

Cloud Computing – A market Perspective and Research Directions

Amol C. Adamuthe, Vikram D. Salunkhe, Seema H. Patil
Rajarambapu Institute of Technology, Sangli, MS, India
E-mail: amol.admuthe@gmail.com

Gopakumaran T. Thampi
Dept. of IT, TSEC, Bandra, Mumbai, MS, India
E-mail: gtthampi@yahoo.com

Abstract—Computational paradigm has been revolving round cloud computing and its offshoots for some time and till we see a breakout resulting in a breakthrough technology driven by advances in microelectronics and material technology. Till we experience a radically efficient technology for computation it is worth juxtaposing the virtues of cloud computing and market's longing for offering cost and quality arbitrage to the marketplace. Integration of cloud computing in enterprises has the potential to influence the way business gets carried out by them in the market place. Different reports show that demand for cloud computing products and processes is in an upward growth trajectory. This paper identified the characteristics, drivers and constraints of cloud computing which influence its adaptation and integration in enterprises. We are also examining India specific opportunities and threats of cloud computing tools and cloud driven practices in the context of fierce competition among enterprises to remain competitive in the marketplace by reducing software licensing fees, cost of capital to acquire digital systems and cost of maintenances.

New directions in cloud computing are analyzed by using Gartner strategic technologies and trend in research publications. Paper focuses on exploring the research issues which are categorized into technical and business in nature for understanding the evolving fortunes of cloud computing. Number of papers published in IEEE is an indication of the popularity and relevance of the continued research initiatives happening in the area. It is also noticed that that very few researchers are attempting to understand the possibility of remodeling business processes leveraging the new found computational paradigm.

Index Terms—Cloud computing, market perspective, drivers, constraints.

I. INTRODUCTION

Cloud computing can be thought of as the successor of grid computing. In reality, it embodies aspects of mainframe, cluster and grid computing [1]. Cloud computing is a shifting of paradigm from old mainframe

environment to the thin client based architecture [2]. Computing clouds are developed on large datacenters hosted by a single organization that provides services to others. These services are flexible, on demand and on a pay-per-use basis.

Cloud computing has received increasing interest from enterprises since its inception [3]. Recently cloud service providers are offering a wide range of solutions to businesses. Enterprise businesses are moving their IT services, applications and infrastructure to cloud-based architecture. According to IHS Technology, the market revenue in this segment will rise rapidly by a factor of three from 2011 to 2017 [4]. Cloud computing markets at \$36 billion in 2008 are expected to reach \$160.2 billion by 2015 [5]. Ovum Research forecasted the global cloud services market will reach revenues of \$66 billion in 2016, with an annual growth rate of almost 30 per cent [6]. Research firm Forrester has projected public cloud services worth \$14.7 billion in 2010 will generate a six-fold increase in revenue for cloud vendors of \$94.1 billion by 2015 [6]. According to paper [7] wide adoption of cloud computing in a near future is unavoidable. The forecasted results from various reports show that cloud computing is growing rapidly.

Table 1 indicates the number of research publications in IEEE Xplore and ScienceDirect searched using keyword "Cloud Computing". This data is collected from the year 2006 to year 2014. The data is accessed in November 2014. The trend of number of papers published in IEEE Xplore and ScienceDirect is increasing.

Table 1. Research Publications (from 2006 to 2014) in IEEE Xplore and ScienceDirect for the "Cloud computing".

Year	IEEE Xplore	ScienceDirect
2006	0	1
2007	0	0
2008	205	10
2009	1103	104
2010	2824	293
2011	4650	618
2012	6844	864
2013	7576	1335
2014	3969	1677

Cloud computing has received attention by both industry professionals and researchers. Increasing interest

of enterprises in cloud computing adoption creates need for analysis of cloud computing. This paper focus on cloud computing analysis by identifying internal characteristics and external factors. The analysis method is similar to strengths, weaknesses, opportunities and threats analysis. SWOT analysis was developed as a planning tool to understand strengths weaknesses, opportunities and threats involved in a project or business. In literature, primarily SWOT analysis is used to analyze the current situation of a technology, but the opportunities and threats can be used for technology forecasting [8].

