

Declaration by Author:

I declare the work reported in the paper is original and carried out by the author. This paper has been presented in an international conference held at Pacific University, Udaipur.

Reports and references of the researchers mentioned in the paper have been acknowledged.

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Topic : Cloud Computing Model for Business

Abstract :

Today, businesses are using information technology as a comprehensive solution for delivery of services. A 'SERVICE DELIVERY' paradigm commonly known as Cloud Computing, has become a viable internet based solution for small and large businesses. With this service delivery platform, organizations can share resources with a minimal investment. Cloud Computing is an affordable and manageable solution for the business. Cloud computing platform helps the organizations to manage various fundamentals viz. interoperability, scalability and virtualization with a cost effective model. Cloud Computing is divided into deployment model and services model. However the challenge towards the organization is to identify an appropriate deployment model and service model to be adopted. There are many Cloud service providers, who offer different services and platforms. In this scenario organizations have to examine their needs and then approach towards the adoption of Cloud services. It is important for the organizations to understand the implications of moving to the Clouds which can minimize risks or failures. This paper will examine the Cloud Computing deployment model and service model and propose a decision roadmap for the Cloud Computing model adoption. Paper also includes the characteristics of the Cloud service models w.r.t. the functions.

Design / Methodology:

To identify & evaluate the various characteristics of Cloud service models, a survey has been carried out to evaluate the appropriate service for the adoptees. The data has been collected by online survey. Total of 87 responses were received and out of that only 65 responses were used for survey analysis. Based on the survey a decisional roadmap is designed for the new Cloud adoptees.

Findings/Outcome:

Cloud computing is known to every business stakeholder as a cost reduction model but the adoption of appropriate model is a big challenge for the organizations. Business stakeholders, who have already adopted it, are finding it difficult to identify the functions to be put on Clouds. Survey also indicates that the services and function portfolio has to be prepared by mutual collaboration of business stakeholders and service providers.

Keywords :

Cloud Computing, Service Delivery Platform, Virtualization, Scalability, Interoperability

Paper Type :

Research Paper

Introduction

An emerging transformation in the Information Technology has been introduced as a service delivery model, commonly known as Cloud computing. Cloud computing is characterized to support businesses by cost reduction, increased business agility, improve visibility, accelerate deployment speed, anywhere any time (broad network area) –on demand accessibility et.al. With this horizon, businesses can access dynamically scalable and virtual IT resources on an internet network. Cloud computing also offers the optimum utilization of resources including elasticity. Cloud computing is a concept where related /requested services are provided by the third party which runs on computers and focuses on delivering value to business (Daryl Plummer, GartnerInc). It's a service delivery platform; resources can be allocated as per the need of the clients. This platform can help to minimize the capex and opex. Because of the key benefits businesses are moving towards Cloud computing adoption. Strategic perspective of Cloud computing is its valued service model, which can meet the business needs and enhance dynamic capabilities to hold its business competence in the market (Pavlou and El Sawy 2006).

Cloud computing offers three different type of services viz. software-as-a-service (SAAS), platform-as-a-service (PAAS) and infrastructure-as-a-service (IAAS) by using delivery architecture such as public, private, hybrid and community models. These Cloud services are provided by third party-service providers. Cloud service provider provides a secure dynamic platform as per the demands of the business client. Pricing and billing is based on as-per-use. By adopting Cloud computing, businesses need to focus less on IT infrastructure maintenance and use their resources in core activities and productive assignment. Various services such as banking, insurance, education, governance, healthcare et.al. are delivered to the customer by using Cloud computing platform. There are many challenges for the Cloud users w.r.t. services and deployment model to be used for delivering services. Businesses have to determine Cloud archetype which can leverage and promote business for real time delivery and long term growth.

The backbone of the Cloud computing is based on the virtualization as defined by the KPMG (2011) shown below.

