Cloud Computing : An Industrial View

Madhavi Dhingra
Asst. Professor
Alkapuri, Gwalior, India
madhavi.dhingra@gmail.com

Alka Arora
Project Delivery Manager
IBM India Ltd.
alkarora.ibm@gmail.com

***Abstract* - Is cloud computing the savior of business? Is it a threat to data security? Does it signal the demise of the corporate IT function entirely? These are some of the questions in the current scenario. Cloud computing is a young phenomenon, and it is suffering through the growing pains typical of its age. Although the upside of cloud computing is considerable, numerous challenges lie ahead. This paper discuss about all the benefits of cloud computing, along with the challenges faced by the industries and software companies. It also presents solutions to some of the major challenges of cloud computing according to their needs.**

I. INTRODUCTION

Cloud computing can be defined as a pool of virtualized computing resources that allows users to gain access to applications and data in a web-based environment on demand[1].

II. BENIFITS OF CLOUD COMPUTING

Cloud computing provides a scalable online environment which facilitates the ability to handle an increased volume of work without impacting on the performance of the system. Cloud computing also offers significant computing capability and economy of scale that might not otherwise be affordable to businesses, especially small and medium enterprises (SMEs) that may not have the financial and human resources to invest in IT infrastructure.

There are various reasons for business organizations to move towards IT solutions that include cloud computing. First of all, organizations are only required to pay when they use certain resources. Secondly, organizations are not required to pay maintenance costs for managing various resources across the enterprise. Finally, cloud computing models provide business agility. Since the entire IT infrastructure can scale up or down to meet desired demands, organizations can easily meet the needs of rapidly changing markets to ensure that they are always on the leading edge for their consumers. In addition to lower expenses, enterprises can benefit from many other primary benefits associated with cloud computing. These can be summarized as follows [2]:

1. Reduced costs: Cloud computing reduces your hardware (computers), software (all those downloaded programs), networking management and overall IT expenses. In addition, with cloud computing, you pay for what you use.
2. Scalability: You can scale your business storage needs seamlessly rather than having to go out and purchase expensive programs or hardware. For instance you can run a cookbook project and pay only for all the cloud applications you need to create, implement and market the project on a month to month basis. You don't have to purchase a piece of hardware, buy software licenses or worry about overloading their servers.
3. Automatic Updates: There is no need for IT to worry about paying for future updates in terms of software and hardware.
4. Remote Access: Employees, partners and clients can access, and update information wherever they are, rather than having to run back the office.
5. Disaster Relief: With your company's data safely stored on secure data centers instead of your server room (previously known as your storage closet), losing power due to hurricanes, earthquakes or a construction worker cutting the power lines, you are back at work as long as you have an internet connection.
6. Easier change management of infrastructure, including maintenance and upgrades: Maintenance of cloud computing applications is easier, because they do not need to be installed on each user's computer and can be accessed from different places. Cloud vendors extensively virtualize and commoditize the underlying components to make it nondisruptive to replace and improve them frequently.
7. Immediate access to hardware resources :Clouds can provide an almost immediate access to hardware resources (for large enterprises, the ease of deploying a full service set without having to set up base infrastructure to support, it can be even more

attractive than cost savings; for start-ups because it allows you to test your business plan very quickly for little money)

8. Response Time: Cloud computing accomplishes a better response time in most cases than your standard server and hardware.
9. Offers improved agility : Offers improved agility to deploy solutions (instead of taking months or weeks, now you just need days or hours) and choice between vendors (particularly when cloud interoperability becomes more of a reality than it is today)
10. Even playing field for small firms: This allows small companies to compete more effectively with some of the larger businesses, balancing the playing field. Small businesses can utilize the same tools that Fortune 100 companies use and can do this because with cloud computing, business will only pay for what it needs.
11. Reduces the headaches of integrating and maintaining servers, storage & software, and eliminates mundane IT management tasks from skilled staff, leaving those tasks as the responsibility of the Cloud dedicated specialists. This allows staff to concentrate on what they are skilled at, and to focus on things that drive the business: service innovation.
12. Cloud Computing can lower IT barriers to innovation and increase interoperability between disjoint technologies

Cloud computing also allows clients to:

• avoid the expense and time-consuming task of installing and maintaining hardware infrastructure and software applications; and

• allow for the rapid provisioning and use of services to clients by optimising their IT infrastructure (Lewin 2009).

External hosting of applications and storage also ensures redundancy and business continuity in the event of a site failure.