Objective of this paper are

- i) Explore cloud computing's capacity to offer cost and quality arbitrage to enterprises.
- ii) Identify factors affecting cloud computing growth trajectory.
- iii) Identify the opportunities and threats to cloud computing in India.
- iv) Explores the new trends in cloud computing.

The rest of the paper is organized as follows: Section II is about related work. Cloud computing definitions and layered architecture is described in section III. Section IV of this paper illustrates market perspective of cloud computing. Section V is about opportunities and threats to cloud computing in India. Cloud computing research directions are presented in section VI. Finally, the conclusions of our study are outlined in Section VII.

II. RELATED WORK

This section presents SWOT analysis / forecasting of various technologies.

Lobo and Khanna in [9], say that cloud model solution needs appropriate focus and opportunity in the Indian market. The research aims at examining the notion of cloud computing using SWOT analysis of the cloud computing services namely, SaaS, PaaS and IaaS.

Marston et al. in [10], identified the strengths, weaknesses, opportunities and threats for the cloud computing industry. According to authors, the biggest factor that impedes the adoption of the cloud computing paradigm is regulation at the local, national and international level. Cloud computing demands a coordinated response from governmental agencies.

Cole et al. in [11], assessed the strengths, weaknesses, opportunities and threats of various energy storage systems and discussed their applications on the generation and transaction level. SWOT analysis with respect to pumped hydro, CAES (Compressed Air Energy Storage), BES (Battery Energy storage), flywheels, SAES (Superconducting Magnetic Energy Storage) and supercapacitors. According to this research, pumped hydro, CAES and BES are technically and economically feasible.

Jandebur et al. in [12], addressed the strengths, weaknesses, opportunities and threats of the near field communication (NFC) technology. This technology has a potential to be adopted in various industry sectors. For

the customers, authors examined if the benefits of convenience and security are really worth the price of an NFC-enabled device. For the service provider, author examined if the benefits of convenience and security are worth the cost to set up the infrastructure for those devices to be used. According to authors the NFC-equipped devices will replace the commonly used plastic card for convenience and security. NFC-enabled device will be used for all identification and financial transactions. Authors believe that companies can improve their efficiency and customer confidence by using NFC technology.

III. CLOUD COMPUTING

Perception of different experts, providers and professionals about cloud computing is slightly differs. The National Institute of Standards and Technology (NIST) defined cloud computing as a “model for enabling ubiquitous, 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” [13]. “Clouds are essentially large distributed computing facilities that make available their services to third parties on demand” [1].

Cloud hides the complex architecture on which it relies upon and provides to its users a single interface. Clouds are usually referred to as a large pool of computing and storage resources. These resources are abstract to end user. Fig. 1 shows the four layer architecture proposed in [14]. The fabric layer contains the raw hardware level resources, such as computing, storage and network. Unified resource layer virtualized the resources so that they can be exposed to upper layer and end users as integrated resources. The platform layer adds on a collection of specialized tools, middleware and services on top of the unified resources to provide a development and deployment platform. The application layer includes the applications that would run in the clouds [14].

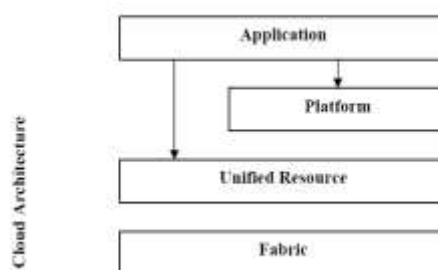


Fig.1. Four-layer architecture [14].