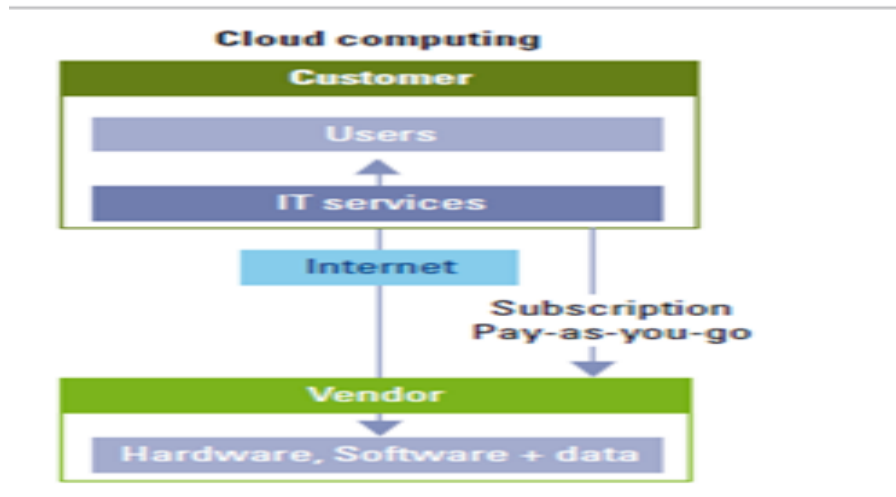


Fig. 1 - Source : KPMG Cloud Architecture (2011)

Prior Research on the Cloud computing Model selection

Cloud computing brought innovation across business organizations and created a value proposition between organizations and users defined by IBM (2012). User proposition include, product and service enhancement, new channels extension and creation of new markets. On the other hand organization perspective includes increase in efficiency, transformation and radical change in business economics.

Cloud computing model is designed to support self-services and on-demand service delivery. Effective delivery of the service is reliant on the collaboration or deployment of models and its complexity. Cloud Models defined by NIST (800-145, 2011) gives a clear view of the service and deployment models shown below –

Service Model	Function
SAAS	It is commonly known as application model, users can access applications as well as databases on a shared platform. Example - Gmail
PAAS	It's a platform used by developers for programming, testing, library service and tools. Example – Google Apps, Microsoft - Azure
IAAS	It provides 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. Example – AmazonEc2, GoGrid, firewalls
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Table 1- Services Models

Service models are more focused on the type of function performed by the user / consumer but deployment model defines environment in which the service model is deployed on the demand of the user/ consumer. Environment ensures the security and the availability of the services to a group/s.

Deployment Model	Environment
Public	It is available for the general public or an industry group. It is owned by the third party – service provider exists at the service provider’s premises.
Private	It is operated by a single organization only and managed internally or by third party for specific business/ organization.
Hybrid	It is combination of two or more Clouds – public or private or community and offers multiple benefits. Data can be shared from private to public to community and vis-a-versa.
Community	It is shared by many organizations w.r.t. specific community. It can be managed internally and externally.

Table 2- Deployment Models

Selection of Service model draws the attention of users or businesses towards the financial aspects too (Misra and Mandal, 2010). Cloud computing is essentially related to receiving and delivering on-demand services. Being a demand oriented model, there is a full control on operational costs and demand of resources. Service providers manage IT resources and provide services (KPMG, 2010). Private model is appropriate for the critical business activities whereas public model can be adopted for non-sensitive data/information. Cloud computing advocates better management of IT resources. By using Cloud computing, organizations utilize their competencies for core activities, as the Cloud services are provided and managed by the service providers/ third party over internet. Service providers’ function on customized architecture in a way that can provide quality and reliable services to the clients. Service providers provide the required services on agreement terms known as service level agreement. (Pankesh Patel, Ajith Ranabahu, Amit Sheth, 2011).

Challenges faced by users and service providers of Cloud adoption are security, data loss, change in technology, organization’s culture, bandwidth, data management, authorization, policy et. al.

