Computing in the Cloud: An Effective Paradigm for Business

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Abstract— **Information Technology has been affecting nearly every facet of human endeavor including the domain of Business. The use of information technology in organizations is inevitable, be it any type of organization. At the same time, the cost of these resources is a constraint for a large number of organizations. The concept of cloud computing is changing the possibilities for computing by giving individuals and small and mid-sized businesses access to an array of powerful applications and services through the Internet that were once unavailable to all but the largest enterprises. The business benefits of cloud computing are extensive and significant. This paper discusses cloud computing and its increasing applications in the domain of business.**

Keywords- business organizations, cloud computing – segments, characteristics, types, service providers.

1. INTRODUCTION

Information Technology (IT) has been affecting nearly every facet of human endeavor. Business as we know it today would, in many cases, be impossible to transact without IT. The role of IT in business sector certainly is of a great importance, it enables businesses to effectively and successfully plan, manage, execute strategies which lead to profit. Information technology has enabled organizations across the world to work in an efficient manner; it plays a very important role in effective management and running of a business. The use of information technology in organizations is inevitable, be it any type of organization. Moreover, the impact of information technology on business is on the rise, as several advancements are focused on implementation in various business processes. In recent years, advances in information technology have made substantial improvements in many aspects of business. By examining highly successful businesses and exploring how they have improved their business using technology, it is possible to identify the impact of information technology on them.

II. CLOUD COMPUTING

Over the years there has been a revolutionary change in the way computers have been used by business. From huge mainframes in the 1960s, minicomputers in the 1970s, personal computers in the 1980s, cell phones and smart phones in the last decade, to the emergence of cloud computing. What technologists like to call "*the cloud*" is the idea of computing on demand. Just as you turn on a tap to get water or plug into a wall to get electricity, the features and functions of stand-alone computers today can be streamed to you over the Internet. Instead of installing all the hardware, software and network equipment at the premises of each user, cloud computing involves centralizing the computing resources (both hardware and software) on the Internet (the cloud) and making these available to those who need it, when needed, which can eliminate wasted resources like idle CPU, storage and other computing resources.

The cloud is changing the possibilities for computing by giving individuals and small and mid-sized businesses access to an array of powerful applications and services through the Internet that were once unavailable to all but the largest enterprises. Its impact will be spectacular on both consumers and firms. On one hand, consumers will be able to access all of their documents and data from any device (the personal laptop, the mobile phone, PDA …), as they already do for email services, and to exploit impressive computational capabilities. On the other hand, firms will be able to rent computing power (both hardware and software) and

storage from a service provider and to pay on demand, as they already do for other inputs as energy and electricity. While the former application will affect our lifestyles, the latter will have a profound impact in terms of cost reductions for businesses.

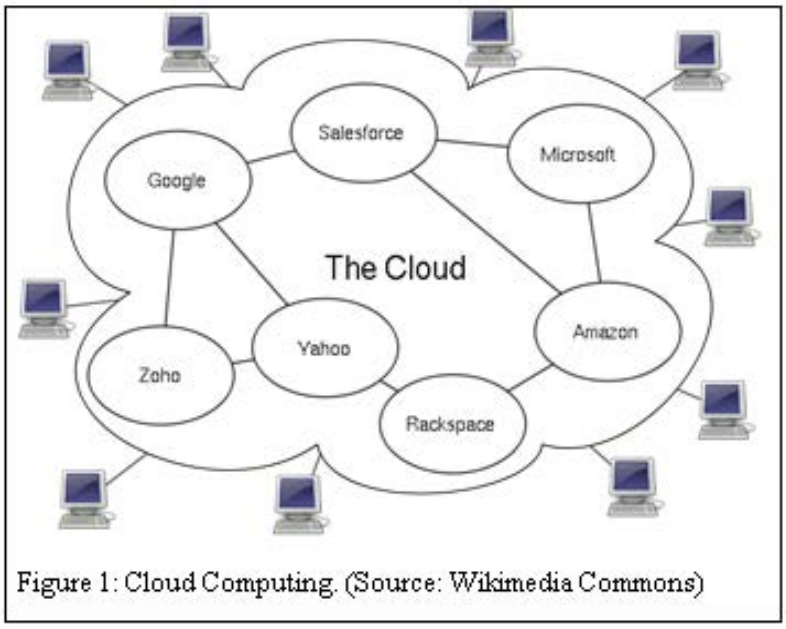

Figure 1: Cloud Computing. (Source: Wikimedia Commons)

A simple example of cloud computing is Gmail or any email services. You do not need software or a server to use them. All a consumer would need is just an internet connection and you can start sending emails. The server and email management software is all on the cloud (internet) and is totally managed by the cloud service provider (Google, Yahoo etc…) The consumer gets to use the software alone and enjoy the benefits. Figure 1 shows diagrammatic representation of cloud computing. Here customers need not purchase the software and hardware individually, these are provided in the cloud by the service providers like Amazon, Google, Salesforce …, customers subscribe to these services and pay for them according to their usage.