Different cloud computing service models are present such as Infrastructure as a Service– IaaS, Platform as a Service– PaaS, Software as a Service– SaaS, Management & Monitoring as a Services– MMaaS, Testing as a Service– TaaS, Storage & Database as a

Service– SDaaS, Security as a Service–SeaaS, Integration as a Service– InaaS etc. Infrastructure as a Service, Platform as a Service and Software as a Service are three important service models. Cloud computing ontology proposed by [15] is depicted as five layers and shown in Fig. 2. This layered architecture represents the inter-dependency between the different layers in the Cloud.

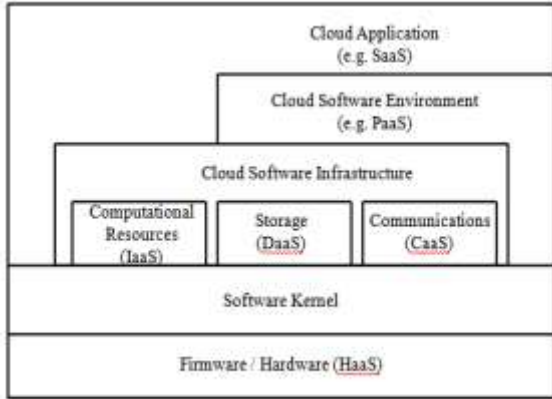


Fig.2. Cloud computing ontology [15].

IV. CLOUD COMPUTING – A MARKET PERSPECTIVE

In recent years cloud computing has a significant impact on all aspects of life. Enterprises require cloud computing for improvement in productivity and revenues. So, it is important for organizations to have insight into cloud computing technology and factors affecting on it’s growth. This section illustrates cloud computing analysis based on market perspectives carried out using research papers, survey reports, white papers and case studies.

A. Cloud Computing’s Capacity to offer Cost and Quality Arbitrage in Real time Enterprise

Table 2. Reasons of Cloud Computing Adoption.

Drivers	References
Business agility	[16, 17, 18]
Improving business processes and tasks	[19]
Ability to replace existing solutions	[20]
Reducing IT infrastructure investment	[16, 17, 20]
Reducing IT management and maintenance resources	[16, 20]
Reduce IT staff, Reduce IT risk	[20]
Operational cost savings	[21]
Increased productivity of IT	[16]
Improving IT control	[16, 20]
Increased capacity/availability (data center, storage etc.)	[16, 20]
Ability to obtain new resources quickly, Ability to scale up and down quickly	[20, 21]
Pricing flexibility	[20, 21]
Disaster recovery / business continuity	[16, 17]
Resource optimization	[17]
Energy efficiency, lower carbon footprint	[20]

Enterprises adopt cloud computing adoption as per company requirements. Few of the reasons of cloud computing adoption are summarized in Table 2. Many of

the reasons are related with financial issues. Challenges in cloud computing adoption are summarized in Table 3. Challenges are technical, business related, market related and legal.

Table 3. Challenges in Cloud Computing Adoption.

Constraints	References
No clear standards or lack of standards	[20, 22]
Market and technology immaturity	[22]
Integration with existing systems	[21]
No clear procurement rules for implementation, Difficulty in measuring ROI of cloud solutions	[20]
Comfort level of IT staff with cloud	[20, 22]
Risk of losing governance or control	[22, 23]
Lack of clear value propositions, Complexity, Reliability and high availability,	[22]
Unclear licensing	[22, 23]
Legal issues	[23]
Interoperability i.e. difficulty in integrating cloud solutions	[20]
Risk of vendor lock-in, Insufficient data availability	[23]
Cloud solutions are not secure enough	[20, 23]