To summarize the past study, although Cloud computing is adopted by limited number of organizations, yet the studies have been done by researchers to evaluate the impact of the Cloud. Selection of Cloud services and service providers are two entities that play an important role in successful Cloud computing adoption. Service level agreement is also taken into consideration for the adoption. Therefore, it is important to find a right solution w.r.t. Cloud computing model adoption.

Scope and Objectives

The scope of the paper is to propose a decisional roadmap for the new Cloud adoptees. The primary objective of the paper is to find the factors which suggest the appropriate Cloud service model to be adopted. Ryan and Gross first indicated the identification and adoption of any model as a process in 1943 (Rogers 1962, p. 79). Rogers categorizes the five stages (steps) as: awareness, interest, evaluation, trial, and adoption. Following these stages (Rogers approach) four factors were identified and tested for the proposed Cloud decisional roadmap viz. knowledge, implementation, persuasion and confirmation. Based on the above factors research question were generated:

- (a) Knowledge is an effective factor for adoption of Cloud service model.
- (b) Persuasion is an effective factor for adoption of Cloud service model.
- (c) Implementation is an effective factor for adoption of Cloud service model.
- (d) Confirmation is an effective factor for adoption of Cloud service model.

Methodology

This paper includes responses of the Cloud user/s and their experience towards the Cloud computing. Based on the analysis, a roadmap is suggested for the new adoptees looking forward to Cloud adoption. A total of 65 respondent's responses (N=65) have been included in the study. These responses were collected by administering a survey questionnaire. The respondents were from the top and middle level Cloud computing users and are using the same services for the past 2 years. Respondents, who participated in this survey were from the banking services (23), online shopping (17), government (1), medical transcription (7), website developers (8), Media

(6), Programmer/project leader (3). Survey helped us to know the existing users' approach towards Cloud computing and acted as a guide for the proposed roadmap designed for the paper.

Analysis

It appears from the survey that organizations have partly transferred their functions to the Clouds. There is resistance among the organizations and even users, due to security concerns and availability of services. Cloud users revealed influential factors in favor of adoption viz. cost reduction, availability of data from anywhere, hardware savings, no worry about the software licensing/ updates, skilled manpower for maintenance et.al. which relieved pressure on the internal resources after Cloud adoption.

From the survey, it has been found that organizations have adopted a multitenant environment i.e. combination of public or private model/ private or community model – which is defined as hybrid deployment model.

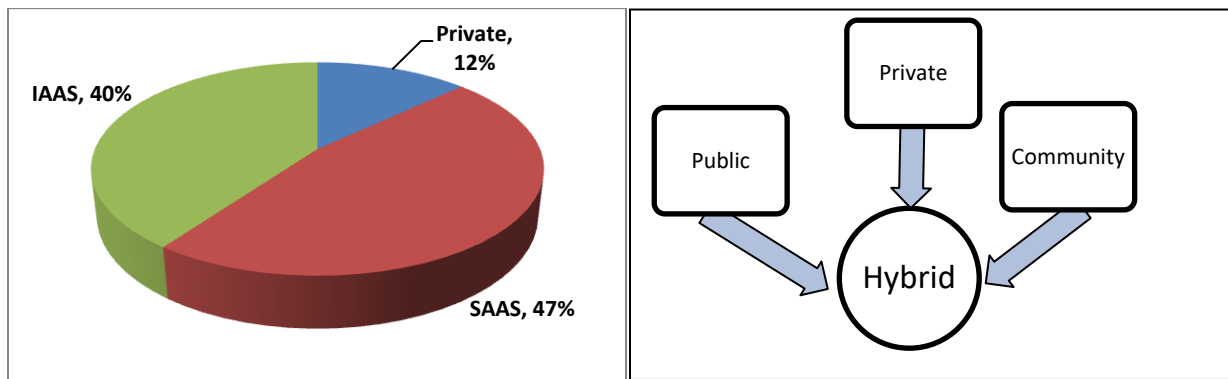


Fig.2 – Data Analysis Chart

Organisations take advantage of two combined deployment models to increase the efficiency without any compromise. They wanted to focus on primary drivers such as security , function alignment and faster availability.

