A Study on Cloud computing & its impact on Job Creation

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Abstract
With the significant advancement in information technology over the last half century cloud computing emerging as a power that creates job opportunities and storage of data securely . As a result of the shift to cloud, there is growing demand for professionals and managers that are more focused on business development than they are in application development. There will be greater opportunities for enterprise architects, and some offshoots will include cloud architects, cloud capacity planners, cloud service managers and business solutions consultants. Jobs being created may not always bear the term "cloud" in their titles, but cloud will form the core of their job descriptions. It is found that IT cloud services helped organizations of all sizes and all vertical sectors around the world generate more than $400 billion in revenue and 1.5 million new jobs. In the next four years, the number of new jobs will generate in million. Cloud computing is attractive to business owners as it eliminates the requirement for users to plan ahead for provisioning, and allows enterprises to start from the small and increase resources only when there is a rise in service demand.

Keywords Cloud computing · Data Storage·

I. INTRODUCTION:

Cloud computing is based on a collection of many old and few concepts. It is a model for enabling convenient on demand network access to a shared pool of configurable computing such as networks, server, storage, applications and services. In such a model, users access services based on their requirements without regard to where the services are hosted or how they are delivered. Concept of cloud computing fills a perpetual need of IT- a way to increase capacity or add capabilities on the fly mode without investing new infrastructure training new personnel or licensing new software. Cloud computing describes a new supplement and delivery model for IT based services based on input and typically involves virtualized resources in this information technology era. The emergence of cloud computing has made a tremendous impact on the Information Technology (IT) industry over the past few years, where large companies such as Google, Amazon and Microsoft strive to provide more powerful, reliable and cost-efficient cloud platforms, and business enterprises seek to reshape their business models to gain benefit from this new paradigm.

Cloud computing is an extension of this paradigm wherein the capabilities of business applications are exposed as sophisticated services that can be accessed over a network. Cloud

service providers are incentivized by the profits to be made by charging consumers for accessing these services. Consumers, such as enterprises, are attracted by the opportunity for reducing or eliminating costs associated with "in-house" provision of these services. However, since cloud applications may be crucial to the core business operations of the consumers, it is essential that the consumers have guarantees from providers on service delivery. Typically, these are provided through Service Level Agreements (SLAs) brokered between the providers and consumers.
This paper is primarily divided into two parts.
The first part examines:

- Presenting the 21st century vision of computing and describing the terms associated with cloud computing and its service providers.
- Differentiating Cloud computing from two other widely explored computing paradigms: Cluster computing and Grid computing.

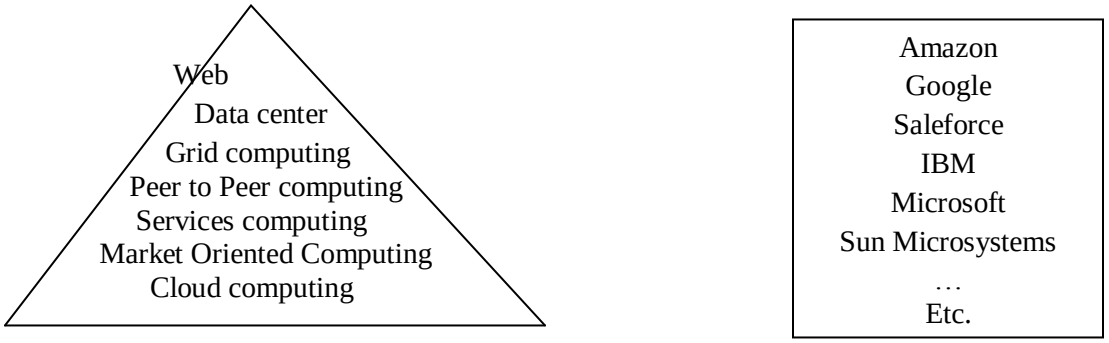
The second part examines:

- Focusing on Cloud computing architecture and services of cloud.
- Effect of cloud computing on job description/creation as well as research challenges.