i) Technical and economical strengths of cloud computing

- Elasticity, On-demand services, Pay-per-use pricing model, Flexibility [24].
- Availability of a host of software systems on a ‘pay for what you use’ basis [7, 25, 26].
- Elastic and scalable computing infrastructure available ‘on-demand’ [7, 25, 26, 27]. The users can in practice access the cloud for services anytime from anywhere [7, 25].
- Cost effective, Flexible and innovative, Round the clock access, Simplified cost and consumption model, Faster provisioning of systems and application, Secured infrastructure, Compliant facilities, Flexible and resilient in disaster recovery, Reduces maintenance cost [28].
- Cloud computing has the possibilities to share software, hardware, information technological infrastructure through the virtualization [2]. The resources shared across multiple applications hosted in the cloud reduces it’s cost [25, 27, 29].
- Reduction in capital expense of organizations as they need not invest in large computer infrastructure and repeatedly invest as computers become obsolete. Shifting CapEx to OpEx [7, 26, 27, 29].
- High availability – Applications can take advantage of a high availability architecture that minimizes or eliminates planned and unplanned downtime, improving user service levels and business continuity [27].
- Assured quality of service (QoS) based on service level agreements (SLA) which organizations can sign with providers [26].
- Backup and Recovery – Organizations can use cloud infrastructure to automatically back up their important data. This will allow quick recovery if

data is corrupted [25, 26, 29].

- Ease of maintenance – The service provider takes care of the software maintenance [27, 29]. Reduction in IT staffing cost [29].
- Platform diversity – Cloud infrastructure offers support for a wide range of client platforms and operating systems [29].
- Faster development - Cloud can provide the basic infrastructure, operating systems and tools on-demand, thereby accelerating the development cycle, whereas we would spend a significant amount of time in setting up the basics in a traditional infrastructure [25, 27, 29].
- Almost unlimited storage – Storing information in the cloud gives you almost unlimited storage capacity [25].

Advantages of Software as a Service

- Global availability of SaaS applications through Internet.
- As most of the people are familiar with using the Internet, SaaS tends to have high adoption rates with lower learning curve [30, 31].
- Lower initial costs: Unlike traditional software application, SaaS applications are not purchased. SaaS applications are based on subscription. No license fees therefore, lower IT costs including hardware, software, and the persons needed to manage it [30].
- No burden of upgrades on customers: The traditional model for business applications required an upgrade and new investment in underlying technology and IT resources to take advantages of new features [31]. Because the SaaS provider manages all updates, there are no patches for customers to download and install [30]. This also removes the version compatibility that is found in traditional software that gets deployed on servers.
- Multitenant architecture: SaaS vendors with true multitenant architectures can scale indefinitely to meet customer demand [30].

Advantages of Platform as a Service

- Pre-built infrastructure – The infrastructure to run applications will be over the Internet. Developers do not need to worry about the storage and hosting and can focus on innovation and development.
- Faster development – PaaS vendors provide the pre-built functionality through APIs and user interfaces, so that users can avoid building everything from scratch. Hence, time to develop gets reduced.
- Richer functionality – Developers can enhance the overall functionality of the application by including the pre-integrated functionality such as search, analytics and reporting etc [32].
- Broad delivery option – PaaS solutions can be built to enable SaaS delivery to multiple OSs and devices such as mobile environments with little or

no custom coding [32].

- Low budget – Building on-premise or traditional applications have always been expensive and complicated. PaaS is offered on demand with pay-as-you-go pricing. Customers are not required to do the capital investment.
- Scalability of applications – Deployed applications can scale over many thousands of users without any changes to the application.

ii) Weaknesses or challenges of cloud computing

- Data lock-in, Data segregation, Scaling resources, Data security and confidentiality, Data location, Deletion of data, Recovery and back-up, “Offline cloud” [33].
- On-demand access, Simplified application acceleration, scalability, Efficient resource allocation, Dynamic provisioning, Scalability, Fault tolerance, Trust [1].
- Need of expertise or training required in the field of cloud computing, Time and wealth constraints, Structure and environment, Adopting cloud based services means outsourcing, which may not be recommended for example, for library profession, Increases dependency, High speed Internet connection is required to connect to cloud, Integration with local hardware and software is difficult, Cloud computing needs adequate financial resources [28].
- Data transfer bottlenecks [34].
- Cloud service providers are not able to guarantee the location of a company's information on specified set of servers in a specified location [10].
- No clear common legal issues across nations and continents with respect to cloud computing data transfer.
- Most of cloud computing standards are under development [35, 36].
- Pricing schemes are different for various service providers [37]. No standard policies for defining the pricing for cloud services.