The definitions of cloud computing are nearly as numerous as its applications. According to National Institute of Standards and Technology (NIST), cloud computing is 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[1].

2.1 Relevance of Cloud Computing

Computing as we know today reflects a paradox – while on one hand, computers continue to become exponentially more powerful and the per-unit cost of computing continues to fall rapidly, on the other hand, as computing becomes more pervasive within the organization, the increasing complexity of managing the whole infrastructure of disparate information architectures and distributed data and software has made computing more expensive than ever before to an organization. Organizations are also increasingly discovering that their substantial capital investments in information technology are often grossly underutilized. Surveys on corporate data centers have found that most of the servers were using just 10-30% of their available computing power, while desktop computers have an average capacity utilization of less than 5% [2]. Equally significant are the maintenance and service costs that have proved to be a drain on scarce corporate resources. The emergence of cloud computing represents a fundamental change in the way information technology services are utilised by business.

Cloud computing represents a convergence of two major trends in IT – (a) IT efficiency, whereby the power of modern computers is utilized more efficiently through highly scalable hardware and software resources and (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 [3]. Economically, the main appeal of cloud computing is that customers only use what they need, and only pay for what they actually use. Resources are available to be accessed from the cloud at any time, and from any location via the internet. There is no need to worry about how

things are being maintained behind the scenes – you simply purchase the IT service you require as you would any other utility. Because of this, cloud computing has also been called *utility computing*, or *IT on demand*.

2.2 Types of cloud services

There are various types of cloud services available. They are mainly of five types, which are discussed below [4].

Software as a Service (SaaS): Making use of this service, applications are run and interacted with, via a web browser, hosted desktop or remote client. A cloud application eliminates the need to install and run the application on the customer's own computer, thus removing the burden of software maintenance, ongoing operation and support. Google Apps, Salesforce.com and social network applications such as Facebook are examples of SaaS.

Platform as a Service (PaaS): This service provides API-level access to a cloud infrastructure layer. Thus, a computing platform or framework as a service is provided. Examples are Microsoft Azure and Google App Engine.

Infrastructure as a Service (IaaS): This service provides the client with a dynamically scalable pool of compute and/or storage resources. The infrastructure includes grids of virtualized servers, networks and other hardware appliances delivered as either Infrastructure 'Web Services' or 'cloud centres'. Examples include Amazon's Elastic Compute Cloud, Google gears and Simple Storage Service.

Business Process as a Service (BPaaS): Any business process (for example, payroll, printing, ecommerce) delivered as a service over the Internet and accessible by one or more web enabled interfaces (PC, smart devices and phones) can be considered as a *Business Process as a Service (BPaaS)*. Advertising services such as Google Adsense, IBM Blueworks Live for business process management are some of the several publicly available services.

Data as a Service (DaaS): **This** describes the ability to define data lists in a cloud service and then query against this data. With the recent surge in cloud computing, many service providers are starting to provide data on-demand, thus opening the world of high-powered analytics and other data-focused offerings to a host of organizations that previously could not afford the cost of entry. Examples are Google Public Data and Xignite Capital Markets Data.

