innovation, providing a platform to turn IT into a more effective and responsive business service. Ensuring on-demand access to pools of trusted infrastructure and services, cloud promises to de-couple business initiatives from the IT capabilities driving them.

1) Cost Reduction: Under constant pressure to reduce the cost of their operations, organizations of all sizes expect their IT to deliver more value for less expense. By eliminating up-front spend on IT and providing IT capability on a pay-per-use basis, cloud has the potential to restructure the IT budget, moving key applications and services to multi-tenancy architectures.

2) Business Growth: Whether the business challenge is expanding into new markets, attracting and retaining new customers, speeding up time-to-market for new products and services, cloud allows organizations to rapidly and easily scale up their operations to support business goals.

3) Rapid Innovation: Cloud has the potential to dramatically change the business landscape by enabling rapid innovation. Cloud removes barriers for greater collaboration, while reducing the risk, and cost, of both entering new markets and experimenting and testing new products and services.

4) Business Agility: Cloud model, with its flexible infrastructures and on-demand pricing, is starting to reset the expectations for IT within business. It presents the opportunity for IT to be re-cast as an enabler of business agility — rather than an inhibitor of business change.

D. Challenges in Cloud Computing

Companies are increasingly aware of the business value that cloud computing brings and are taking steps towards transition to the Cloud. A smooth transition entails a thorough understanding of the benefits as well as challenges involved. Like any new technology, the adoption of Cloud Computing is not free from issues. Some of the most important challenges are as follows.

1) Security and Privacy: The main challenge to cloud computing is how it addresses the security and privacy concerns of businesses thinking of adopting it. The fact that the valuable enterprise data will reside outside the corporate firewall raises serious concerns. Hacking and various attacks to Cloud infrastructure would affect multiple clients even if only one site is attacked. These risks can be mitigated by using security applications, encrypted file systems, data loss software, and buying security hardware to track unusual behavior across servers.

2) Service Delivery and Billing: It is difficult to assess the costs involved due to the on-demand nature of the services. Budgeting and assessment of the cost will be very difficult unless the provider has some good and comparable benchmarks to offer. The service-level agreements (SLAs) of the provider are not adequate to guarantee the availability and scalability. Businesses will be reluctant to switch to cloud without a strong service quality guarantee.

3) Interoperability and Portability: Businesses should have the leverage of migrating in and out of the Cloud and switching providers whenever they want, and there should be no lock-in period. Cloud Computing services should have the capability to integrate smoothly with the on-premise IT.

4) Reliability and Availability: Cloud providers still lack round-the-clock service; this results in frequent outages. It is important to monitor the service being provided using internal or third-party tools. It is vital to have plans to supervise usage, SLAs, performance, robustness, and business dependency of these services.

5) Performance and Bandwidth Cost: Businesses can save money on hardware but they have to spend more for the bandwidth. This can be a low cost for smaller applications but can be significantly high for the data-intensive applications.

Delivering intensive and complex data over the network requires sufficient bandwidth. Because of this, many businesses are waiting for a reduced cost before switching to the cloud.

III. MERITS OF CLOUD COMPUTING IN ENTERPRISE PERSPECTIVE

1) Cost Efficiency: Apart from storage and infrastructure costs, cloud services minimize all the other costs – updating and managing software or applications, hiring and training new staff and even decreased on-site energy costs.

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2) Enable IT Innovation: Probably the simplest benefit of the cloud – it is reshaping IT into a proactively innovative bunch that focuses less on manual system administration, and more on improving the technology. From integration, mobility to even user personalization, giving your IT the cloud can make their jobs much easier – and more enjoyable.

3) Facilities Consolidation: Many organizations are attracted to Cloud Computing by the savings that come from consolidating their data centers. Resources that can be pooled include storage, compute, memory, and network bandwidth. In addition, because cloud services are largely location independent, organizations can save on real estate and energy costs—and reduces their carbon footprint at the same time.

4) Labor Optimization: Because a cloud deployment does not require as much provisioning, software development, or maintenance as a conventional infrastructure, organizations can make better use of valuable expertise by redirecting the workforce from routine operational and maintenance duties to mission-critical tasks.

5) Asset Utilization: Many of today's public sector data centers are characterized by relatively poor asset utilization (often as low as 25 percent). There is also considerable duplication of equipment and effort across agencies and departments. When they can share applications, storage, and compute power, organizations do not have to build for peak usage that rarely occurs. Furthermore, they do not have to rely solely on the resources they own.

6) Mobility: If development platform, suite of office tools or custom content management system – cloud mobility enables access anywhere with a Web connection (just about).

7) Scalability: Pay only for the application and data storage we need.

8) Elasticity: Private cloud can be scaled to meet your changing IT system demands.

Table-1 will simply expose the advantages of Cloud Computing.

TABLE-I
DIFFERENCE BETWEEN CLOUD COMPUTING MODEL AND IN-HOUSE MODEL

CLOUD COMPUTING MODEL	IN-HOUSE MODEL
Little or no capital investment	Large up-front capital investment
IT staff free to attend to other concerns	Requires IT staff to attend to servers, applications, etc.
Service level guarantee	Nobody to blame but yourself
Physical security included	Extra physical security required
Security built into cloud platform	Additional security tools must be deployed and maintained
Backup and disaster recovery included	Must deploy backup and disaster recovery protocols

IV. MILESTONES OF CLOUD COMPUTING IN ENTERPRISE PERSPECTIVE

There are a number of reasons why you might not want to adopt Cloud Computing for your particular needs. Let's examine a few of the risks related to Cloud Computing:

1) Requires a constant Internet connection: Cloud Computing is impossible if there is no Internet connection. Since the Internet connect both your applications and documents. A dead Internet connection means no work, period and, in areas where Internet connections are few or inherently unreliable, this could be a deal-breaker. In offline, Cloud Computing simply doesn't work.