II. CLOUD COMPUTING IN 21st CENTURY :

The creation of the Internet has marked the foremost milestone towards achieving this grand 21st century vision of '*computer utilities*' by forming a worldwide system of computer networks that enables individual computers to communicate with any other computers located elsewhere in the world. This internetworking of standalone computers reveals the promising potential of utilizing seemingly endless amount of distributed computing resources owned by various owners.

There are lots of terms have been included with cloud computing day by day.



(a) Hierarchy of Computing **(b) Cloud Service Providers**

Fig. 1

Today there are lots of Cloud Service Providers. These all service Providers have began to establish new *data centers* for hosting cloud computing applications in various locations around the world to provide redundancy and ensure reliability in case of site failures. Providers can provide access virtual machine as a service such as Amazon Elastic compute cloud, it allows consumer to install their own applications from underlying hardware and other virtual machine machines.
Grid computing enables the sharing, selection, and aggregation of a wide variety of geographically distributed resources including supercomputers, storage systems, data sources,

and specialized devices owned by different organizations for solving large-scale resource-intensive problems in science, engineering, and commerce.

Peer-to-Peer (P2P) computing allows peer nodes (computers) to share content directly with one another in a decentralized manner. In pure P2P computing, there is no notion of clients or servers since all peer nodes are equal and concurrently be both clients and servers. The goals of P2P computing include cost sharing or reduction, resource aggregation and interoperability, improved scalability and reliability, increased autonomy, anonymity or privacy, dynamism, and ad-hoc communication and collaboration.

Services computing focus on the linkage between business processes and IT services so that business processes can be seamlessly automated using IT services. Examples of services computing technologies include Service Oriented Architecture (SOA) and Web Services. The SOA facilitates interoperable services between distributed systems to communicate and exchange data with one another, thus providing a uniform means for service users and providers to discover and offer services respectively.

Market-oriented computing views computing resources in economic terms such that resource users will need to pay resource providers for utilizing the computing resources. Therefore, it is able to provide benefits, such as offering incentive for resource providers to contribute their resources for others to use and profit from it, regulating the supply and demand of computing resources at market equilibrium, offering incentive for resource users to back off when necessary, removing the need for a central coordinator (during the negotiation between the user and provider for establishing quality of service expectations and service pricing), and enabling both users and providers to make independent decisions to maximize their utility and profit respectively. *Cloud computing* enables business and users to access application from anywhere in the world on demand.

The traditional cloud computing service provider is divided as the infrastructure providers who supervise cloud platforms and lease resources according to a pay-per-use based model, and service providers, who rent resources from more infrastructure providers to serve the end users.

From the past few years , the cloud computing has made a tremendous impact on the Information Technology (IT) industry, where large companies such as Google, IBM, Amazon and Microsoft struggle to provide more powerful, reliable and cost-efficient cloud platforms, and business enterprises seek to find new paradigm in their business models. Indeed, cloud computing provides several compelling features that make it attractive to business owners, like Less up-front investment, Lowering operating cost, Highly scalable, Easy access, Reducing business risks and maintenance expenses.

Today, the latest paradigm to emerge is that of Cloud computing which promises reliable services delivered through next-generation data centers that are built on virtualized compute and storage technologies. Consumers will be able to access applications and data from a "Cloud" anywhere in the world on demand. The consumers are assured that the Cloud infrastructure is very robust and will always be available at any time.

III. COMPARISION BETWEEN CLUSTER, GRID & CLOUD:

Cluster: we can say that a cluster is a type of parallel and distributed system, which consists of a collection of inter-connected stand-alone computers working together as a single integrated computing resource.

For eg. Peer-to-Peer (P2P) computing allows peer nodes (computers) to share content directly with one another in a decentralized manner. In pure P2P computing, there is no notion of clients or servers since all peer nodes are equal and concurrently be both clients and servers.
Grid: A Grid is a type of parallel and distributed system that enables the sharing, selection, and aggregation of geographically distributed 'autonomous' resources dynamically at runtime depending on their availability, capability, performance, cost, and users' quality-of-service requirements. For eg. Client server model like many node are inter linked together with internet involve sharing, selection of data etc.

Table 1: Comparison between Characteristics of Clusters, Grids, and Cloud Systems.