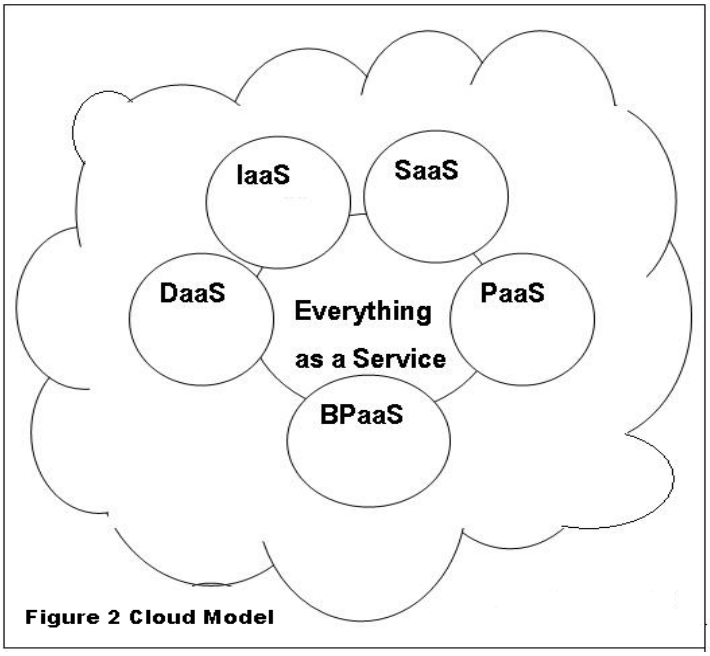

Figure 2 Cloud Model

Cloud model (figure 2) is getting evolved by adding new services to it. In simplest terms, the cloud is the next stage in the evolution of the internet. Through the cloud, everything will be delivered as a service, from computing power to business processes as well as personal interactions. [**5]**

2.3 Characteristics of Cloud Computing

Characteristics of cloud computing that distinguishes it from traditional form of computing can be classified into three groups (figure 3) [6].

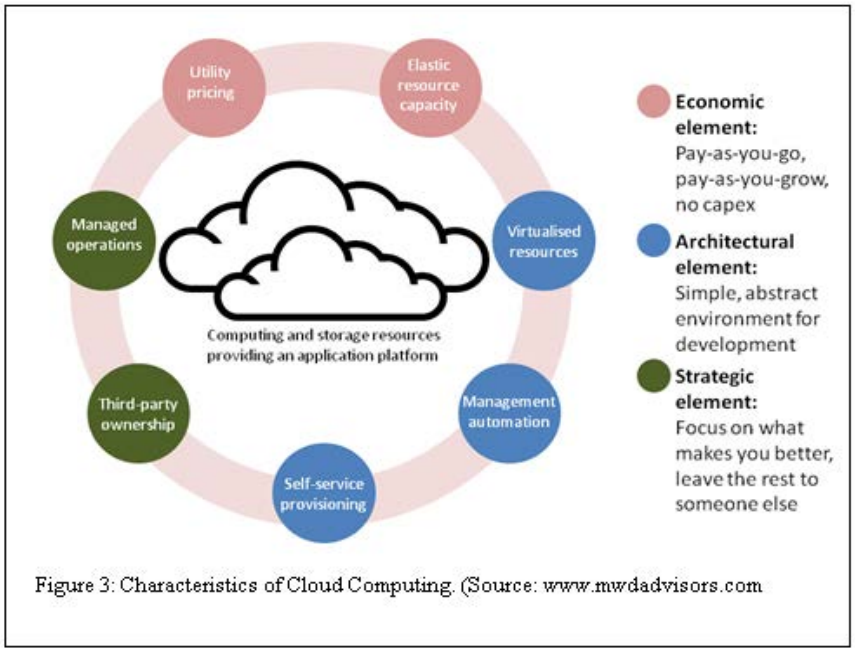

Figure 3: Characteristics of Cloud Computing. (Source: www.mwdadvisors.com

2.3.1 Economic: The economic value of Cloud is largely about being able to align the timing and size of the investments you make with the value you receive. Cloud Computing is based on utility-based pricing model, where users of the platform consume computing and storage services on demand and pay for them according to usage, thus incurring only an operating expenses ("pay as you go"), instead of paying for infrastructure resources up-front using capital expenditures. Also cloud computing differs in the way it scales computing and storage resources up and down. Instead of tapping from a fixed set of resources, users can add or remove capacity at will, almost instantaneously, and only pay for what they actually use. While utility pricing let users pay as per usage, elastic resource capacity ("pay as you grow") lets them pay as they grow (or shrink). You do not pay millions for infrastructure that only delivers value months or years later; you pay for what you actually need, when (or soon after) you use it. And you do not purchase (capex) an asset that is idle most of the time.

For example, a Director of Sales can create CRM accounts for ten of her sales people on Salesforce.com by using her corporate credit card, without having to ask the CFO for a budget, and without having the IT Department initiate a requisition process for a new server ("pay as you go"). Similarly, the Director of Sales can add five more accounts for the sales people that were recently added to her team following the merger with another company, without having to worry about adding new servers or buying more hard drives ("pay as you grow").