For identification of the effectiveness of factors, descriptive statistics method was applied to arrive on comprehensive characteristics of a data set/population.

<i>Knowledge</i>		<i>Persuasion</i>		<i>Confirmation</i>		<i>Implementation</i>	
Mean	4.58	Mean	2.72	Mean	3.02	Mean	3.55
Standard Error	0.06	Standard Error	0.06	Standard Error	0.07	Standard Error	0.08
Median	5.00	Median	3.00	Median	3.00	Median	3.00
Mode	5.00	Mode	3.00	Mode	3.00	Mode	3.00
Standard Deviation	0.50	Standard Deviation	0.45	Standard Deviation	0.60	Standard Deviation	0.66
Sample Variance	0.25	Sample Variance	0.20	Sample Variance	0.36	Sample Variance	0.44
Kurtosis	1.94	Kurtosis	-0.99	Kurtosis	-0.09	Kurtosis	0.42
Skewness	0.35	Skewness	-1.02	Skewness	0.00	Skewness	0.80
Range	1.00	Range	1.00	Range	2.00	Range	2.00
Minimum	4.00	Minimum	2.00	Minimum	2.00	Minimum	3.00
Maximum	5.00	Maximum	3.00	Maximum	4.00	Maximum	5.00
Sum	298	Sum	177	Sum	196	Sum	231
Count	65	Count	65.00	Count	65.00	Count	65
Confidence Level(95.0%)	0.12	Confidence Level(95.0%)	0.11	Confidence Level(95.0%)	0.15	Confidence Level(95.0%)	0.16

Table 3- Data Analysis

The statistics in table (3) shows, the mean value of knowledge as 4.58, which indicates the effectiveness of knowledge factor among other factor variables (Implementation – 3.55, Confirmation- 3.02, Persuasion-2.72). It is justified too; knowledge will help to identify primary level and helps to scale down the adoption approach. Knowledge addresses the basic understanding of the technology and Clouds services. Lack of knowledge and skills are the barriers for adoption of IT (Blackburn, Athayde, 2000; Ndubisi, Jantan, 2003).

Besides the above factors, other factors relating to Cloud services performance have been evaluated and ranked on the basis of the mean value to find the most crucial factor.

Performance Factors	Mean	Rank	Meaning
Linearity	4.6	1	System performance to balance the load w.r.t. signals
Customer Response Time	4.3	2	Request response time
Loadbalancing	3.8	3	Unhealthy instances within a pool of service

Agility	3.7	4	Quick response based on the customer resources scale (up/dpwn)
Reliability	3.5	5	Availability of services
Througput	3.4	6	Service response time
Durability	3.1	7	Data loss/ other calamity

Table 4- Performance Factors and its Ranks

Among the above, linearity and cutomer response are the most significant performance factors. Therefore as per the statistics , Cloud service environment ambit requires monitoring and better management during peak hours.

Survey revealed that respondents have little information about the deployment of Cloud services. Majority of users are using Clouds for specific functions viz. website maintenance, data storage, CRM & ERP, BPM, Ecommerce, email- messaging et.al. Among organisations, IAAS users are 40%, SAAS- 47% and PAAS -13%.

Further, only 48% of respondents were clear about the agreement criteria in Service Level Agreement (SLA) which is an important component of Cloud services. Some repondents have mentioned that top level managements have signed SLA but not explained the criterias to the actual users in their organisations. This was one of the critical problem observed during the study. 65% respondents using Cloud from last 2 years were satisfied by their service provider's approach and time to time assistance as and when required by them, 89% showed satisfaction on security issues, while 11% respondents were unaware of security issues.

Cloud Adoption Roadmap

Cloud computing is an on-demand concept , where user has to pay-per-usage. As discussed above, Cloud computing comprises of service and deployment model. Keeping in view the above factors , a well planned roadmap can be suggested to achieve the optimal level of productivity by using an appropriate Cloud service. David Smith (Technology Future Inc.,2005) stated that a process roadmap is one of the communication tools to link strategic operation, collaborative ventures and business plans.