Characteristics	Clusters	Grids	Clouds
Ownership	Single	Multiple	Single
Size	100s approx.	1000s approx.	100s to 1000s approx.
Operating System	OSs Linux/ Windows	Any standard operating system.	A hypervisor (VM) on which multiple OSs run.
Population	It includes set of dedicated linked Computers.	It includes high-end computers i.e. Servers, clusters.	It includes commodity computers and high-end servers and network attached storage.
Interconnection	These are Dedicated.	Mostly Internet	Internet dedicated
Network | Speed	High-end with low latency and high bandwidth.	High latency and low bandwidth.	High-end with low latency and high bandwidth.
Security	Traditional Login/password-based Medium level of Privacy depends on user privileges.	Public/private key pair based authentication and mapping a user to an account. Limited support for privacy.	Each user/application is provided with a virtual machine. High security/privacy is guaranteed.
Resource Management	Centralized	Distributed	Centralized/Distributed
Allocation	Centralized	Decentralized	Both centralized/decentralized
Pricing of Services	Limited, not open market.	Dominated by public good or privately assigned	Utility pricing, discounted for larger customers.
User Management	Centralized	Decentralized/Virtual Organization based.	Centralized or can be delegated to third party.

Cloud is a type of parallel and distributed system consisting of a collection of inter-connected and Virtualized computers that are dynamically provisioned and presented as one or more unified computing resource(s) based on service-level agreements established through negotiation between the service provider and consumers .Cloud computing platforms possess characteristics of both clusters and Grids, with its own special attributes and capabilities such strong support for virtualization, dynamically compassable services with Web Service interfaces, and strong support for creating 3rd party, value added services by building on Cloud compute, storage, and application services

IV. **CLOUD COMPUTING ARCHITECTURE:** The architecture of a cloud computing environment can be divided into 4 layers: the hardware/datacenter layer, the infrastructure layer, the platform layer and the application layer, as shown in Fig.1. We describe each of them in detail:

The hardware layer: This layer is responsible for managing the physical resources of the cloud, including physical servers, routers, switches, power and cooling systems. In practice, the hardware layer is typically implemented in data centers. A data center usually contains thousands of servers that are organized in racks and interconnected through switches, routers or other fabrics. Typical issues at hardware layer include hardware configuration, fault tolerance, traffic management, power and cooling resource management.

The infrastructure layer: Also known as the virtualization layer, the infrastructure layer creates a pool of storage and computing resources by partitioning the physical resources using virtualization technologies such as Xen, KVM and VMware.

The platform layer: Built on top of the infrastructure layer, the platform layer consists of operating systems and application frameworks. The purpose of the platform layer is to minimize the burden of deploying applications directly into VM containers. For example, Google App Engine operates at the platform layer to provide API support for implementing storage, database and business logic of typical web applications.

The application layer: The most visible layer to the end-users of the cloud. Normally, the users access the services provided by this layer through web-portals, and are sometimes required to pay fees to use them.

IV. **CLOUD COMPUTING SERVICES:**

Cloud computing employs a service-driven business model. In other words, hardware and platform-level resources are provided as services on an on-demand basis. Every layer of the architecture described in the previous section can be implemented as a service to the layer above. However, in practice, clouds offer services that can be grouped into three categories: software as a service (SaaS), platform as a service (PaaS), and infrastructure as a service (IaaS).

1. ***Infrastructure as a Service*:** IaaS refers to on-demand provisioning of infrastructural resources, usually in terms of VMs. The cloud owner who offers IaaS is called an IaaS provider. Examples of IaaS providers include Amazon EC2, Go Grid and Flexi scale. Hence IaaS is the delivery of associated Software and hardware as a service. Hardware like server, storage and network, and associated software like operating systems, virtualization technology and file system. It is an evolution of traditional hosting to allow users to provide resources on demand and without require any long term commitment. Different PaaS services, the IaaS provider does

very little management other than keep the data center operational and end-users must deploy and manage the software services themselves-just the way they would in their own data center.