2.3.2 Architectural: The architectural value of Cloud is about having a simple, consistent abstract environment presented to developers and operations folks that hides a lot of complexity, making it much quicker and easier to develop and deploy applications. Unlike traditional computing, most Cloud Computing platforms usually standardize on a single kind of CPU, a single hypervisor, a single operating system, and a single database. This results in obvious business benefit in the way of dramatic reduction of operating costs through aggressive management automation. Similarly, while traditional Application Service Provider (ASP) model required dedicated servers that had to be provisioned for each customer, which meant that technical resources had to be involved every time a new customer would be signed resulting in hefty setup fees and service taking a few days to become operational. But with Cloud Computing, self-service provisioning is possible, so business end users like our Director of Sales can provision applications and user accounts in a few mouse clicks, and these become available instantly.

2.3.3 Strategic: The strategic value of Cloud might be easily conflated with the economic value, but it is different. Cloud platforms help you focus on what makes your organisation more effective and different, and leave all the other stuff to a third party that is dedicated to doing a great job for a competitive price. This is about focus and it is also about avoiding having to train people to do things that fundamentally do not add value to your organization. Thus through third-party ownership cloud computing is a new form of outsourcing that helps in the allocation of scarce capital resources to their core business.

2.4.Types of Cloud

2.4.1.Public Cloud— A public cloud is available over the internet to everyone. The cloud provider manages and owns everything from operations and facilities to computing resources. Popular public clouds are Amazon EC2, Google App Engine and MicrosoftAzure.

2.4.2.Private Cloud— A private cloud is available only to trusted users of an organization or group. Everything in a private cloud can be managed either by the organization or the cloud provider.

2.4.3 .Hybrid Cloud— A hybrid cloud is a mix of multiple public and private clouds and it addresses the challenges of a pure public or private cloud environment.

2.4.4.Community Cloud— A community cloud is accessible to the members of a larger community comprised of different organizations or groups, and where partner organizations and the cloud provider co-manage everything from operations to facilities.

III. BENEFITS OF CLOUD COMPUTING IN BUSINESS DOMAIN

For sure, the diffusion of cloud computing is going to create a solid and pervasive impact on the global economy. By altering the basic economics of access to computing and storage, the cloud has the potential to reshape how businesses are organized and operate. Moreover, cloud computing will also exert a fundamental impact on the cost structure of all the industries using hardware and software, and therefore it will have an indirect but crucial impact on their market structures [7]. There are many reasons why organisations of all sizes and types are adopting this model of IT. It provides a way to increase capacity or add capabilities on the fly without investing in new infrastructure, training new personnel, or licensing new software. Ultimately, it can save companies a considerable amount of money. Some of the major benefits that cloud computing can offer for organizations are:

Removal / reduction of capital expenditure: Customers can avoid spending large amounts of capital on purchasing and installing their IT infrastructure or applications by moving to the cloud model. Capital expenditure on IT reduces available working capital for other critical operations and business investments. Cloud computing offers a simple operational expense that is easier to budget for month-by-month, and prevents money being wasted on capital assets. Additionally, customers do not need to pay for excess resource capacity in-house to meet fluctuating demand. This generalized reduction of the fixed costs of entry and production, in terms of shifting fixed capital expenditure in IT into operative costs depending on the size of demand and production contributes to reduce the barriers to entry especially for SMEs.

Reduced administration costs: IT solutions can be deployed extremely quickly and managed, maintained, patched and upgraded remotely by your service provider. Technical support is provided round the clock by service providers for no extra charge, reducing the burden on IT staff [8]. This means that they are free to focus on business-critical tasks, and businesses can avoid incurring additional manpower and training costs.

Improved resource utilization: Combining resources into large clouds reduces costs and maximises utilisation by delivering resources only when they are needed. Businesses need not worry about over-provisioning for a service whose use does not meet their predictions, or under-provisioning for one that becomes unexpectedly popular. Moving more and more applications, infrastructure, and even support into the cloud can free up precious time, effort and budgets to concentrate on the real job of exploiting technology to improve the mission of the company. It really comes down to making better use of your time – focusing on your business and allowing cloud providers to manage the resources to get you to where you need to go. Sharing computing power among multiple tenants can improve utilisation rates, as servers are not left idle, which can reduce costs significantly while increasing the speed of application development.

Economies of scale: Cloud computing customers can benefit from the economies of scale enjoyed by providers, who typically use very large-scale data centres operating at much higher efficiency levels, and multi-tenant architecture to share resources between many different customers. This model of IT provision allows them to pass on savings to their customers.