This paper proposes a roadmap (based on the factors analysed above) as shown below:

- (a) Identify business objectives (**Knowledge**) – cost of operation, growth potential, regulatory compliance, profit margin, market & social perspective.
- (b) Analyse internal computing infrastructure (**Confirmation/authentication**) – computer (desktop/laptop/tablet) and internet connection.
- (c) Identify an appropriate service model to achieve business objectives (**implementation/execution**) - Organisations have to determine the functions to redistribute on Cloud as given below:

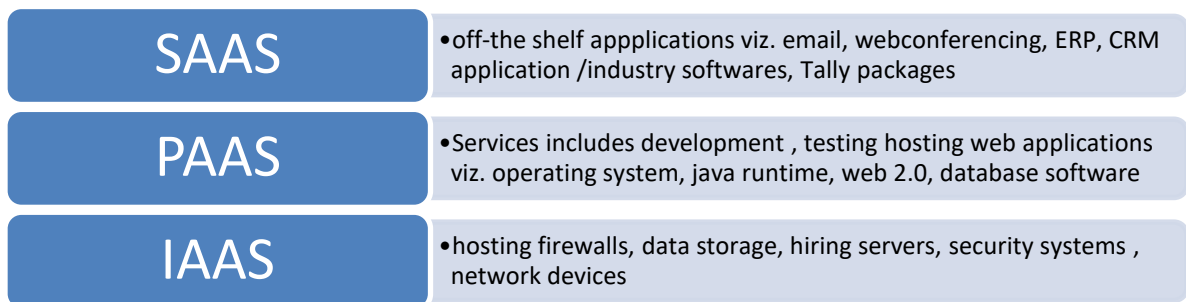


Fig. 3- Services Models examples

- (d) After determining the service model - (**implementation/ execution**) - next step is to select a deployment model of how services can be provisioned (as shown below) to the organisation’s internal or external stakeholders as the case may be.

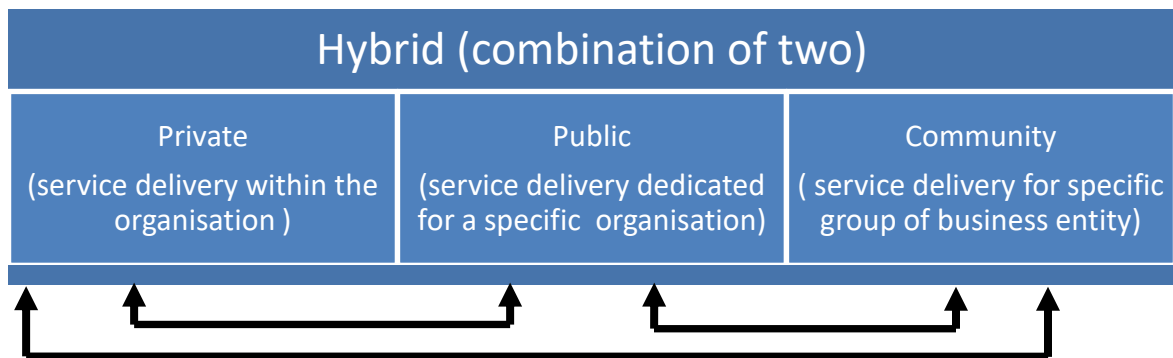


Fig.4- Deployment Model Example

- (e) Identify service provider and measure the service architecture which is built on five layers viz. hosting servers & virtual machines, technology infrastructure, Network and enduser service delivery .These layers provide a smooth delivery including - security, system availability , elasticity, durability, agility , automation and customer response time. (**Persuasion**)

- (f) Service Level Agreement (SLA) has to be prepared on terms containing security, quality services, disaster recovery, data location, uninterrupted connectivity and service availability as and when required. (*Persuasion*)

Having said that, the strategic framework is a necessity for successful Cloud services adoption. NIST (XXX-0XX, 2011) published a decision framework which states framework with three levels namely selection of services, provision and management. This strategy was designed by Vivek Kundra (US –CIO) and was named as ‘Federal Cloud Computing Strategy’. It stated that the Federal strategy framework is flexible and can be adjusted as per the organization’s need.