A. Why Large Public and Private Sector Organizations Are Seriously Considering Cloud Computing?

Cloud Computing gives you access to completely different levels of scale and economics in terms of the ability to scale very rapidly and to operate IT systems more cost-effectively than previously possible, as we can see by the results of the following poll [3]:

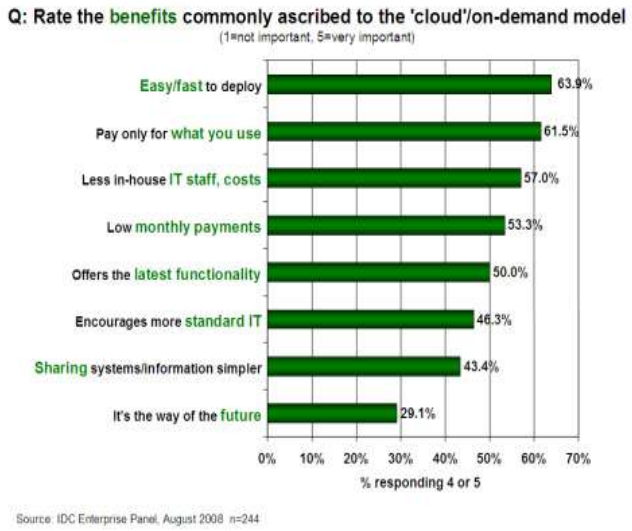

Fig. 1: Rating of Benefits, Source: IDC, August 2008

We can say that the three main categories of benefits are:

1. Faster delivery of service

2. Reduction of cost

3. IT department transformation (focus on innovation vs. maintenance & implementation)

During economic downturns, the ability to speed up time-to-value and time-to-market becomes more critical than ever, and represents probably the most important benefit of the Cloud. Many companies are delaying projects unless they deliver a return on investment within weeks. With Cloud Computing, companies can speed up those times, because No upfront capital investments and less financial risk (allows companies to shift from capital to operational expenses, which also means better cash flow and a more competitive business); no more upfront huge capital investments on on-premise infrastructure (applications, servers, network, maintenance, licenses, hardware, facilities, etc.) with uncertain payoff and that may never be needed. After all, what if the benefits don't materialize? With Cloud Computing, you only pay for what you use when you need it and you can terminate the contract.

III. CHALLANGES TO CLOUD ADOPTION

There are some challenges which need to be concerned about –

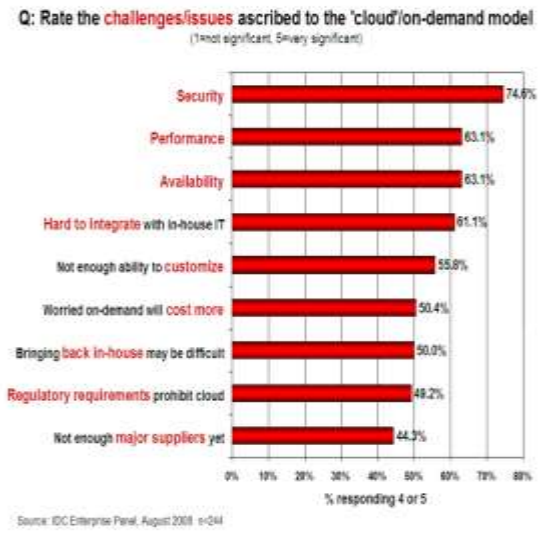

Fig. 2: Rating of Challenges, Source: IDC, August 2008

A. Cloud Security Challenges

- Trusting vendor's security model
- Customer inability to respond to audit findings
- Obtaining support for investigations
- Indirect administrator accountability
- Loss of physical control; Data dispersal and international privacy laws
- Proprietary implementations can't be examined
- Need for isolation management
- Multi-tenancy
- Logging challenges
- Data ownership issues
- Quality of service guarantees
- Dependence on secure hypervisors
- Attraction to hackers (high value target)
- Possibility for massive outages
- Encryption needs for cloud computing[4]

B. Four common cloud challenges and solutions business faces

1. Security - The relative security of cloud computing services is a contentious issue that may be delaying its adoption.[5]Physical control of the Private Cloud equipment is more secure than having the equipment off site and under someone else's control. Physical control and the ability to visually inspect the data links and access ports is required in order to ensure data links are not compromised. Issues barring the adoption of cloud computing are due in large part to the private and public sectors unease surrounding the external management of security-based services. It is the very nature of cloud computing-based services, private or public, that promote external management of provided services. This delivers great incentive to cloud computing service providers to prioritize building and maintaining strong management of secure services. [6] Security issues have been categorized into sensitive data access, data segregation, privacy, bug exploitation, recovery, accountability, malicious insiders, management console security, account control, and multi-tenancy issues. Solutions to various cloud security issues vary, from cryptography, particularly public key infrastructure (PKI), to use of multiple cloud providers, standardisation of APIs, and improving virtual machine support and legal support.[7,8,9]

Cloud computing offers many benefits, but it also is vulnerable to threats. As the uses of cloud computing increase, it is highly likely that more criminals will try to find new ways to exploit vulnerabilities in the system. There are many underlying challenges and risks in cloud computing that increase the threat of data being compromised. To help mitigate the threat, cloud computing stakeholders should invest heavily in risk assessment to ensure that the system encrypts to protect data; establishes trusted foundation to secure the platform and infrastructure; and builds higher assurance into auditing to strengthen compliance. Security concerns must be addressed in order to establish trust in cloud computing technology.