Scalability on demand: Scalability and flexibility are highly valuable advantages offered by cloud computing, allowing customers to react quickly to changing IT needs, adding or subtracting capacity and users as and when required and responding to real rather than projected requirements. Even better, because cloud-computing follows a utility model in which service costs are based on actual consumption, you only pay for what you use. Customers benefit from greater elasticity of resources.

Quick and easy implementation: Without the need to purchase hardware, software licences or implementation services, a company can get its cloud-computing arrangement off the ground in minutes.

Helps smaller businesses compete: Historically, there has been a huge disparity between the IT resources available to small businesses and to enterprises. Cloud computing has made it possible for smaller companies to compete on an even playing field with much bigger competitors. It dramatically lowers the cost of entry for smaller firms trying to benefit from compute-intensive business analytics that were hitherto available only to the largest of corporations. These computational exercises typically involve large amounts of computing power for relatively short amounts of time, and cloud computing makes such dynamic provisioning of resources possible. Renting IT services instead of investing in hardware and software makes them much more affordable, and means that capital can instead be used for other vital projects[9].

Quality of service: Cloud service providers usually offer 24/7 customer support and an immediate response to emergency situations. They ensure that your applications and/or services are always online and accessible.

Anywhere Access: Cloud-based IT services let you access your applications and data securely from any location via an internet connection. It's easier to collaborate too; with both the application and the data stored in the cloud, multiple users can work together on the same project, share calendars and contacts etc. Due to the 'anywhere access' nature of the cloud, users can simply connect from a different location – so if your office connection fails and you have no redundancy, you can access your data from home or the nearest Wi-Fi enabled point. Because of this, flexible / remote working is easily enabled, allowing you to cut overheads and meet new working regulations.

Disaster recovery / backup: Most organizations do not have adequate disaster recovery or business continuity plans, leaving them vulnerable to any disruptions that might occur. Cloud computing providers provide an array of disaster recovery services, from cloud backup (allowing you to store important files from your desktop or office network within their data centres) to having ready-to-go desktops and services in case your business is hit by problems. This mean you donot have to worry about worry about data backup or disaster recovery, as this is taken care of as part of the service. Files are stored twice at different remote locations to ensure that there's always a copy available 24 hours a day, 7 days per week.

Helps innovations and entrepreneurship: Cloud computing can lower IT barriers to innovation, as can be witnessed from the many promising startups, from the ubiquitous online applications such as Facebook and Youtube to the more focused applications like TripIt (for managing one's travel) or Mint (for managing one's personal finances). Cloud computing also represents a huge opportunity to many third-world countries that have been so far left behind in the IT revolution due to lack of resources for widespread deployment of IT services.

A recent survey was conducted by Google and VansonBourne [10] to study the impact of cloud computing on business. The survey finds that the majority believe that the cloud computing brings many business benefits, such as increased flexibility(57%),capacity(56%) and scalability (53%). It is also seen that 38% have already adopted cloud computing and a further 29% are making plans to adopt it. Another finding is that 96% believe that cloud computing provides their business with quantifiable benefits such as reduces IT maintenance costs, reduced IT spend, reduced operational costs and improved process efficiency; 94% say that cloud computing is important to the success of their organization over the next twelve to eighteen months; 55% believe that cloud computing offers better value than traditional outsourcing. It is also seen that 61% believe that cloud computing increases the IT department's ability to innovate, and 58% believe it increases the IT department's contribution to corporate strategy.

IV. SERVICE PROVIDERS IN CLOUD COMPUTING

There are many players in the cloud computing arena. These service providers have offerings, covering all the levels of cloud computing like IaaS, PaaS and SaaS. Some of the prominent providers in international markets are:

Amazon - The number one company for Cloud based Service provider, specializes in IaaS. It offers through Amazon Web Services (AWS): Amazon Elastic Compute Cloud (EC2), Amazon SimpleDB, Amazon CloudFront, Amazon SQS. It claims to have 82 billion objects stored in Amzon S3 (Simple Storage Service) [11].

Google - Specializes in PaaS & SaaS. As SaaS it offers Google Apps: a web-based communication, collaboration & security apps which includes Gmail, Google Calendar, Google Talk, Google Docs & Google Sites. As PaaS it offers Google App Engine: a platform for developing and hosting web applications in Google-managed data centers [12].