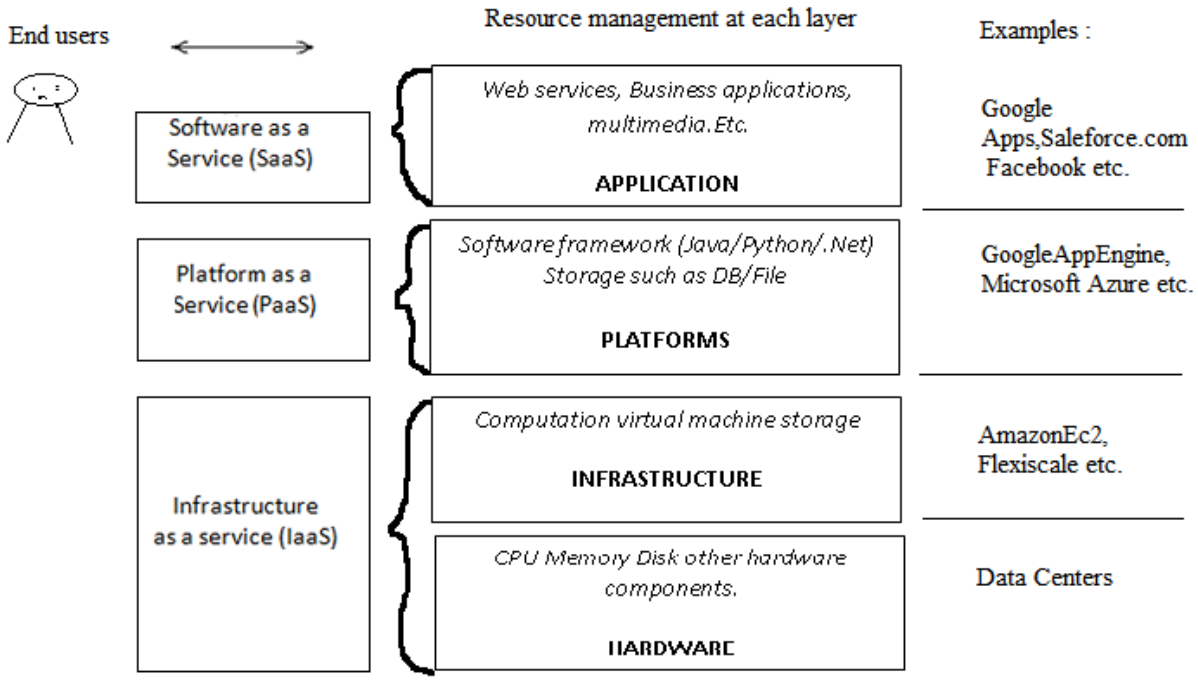


Fig.2

2. ***Platform as a Service*:** PaaS refers to providing platform layer resources, including operating system support and software development frameworks. Examples of PaaS providers include Google App Engine, Microsoft Windows Azure. Hence PaaS is an application development and deployment platform provided as a service to developers over the Web. Middleman's equipment can be used to develop programs and transfer it to the end users through internet and servers. The Cost and Complexity of Development and Deployment of Applications can be reduced to a great extent by developers by using this service.

3. ***Software as a Service*:** SaaS refers to providing on demand applications over the Internet. Examples of SaaS providers include Salesforce.com, Rackspace and SAP Business By Design.
The business model of cloud computing is depicted by Fig.2 According to the layered architecture of cloud computing, it is entirely possible that a PaaS provider runs its cloud on top of an IaaS provider's cloud. However, in the current practice, IaaS and PaaS providers are often parts of the same organization (e.g., Google and Salesforce). This is why PaaS and IaaS providers are often called the *infrastructure providers* or *cloud providers*.

V. **EFFECT OF CLOUD COMPUTING ON JOB/EMPLOYMENT:** Just as cloud computing is a game-changer for many companies; it is also changing the nature of jobs – not only within the information technology department, but in other parts of the enterprise as well.

For senior-level executives, especially chief information officers, the changes reflect the more strategic role IT plays in the direction of businesses. For the business, it introduces more reliable and predictable supporting technology.

As a result of the shift to cloud, there is growing demand for professionals and managers that are more focused on business development than they are in application development. There will be greater opportunities for enterprise architects, and some offshoots will include cloud architects, cloud capacity planners, cloud service managers and business solutions consultants. Jobs being created may not always bear the term "cloud" in their titles, but cloud will form the core of their job descriptions.