Cloud Computing adoption security & Governance

As observed by the survey, organisations have placed minimal functions into Cloud, due to security issues. Security is one of the critical issues as Cloud computing services are provided and managed by a third party.

Other than security, some more issues are also related to the adoption viz. end user service throughput, geographical data location, scalability, service mobility, bandwidth et.al. These issues can be managed by a selection of service providers and SLA which can meet the organisation’s needs.

According to Forrester research (2012) 80% of organisations are in favor of Cloud computing adoption, but when it comes to adoption it is only 25% who actually do so. Statistics indicates that Indian organisations are conservative in nature and more cautious about the theft or loss of organisation’s data. It brings out the fact that there is a lack of standardisation and policy making in India. Government of India has taken initiative and designed a National Telecom Policy-2012 to accelerate economic growth by emphasising on quality telecommunication services in rural, remote and offshore areas. Policy includes actively promoting multiple services such as e-governance, Cloud grids etc. It further emphasizes that “Cloud computing will significantly speed up design and roll out services, enable social networking and participative governance and e-Commerce on a scale which was not possible with traditional technology solutions.” KPMG published (2012) key steps laid down for adoption of Cloud in India shown below:

- Creation of a nodal agency for laying baselines for Cloud adoption.

- Empowering the nodal agency to develop a Cloud policy for adoption of Cloud by Govt. bodies and Indian citizens and organizations.
- Empowering the nodal agency to interpret existing laws such as IT Act 2000 in context of Cloud to ensure the interest of Indian entities in the Cloud.
- Empowering nodal agency to work with various government departments and ministries including state government to incentivize Cloud adoption in India.
- Launching specific projects in the area of Healthcare and Education for accelerating ‘use cases’.
- Defining policies and enact rules / regulations for incentivizing setup of Cloud providers in India. (*Source KPMG, Indian Cloud Revolution, CII*)

Another initiative taken by the Department of Electronics and Information Technology announced 18 points agenda where, Point 3 states – National Cloud Initiative Phase-I. Objectives of this initiative are –

- Optimum utilization of infrastructure leading to cost effectiveness
- Speeding up development and deployment of e-Gov applications
- Easy replication of successful applications to avoid duplication of efforts.

Outcome for the above mentioned initiative expected by December 2013 are –

- Establish Cloud infrastructure at NIC Data Centre
- Setting up the Institutional Structure
- Launch of National Cloud, (Phase-I)
- Centre of Excellence (CoE) on Cloud Computing.

In order to manage risks, it is evident that Government has been taking initiatives. Awareness about the same is required among the organizations looking for Cloud adoption. Management is the key for managing risks. Lack of proper management can possibly increase the potential of risks which may include service management, service delivery, service response data loss, so on and so forth.

Conclusion

Cloud computing is one of the dynamic tools which helps organizations to minimize the investment cost on technology. This paper gives a structured approach for a Cloud model

selection. Its service delivery model allows users to pay-per-use, as one can recharge his/her mobile on internet network. With the given structured approach businesses can put on their services such as HR solutions, payroll applications, inventory management solutions, videos, CRM & ERP / SAP solutions, document control and management on Clouds. Adequate security is a major concern among organizations. A risk management governance framework will help to minimize risks. Service level agreement is to be carefully managed by focusing on the performance sensitivity, trustworthiness, financial and operational aspects and potential of handling faults/errors. Cloud computing adoption is one of the viable service model, significantly impacting the productivity, cost reduction, scalability with high degree of automation in functions delivery but, a cautiously structured approach is to be followed for the same.

Future Work & Limitations

Study is limited to the adoption framework and characteristics. Further a risk model framework can also be explored based on Indian Government's governance policy. Risk model will help to reduce the probability of risks.

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