2) Stored data might not be secure: With Cloud Computing, all data is stored on the cloud. Cloud Computing companies say that data is secure, but it's too early in the game to be completely sure of that. Only time will tell if your data is secure in the cloud.

3) Reliability: Theoretically, data stored in the cloud is unusually safe, replicated across multiple machines. But on the off chance that data goes missing, you have no physical or local backup. (Unless you carefully download all your cloud documents to your own desktop—which few users do.) Put simply, relying on the cloud puts you at risk if the cloud lets you down.

4) Security and Privacy Compliance: Security can also be a concern in the cloud, particularly if you manage confidential data like customer information. Compliance in the cloud may also become an issue, which may require deploying a private cloud if you do have to secure private data. Making sure every existing tool, software and computer is compatible with the Web based service, platform or infrastructure. While on-site IT may have a little more control in managing integration and compatibility, it is often "what you see is what you get" in the cloud.

5) Resource Allocation: Resource Allocation mechanisms that provide an automated provisioning of resources. In this way, one of the main purposes of any Cloud Operator is to schedule developers' applications while aiming for the best utilization of available resources. Resource management in a Cloud environment is a hard problem, due to the scale of modern data centers; the heterogeneity of resource types and their interdependencies; the variability and unpredictability of the load; as well as the range of objectives of the different actors in a Cloud ecosystem.

6) Unpredicted Costs: Sure, the cloud can substantially reduce staff and hardware costs, but the price could end up being more than you bargained for. Migrating to the cloud is also an understated cost, and making sure the current systems that support your business while moving to the cloud could raise operating costs substantially.

7) Contracts and Lock-Ins: Traditional IT could be downsized, upsized, contracted-in and otherwise controlled by you. On-site hardware, software,

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infrastructure and platforms always carried some obligations, but now the cloud service provider, for the most part, has all the decision power. Vendor lock-in is also a major issue – as it was with old IT – and this could add up to cost and performance disadvantages later.

8) Changes in the IT Organization: The IT organization will be affected by Cloud Computing, as has been the case with other technology shifts. There are two dimensions to shifts in technology.

a. Acquiring the new skill sets to deploy the technology in the context of solving a business problem.
b. How the technology changes the IT role.

During Third generation language, training was delivered in separate manuals and the user used the computer to solve problems only down predefined paths. With the advent of fourth-generation languages, roles within IT, such as system analyst and programmer, became merged into analyst/programmer, users started to write their own reports, and new applications, including operational data stores, data entry, and query programs, could be rapidly deployed in weeks. IT's role will change once again: the speed of change will impact the adoption of cloud technologies and the ability to decompose mature solutions from hype to deliver real value from Cloud technology; and the need to maintain the controls to manage IT risk in the business will increase.

9) Political Issues: In the Cloud computing world, there is variability in terms of where the physical data resides, where processing takes place, and from where the data is accessed. Given this variability, different privacy rules and regulations may apply. Because of these varying rules and regulations, by definition politics becomes an element in the adoption of Cloud Computing, which is effectively multijurisdictional. For Cloud Computing to continually evolve into a borderless and global tool, it needs to be separated from politics. Currently, some major global technological and political powers are making laws that can have a negative impact on the development of the global Cloud. Providers have been unable to guarantee the location of a company's information on specified set of servers in a specified location. However, Cloud Computing service providers are rapidly adopting measures to handle this issue.

V. CONCLUSION

Adopting Cloud Computing technology should start by evaluating the economical processes of the organization. IT is supposed to be, an integrated part of a business. Cloud Computing need to support or improve the economical processes. Before adopting the cloud, the companies should learning their processes and evaluate the risks and advantages brought to their business. Since the small and mid-size companies have less complex processes, they should be the first category of businesses to use Cloud Computing services. Cost reduction is the one of the most important advantages offered by Cloud Computing. Related to the IT governance principles we should study first the value brought by cloud services to our organization. This value is defined by two characteristics: service and promise. Any organization has customers and the main scope is satisfying their needs. In my opinion, first the organization should define their objectives related to these elements of the balanced scorecard: financial, customer, security, control, internal and learning-development and then we should identify the way cloud services can maintain these objectives.

VI. FUTURE SCOPE

An effective cyber-security policy and resource allocation method should be comprehensive and encompass all (public and private sector) entities. The public and private sectors should continue to work together to:

- Identify and prioritize recent and evolving risk areas;
- Develop and validate effective measures and mitigation controls. This would involve establishing a standard that mandates certain minimum requirements to ensure an adequate level of electronic information exchange security.
- Enhance the effective resource allocation method.
- Ensure that these strategies are implemented and updated at the respective level.

It is reasonable to assume that higher levels of security can only be achieved at higher marginal costs. To encourage a culture of security, governments could incubate and create market incentives for cloud service providers to integrate security into the software and hardware and system development life cycle. An improved level and type of security is likely to increase the marginal cost of security violations, which in turn will reduce the marginal benefits of cybercrime.

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