The research, commissioned by Microsoft, also found that IT innovation created by cloud computing could produce $1.1 trillion a year in new business revenues. "The cloud is going to have a huge impact on job creation," says Susan Hauser, Microsoft corporate vice president of the Worldwide Enterprise and Partner Group.

The study on clouds impact on job creation shows businesses that move to the cloud are freeing up time and money to invest in innovation and job creation. Among the study's findings:

(a) Cloud computing will create nearly 14 million new jobs between 2011 and 2015.

(b) By 2015, business revenues from IT innovation enabled by the cloud could reach US$1.1 trillion a year.

(c) Cloud-related jobs will accrue evenly to businesses with 500 or fewer employees and those with more than 500 employees.

(d) More than one-third of cloud-enabled jobs will occur in the communications and media, banking, and discrete manufacturing industries.

(e)China and India will account for about half of all new cloud-related jobs.

Hence by study we find that cloud computing will increase the growth rate of jobs during 2012 to 2015 by 14 percent.

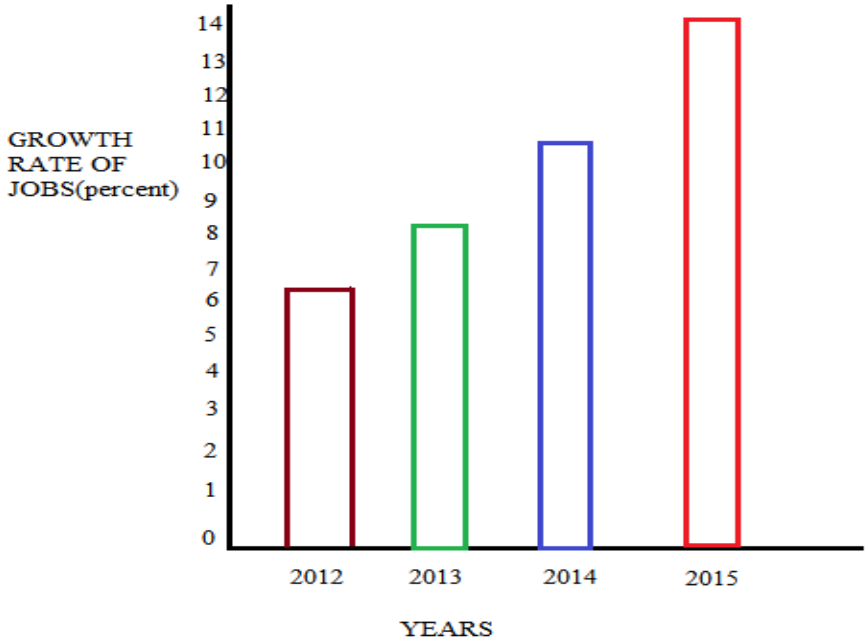


Fig.3 Total jobs generated by cloud computing over worldwide.

*By seeing graph (*fig.3*), we can easily find that initially the growth rate of jobs in 2012 is around 6 percent, as time moves it will gradually increase in 2013 growth rate is approx 8 percent. Finally in 2015 it will reach up to 14 percent (approx).*

Study find that US is leading the way in cloud job creation but little stands in the way of European businesses to catch up. The development of cloud computing will promote economic growth, increase productivity and shift the type of jobs and skills required by businesses. We can maintain growth rate of job creation by cloud computing by following these ideas as (1) Improved education and re-training in 'eSkills' will be essential. (2)Energy pricing is key to the location of cloud data centers. (3)Providing incentives for companies to adopt green energy practices can attract investment in the cloud. (4)Ensuring data transfer policies, such as privacy rights protection, do not impede the development of cloud services.