VMware - It offers vCloud: Run, secure and manage applications in the private cloud or have them federated on-demand to partner-hosted public clouds. vCloud is giving a tough competition to more established Amazon's AWS [13].

SALESFORCE.COM - Leader in SaaS. Offers Salesforce CRM (Sales Cloud 2, Service Cloud 2) & Force.com Platform (Custom Cloud 2, Development Platform)[14].

MICROSOFT - Specializes in PaaS. It offers Azure, a Windows-as-a-service platform consisting of the operating system and developer services that can be used to build and enhance Web-hosted applications[15].

IBM – IBM has Blue Cloud computing platform. IBM Smart Business Development and Test on the IBM Cloud is designed to augment and enhance software development and delivery capabilities, particularly in large enterprises [16].

NETSUITE - Specializes in SaaS. It offers SuitCloud Platform: a comprehensive offering of on-demand products, development tools and services designed to help customers and software developers take advantage of the significant benefits of cloud computing. Also a leading provider of web-based Business Software Suite for CRM, ERP tools and Accounting[17].

The above section has discussed some of the service providers and their offerings in cloud computing. Their number and types of offering is increasing at a very fast rate and all those cannot be discussed here. The above sections discussed one of the recent advancements seen in IT known as Cloud Computing and its implications on the business domain. As we have seen that the developments in IT have been rapid and its absorption by the industry have been equally fast, so will be the case with cloud computing [18]. The adoption of cloud computing by businesses will surely result in increased efficiency and effectiveness and thus leading to competitive advantage for its users. Cloud computing perhaps makes the most sense for businesses, as the service offers increased flexibility and security at a price precipitously lower than the old paradigm of hardware and software upgrades[19]. And, the adoption of cloud computing by businesses will surely result in increased efficiency and effectiveness and thus leading to competitive advantage for its users.

V. CONCLUSION

This paper discusses briefly about cloud computing and its increasing applications in business. IT has become an inseparable part of business organizations. But with the advent of cloud computing, organizations can get augmented benefits of IT at a lesser cost, this making them more valuable in the competitive market. The business benefits of cloud computing are extensive and are not limited to being benefits within the IT department. The benefits are significant and affect the entire enterprise.

REFERENCES

[1] Rob Lovell, White Paper: Introduction to cloud computing, ThinkGrid, 2009.
[2] Jeffrey, F. Rayport and Andrew Heyward, Envisioning the Cloud: The Next Computing Paradigm, 2009, www.market spaceglobal.com.
[3] Kim W, Cloud Computing: Today and Tomorrow Journal of Object Technology, 8(1): p. 65-72, 2009.
[4] Abhinav Garg, Sapient global Markets . cloud computing for the financial services industry. *www.sapient.com/assets*
[5] Shane Robison, Everything as a service. http://www.hp.com/hpinfo/initiatives/eaas/index.html
[6] Neil Ward-Dutton, Strategic Insight: Exploring the business value of Cloud Computing, MWD Advisors, 2009.
[7] Wyld, C. David, Moving to the Cloud: An Introduction to Cloud Computing in Government, E-Government Series, IBM Centre for the Business of Government, 2009.
[8] Gomolski, B. U.S. IT Spending and Staffing Survey, 2005, Gartner Research .
[9] Marston, Sean R., Li, Zhi, Bandyopadhyay, Subhajyoti, Ghalsasi, Anand and Zhang, Juheng, Cloud Computing: The Business Perspective. November 23, 2009. Available at SSRN: http:// ssrn.com/abstract=1413545.
[10] Vanson Bourne and google The business impact of the cloud. http://www.fiveinthecloud.com/static/pdf/EMEA_CFO_Research_Business_Impact_of_the_Cloud..pdf
[11] Amazon Cloud Drive, www.amazon.com/clouddrive.
[12] Advantages of google cloud, www.google.com/apps/intl/business/cloud.html.
[13] V.M. Ware, Addressing Desktop Challenges, VMWare, 2008.
[14] salesforce.Why salesforce is the best CRM option for all business sizes
[15] Microsoft . windowsAzure – powerful capabilities http://www.windowsazure.com.
[16] Empower your enterprise with cloud computing, www.ibm.com.
[17] netsuite, The #1 cloud ERP/financials software suite www.netsuite.com
[18] The Economic Times. Cloud computing in India to grow 40 pc by 2014: IDC study. 2 Dec, 2010.
[19] Rob Borium, 5 Reasons cloud computing is the future.www.business2community.com/tech-gadgets