B. Factors which boost up Cloud Computing Growth Trajectory

According to reports published by McKinsey Global Institute, KPMG and NASSCOM, IDC, Gartner etc cloud computing will make a huge impact on enterprise, communities and societies in recent years. This subsection lists the factors which boost up cloud computing growth trajectory. The factors are categorized in technology development, market maturity, industry growth, government support, market need etc.

iii) Current state of Cloud Computing in Hype-cycle

The hype cycle model was developed by Jackie Fenn of Gartner. Hype cycle model express the level of the technology's maturity and the degree of its adoption and commercialization. Fig. 3 shows cloud computing hype-cycle based on Gartner Hype-cycle. Peoples expectations describe the bell shape curve which shows the initial

enthusiasm and disappointment arrived by positive and negative hype. In year 2013 and 2014 cloud technology is in trough of disillusionment phase. Cloud computing is moving fast through hype-cycle stages.

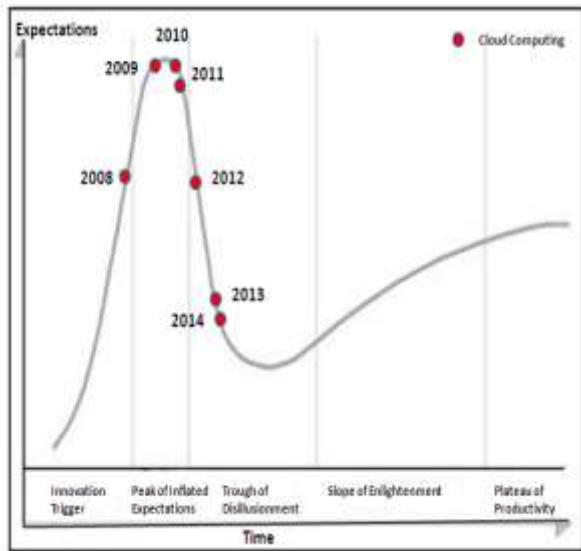


Fig.3. Cloud computing hype-cycle based on Gartner hype-cycle. Source: (Gartner hype-cycle of cloud computing 2009, 2010, 2011 and 2012), (Gartner hype-cycle for emerging technology 2008, 2013 and 2014)

iv) *Relating Cloud Computing Hype-cycle and Life cycle*

Fig. 4 shows news articles, papers and patents of cloud computing. The term ‘cloud computing’ is used as keywords in the field of title to find out number of news article in Google trends, papers published in IEEE and ScienceDirect and patents filed in U.S. patents office and Espacenet. Increase in number of papers and patents indicates that engineering and business knowledge in cloud computing is increasing very fast. This increases the probability of success of cloud computing in market place.

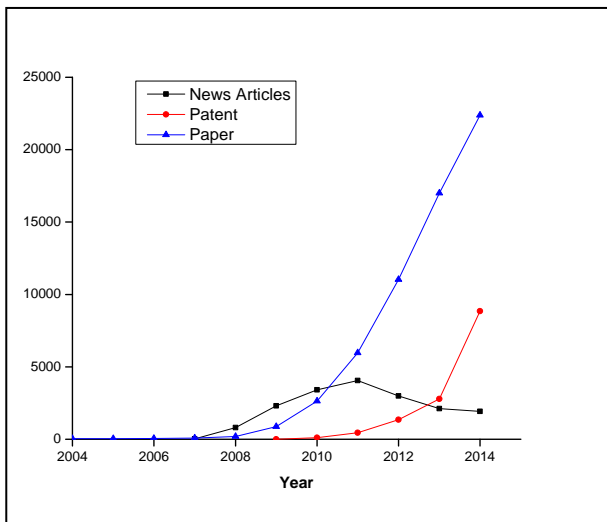


Fig.4. Cloud computing hype-cycle and lifecycle.

v) *Cloud computing Industry Evolution*

Fig. 5 shows the increase in number of cloud service providers. Increasing number of providers shall lead to increase in market competition. Market competition will lead to product innovations and cost reductions.