A perusal through recent job openings provides a glimpse of the new emerging class of professionals and managers who will make IT happen in the years ahead. Here are just a few job titles and descriptions culled from recent help-wanted sites and how much engagement there is with the business:

a) **Cloud Specialist:** This professional will "provide expertise, design, engineering, troubleshooting of the cloud environment, collaborate with project managers and engineers to ensure cloud computing best practices are followed and applied."
b) **Cloud Computing Architect:** Serves a critical role to drive the architect/design and implementation for cloud-based solutions. Drive the architecture/design and implementation to migrate [our product] to a cloud-based PaaS and SaaS product. Interact effectively with CTO, product manager, and engineering managers.
c) **Systems Engineer – Cloud Computing:** This individual will be a member of the system engineering team and will support an initiative to transition [federal agency] services to a cloud computing environment. The job will include developing the agency's cloud computing strategy, cloud suitability assessment, and 3-5 year cloud computing plan for an environment that is comprised of programs that are safety critical (high RMA, security, and performance levels) and as well as administrative and support
d) **Cloud Architect – Infrastructure:** This is a technical role where you will be working with key clients and prospects helping them architect proper cloud solutions. Prime responsibilities include designing and architecting innovative and practical cloud based solution for clients; defining and recommending the cloud adoption roadmap for clients; interacting at the client's CIO/CTO levels and their architecture teams.
e) **Cloud Alliance Manager:** It Focuses on the overall, ongoing management of [our] cloud computing service provider partnerships. This is done through the development and implementation of successful marketing programs unique to the specific cloud category, business units and selling venues, supported by the development of competitive strategies relative to vendors, pricing, assortment and solutions.
f) **Virtualization & Cloud Computing Subject Matter Expert:** It support cloud computing strategy and roadmap development from a mission and technical perspective including identification of potential obstacles and solutions regarding the use of cloud computing in a client environment.

VI. **RESEARCH CHALLENGES:** Although cloud computing has been widely adopted by the industry, the research on cloud computing is still at an early stage. In this section, we summarize some of the challenging research issues in cloud computing.

(a). Automatic service provision: One of the key features of cloud computing is the capability of acquiring and releasing resources on-demand. The objective of a service provider in this case is to allocate and de-allocate resources from the cloud to satisfy its service level objectives (SLOs), while minimizing its operational cost. In automatic provisioning we can apply the following approaches: (1) Constructing an application performance model that predicts the number of application instances required to handle demand at each particular level, in order to satisfy QoS requirements; (2) Periodically predicting future demand and determining resource requirements using the performance model; and (3) Automatically allocating resources using the predicted resource requirements.

(b). Building an Open Cloud Ecosystem: There are several large projects funded by the European Commission that are already addressing these challenges or are building test beds to bridge the usability and cultural gaps of cloud computing. Most of these projects are re-using existing open-source components, so actively contributing to build an open cloud ecosystem. A very good example is the high number of innovative projects using and contributing to the Open Nebula open-source community.

(c). Platform Management: Challenges in delivering middleware capabilities for building, deploying, integrating and managing applications in a multi-tenant, elastic and scalable environments.(1)Scalability and multi-tenancy of application containers (2)Placement optimization algorithms of containers in resources.

(d). Data security: Data security is another important research topic in cloud computing. Since service providers typically do not have access to the physical security system of data centers, they must rely on the infrastructure provider to achieve full data security. Even for a virtual private cloud, the service provider can only specify the security setting remotely, without knowing whether it is fully implemented. The infrastructure provider, in this context, must achieve the following objectives: (1) *confidentiality*, for secure data access and transfer, and (2) *auditability*, for attesting whether security setting of applications has been tampered or not. Confidentiality is usually achieved using cryptographic protocols, whereas auditability can be achieved using remote attestation techniques.

VII**. CONCLUSION:**

As Clouds are designed to provide services to external users, providers need to be compensated for sharing their resources and capabilities. However, despite the significant benefits offered by cloud computing, the current technologies are not matured enough to realize its full potential. Many key challenges in this domain, including automatic resource provision and security management etc., are only starting to receive attention from the research community. Therefore, we believe there is still tremendous opportunity for researchers to make groundbreaking contributions in this field, and bring significant impact to their development in the industry.

In this paper, we have proposed architecture of cloud computing & its services and impact on job creation within Clouds. The rise of cloud computing is rapidly changing the landscape of information technology, and ultimately turning the long-held promise of utility computing into a reality. In this paper we cover its essential concepts, architectural designs, key technologies as well as research directions. As the development of cloud computing technology

is still at an early stage, we hope our work will provide a better understanding of the design challenges of cloud computing, and pave the way for further research in this area.

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