2. Regulatory Compliance - In order to obtain compliance with regulations including FISMA, HIPAA, and SOX in the United States, the Data Protection Directive in the EU and the credit card industry's PCI DSS, users may have to adopt *community* or *hybrid* deployment modes that are typically more expensive and may offer restricted benefits [10].

3. Choosing among public vs. private vs. hybrid clouds - The cloud providers offer different types of clouds (cloud deployment models) to an organization according to their business requirements, so an organization should make the right choice of cloud.

4. Integration and Interoperability - This is the ability of two or more systems work together in order to exchange

information and use that exchanged information. Many public cloud networks are configured as closed systems and are not designed to interact with each other. The lack of integration between these networks makes it difficult for organizations to combine their IT systems in the cloud and realize productivity gains and cost savings. To overcome this challenge, industry standards must be developed to help cloud service providers design interoperable platforms and enable data portability. Organizations need to automatically provision services, manage VM instances, and work with both cloud-based and enterprise-based applications using a single tool set that can function across existing programs and multiple cloud providers. In this case, there is a need to have cloud interoperability.

IV. Industry View On Challenges And Solutions

Organizations across all industries continue to share one commonality: squeezed budgets. In the midst of this challenge remains the need to deliver innovative services to stay competitive—whether that's building local government services for online citizens, enabling patients to email their doctors and access their health records online or enabling design engineers to collaborate across the world. Cloud computing, with its ability to spin out extra compute power within hours rather than months, is proving to be a key enabler.

While the capabilities of cloud computing can be applied to almost any industry, how those capabilities take shape varies widely. Similarly, the challenges of cloud computing are common across industries, but each industry's solution depends on how cloud is being applied.

To understand these challenges and solutions, we've taken a look at how cloud could be applied to five primary industry sectors:

- Communications, media and entertainment
- Financial services
- Public Sector, incorporating:
    - Government
    - Education
- Healthcare and Life Sciences
- Manufacturing, incorporating:
    - Automotive
    - Aerospace
    - Consumer Goods
    - High Tech/Electronics
    - Logistics
    - Oil & Gas
    - Retail
    - Utilities

A. *Media Service Providers Transforming Into Content Providers*

Regulatory changes have leveled the playing field for communication service providers and media companies. The cloud is enabling service providers to create and deliver new services quickly without incurring huge losses if a new venture fails. Now cable companies, satellite operators and carriers can offer media content streaming themselves, rather than just the transport for other providers to deliver content. This opens up a brand new area of business possibilities for media service providers.

B. *Financial Services Companies Find New Revenue Streams*

Financial institutions are already using clouds for non-core activities, such as data backup, storage and management. But the cloud has potential for handling more sophisticated functions, too. For example, some banks are using the public cloud's massive scalability to carry out mathematical simulations much faster than is possible using in-house facilities.

And now that some traditional forms of revenue are disappearing due to regulatory changes, the cloud will serve as a key enabler for financial institutions looking for new revenue streams.

C. *More Efficiency And Integration In The Public Sector*

To help manage the vast repositories of information that government agencies have to manage, public or hosted private clouds are a cost-effective option. And more cloud service providers are seeking certification and accreditation to address the security needs of government organizations. Cloud also enables tighter collaboration of different government agencies. For example, a community cloud can serve participants with common goals and interests.

D. *Healthcare Organizations Navigate Complex Regulatory Landscape*

Cloud is allowing healthcare organizations to comply with the tremendous changes that are occurring in the industry. Cloud could help organizations speed up deployment of electronic health records, helping avoid the financial

penalties of failing to comply. The cloud is also opening the door for organizations to deliver innovative new services, such as enabling patients to communicate with physicians using mobile applications, 24 hours a day.

E. Manufacturers Become More Competitive On A Global Scale

Cloud helps manufacturers meet the challenges of globalization. The cloud enables partners and employees across the world to collaborate on designs. The speed with which the cloud enables manufacturers to operate helps increase their competitiveness against new players in emerging nations[11].

V. Conclusion

By discussing the benefits of cloud computing, it is clear that Cloud computing is promising to become the most important technology development since the Internet. Cloud computing can speed time to market and provide important flexibility, enabling much greater responsiveness to customer, market and economic changes.

Certainly, many challenges, from data security to service levels, must be resolved before cloud computing can reach its full potential. Some of the challenges are sorted out, others are still there to be solved. In all, cloud computing still has a long way to go before proving its full value.

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