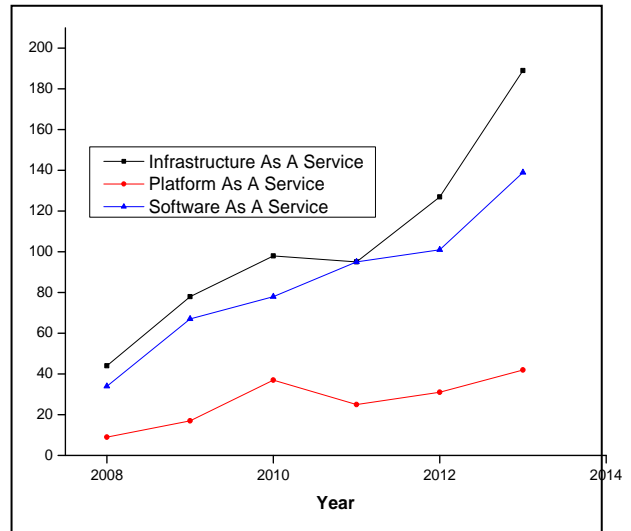


Fig.5. Cloud computing providers.

vi) *“S curve” of Computational Technologies*

Fig. 6 shows the actual cumulative IEEE Papers for selected computational technologies. Mainframes and minicomputers are relatively older technologies in computational technology family. Their growth is slow. Autonomic computing, cluster computing, grid computing and cloud computing are newer technologies. Very few historical data is available for these technologies. Progress rate of grid computing and cloud computing is much higher than other technologies.

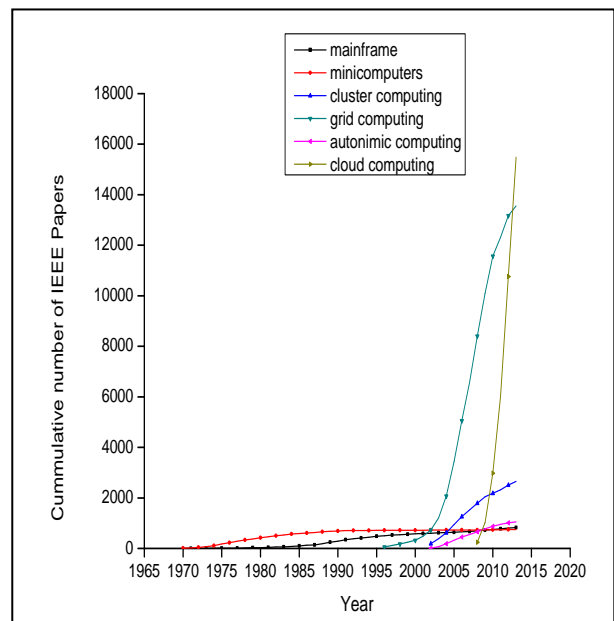


Fig.6. Actual Cumulative IEEE Papers for computational technologies.

vii) Government Support

- Governments such as US, UK, Japan and Australia are encouraging for cloud computing adoption and development.
- In the recent years, the interest in cloud computing in the Asia Pacific region has grown exponentially.
- Cloud computing technology enables the governments and local firms to benefit from the effective use of information technology [10].

viii) Market Growth

- Giant enterprise such as Google, Amazon, Microsoft, Adobe, Oracle, RedHat etc. are making investment in cloud computing.
- Collaborations and acquisitions are happening between cloud providers and vendors.
- Many big enterprises are using cloud computing services for their business such as Coca-Cola Enterprises, Times newspaper, Mogulus TV channels, Animoto etc.
- Increasing support from hardware and software vendors to cloud computing.

ix) Prerequisite for Cloud Adoption

- Rising computer penetration, Improvement in bandwidth availability, Innovations in commodity server market, Improvements in storage technology [38].
- Different survey reports shows that user attitude towards cloud computing adoption is increasing.

x) Cloud Computing Technology Improvement

- Modern information services can be offered through cloud computing [28, 34].
- All time availability is possible through cloud computing [2].
- Adaptive to future needs [28, 34].
- High-technology work environment [28, 34].
- Strong experience and involvement in standardization efforts / process [28].
- Increase in knowledge base (patents and papers).
- Clouds computing architectures, service models, deployment models, security models are evolving very fast.

xi) Market Need

- Increasing, variable and quick demand for storage and computations from different applications and enterprises.
- Good opportunity for SMEs for making progress without worrying about the upfront investments [34].
- Increasing maintenance cost in traditional IT department of an enterprise. According to IDC report approximately 70 percent of an IT budget is spent on maintaining current IT infrastructures versus adding new capabilities.
- Need to increase utilization of hardware resources

in distributed systems.

- Need of eco-friendly systems. Solution to minimize the use of servers due to it's high energy consumption.
- Marketplace enhancement in terms of functionality, innovation and price [34].
- Need of non-monopolistic business system.
- Cloud computing is suitable for big data and analytics.

C. Factors which adding up bottleneckness leading to resistance in breakthrough success of CC

- Heavy investment by enterprise in existing systems.
- Users of Internet are increasing tremendously which will lead to the data transfer bottlenecks and the available Internet bandwidth constraint issue may arise. Therefore large Internet bandwidth is big requirement.
- Third party service provider dependency is required for cloud computing [2].
- Lack of specific standard regulations (local, national and international) [34].
- Migration from one to another platform is difficult [28, 34].
- Hidden cost (backup, system recovery and problem solving) [28, 34].

Many of the threats listed above can be minimized by initiatives by researchers, providers and governments.

- Threat from inventions form physics, micro-electronics and material science. Technologies in research such as quantum computing, autonomic computing and edge computing [39].
- Open source software movement can be threat for software as service.

V. OPPORTUNITIES AND THREATS FOR CLOUD COMPUTING IN INDIA

Worldwide cloud computing adoption is increasing very rapidly. India is not an exception for this. "In India, cloud services revenue is projected to have a five-year projected compound annual growth rate (CAGR) of 33.2 percent from 2012 through 2017 across all segments of the cloud computing market. Segments such as software as a service (SaaS) and infrastructure as a service (IaaS) have even higher projected CAGR growth rates of 34.4 percent and 39.8 percent," said Ed Anderson, research director at Gartner [40]. The research by IDC titled "Indian Cloud Market Overview 2011-2016" provides estimates that Indian cloud market will grow over 70% from 2014. This section illustrates the opportunities and threats for cloud computing in India.

A. Opportunities

- The Indian government's Digital India project provides potential opportunities for cloud adoption at a cost of \$19 billion between 2014-2018.

- The Government of India is embracing cloud computing technology for expanding its e-governance initiatives throughout the country [41].
- Indian manufacturing sector has come a long way and the use of IT in manufacturing can be found since last over two decades. Since 2010, CIOs in Indian manufacturing have started adopting cloud models and this is highlighted in many research studies and industry circles [41].
- Government of India has embarked upon an ambitious initiative called GI Cloud also named MeghRaj. This decision has been taken to utilize and harness the benefits of cloud computing. The focus of this initiative is to accelerate delivery of e-services in the country while optimizing ICT spending of the government [42].
- Microsoft to invest Rs 1,400 crore in India cloud data centers. Microsoft Launches Cloud Accelerator Program for Indian Enterprises & Government. TCS involved in putting data centers in India.
- Increased number of IT companies and ISPs in India.
- The key drivers for IT growth in India is highlighted by the growing acceptance of cloud based solutions, embracing merging technologies like Internet of Things (IoT), Big Data, mobile technologies (3G, 4G) and fuelled by Indian government’s initiatives for a digital India.

B. Threats

- Data transfer bottlenecks and therefore the available network bandwidth constraint issue may arise.
- Poor connectivity [43] degrades the quality of service.
- Although the government of India has initiated the movement of using the cloud for e-governance applications, no common legal issues across India for cloud services.
- India is not yet economically strong therefore direct service cost and hidden cost (backup, system recovery and problem solving) [28, 34] may affect the adoption of cloud.
- No clear procurement rules for cloud implementation in India.

VI. NEW DIRECTIONS IN CLOUD COMPUTING

This section discusses new directions in cloud computing based on trend in research publications in IEEE and Gartner strategic technologies.

A. Research Publication Trend

Although cloud computing can be thought of as a business model, this domain has too many research issues that need to be solved. Otherwise they may affect the adoption decision of cloud computing by the organizations.

As shown in the Fig. 7, the cloud computing research areas are classified into two categories namely, Technical Aspects and Business Aspects.

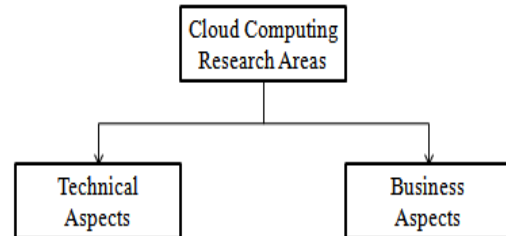


Fig.7. Classification of cloud computing research areas.

The research issues in cloud computing under technical aspects category are given in Table 4. This category of research areas includes the areas, which concentrates on the technical characteristics or attributes of cloud computing.

Research trends of cloud computing - technical aspects in IEEE are shown in Fig. 8. These trends indicate number of publications happed in each research area coming under the technical aspects category.

Table 4. Research issues in Cloud Computing - Technical Aspects.

Technical Aspects	References
Security	[1, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55, 56, 57, 58]
Privacy	[1, 44, 47, 57, 59, 60]
Availability	[33,50,57]
Reliability	[44]
Virtualization	[51, 53, 61,62, 63]
Architecture	[64]
Optimization	[61, 65,66,64]
Comparative study of Cloud with previous technologies	[54]
Multi-tenancy	[65, 67]
Mobile Cloud computing	[68, 69, 70, 71,72]
Performance	[33, 50,56, 73]
Energy management / Energy efficiency	[1, 64, 65, 74]
Interoperability	[1, 54,61, 75]
Technical loss of control	[1, 56]
Data Portability / Integration, Software Compatibility	[56]
Open Source Usage, Confidentiality, Cloud Provider Malfeasance	[57]

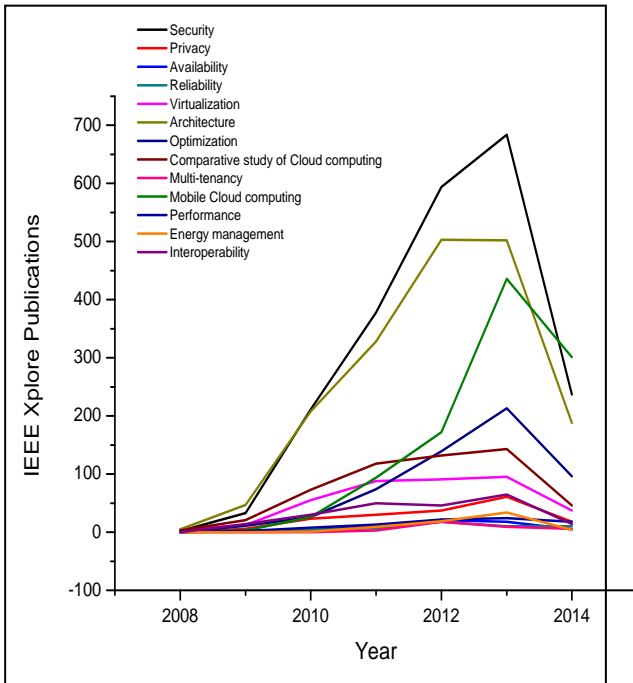


Fig.8. Research trend of Cloud Computing - Technical Aspects in IEEE Xplore.

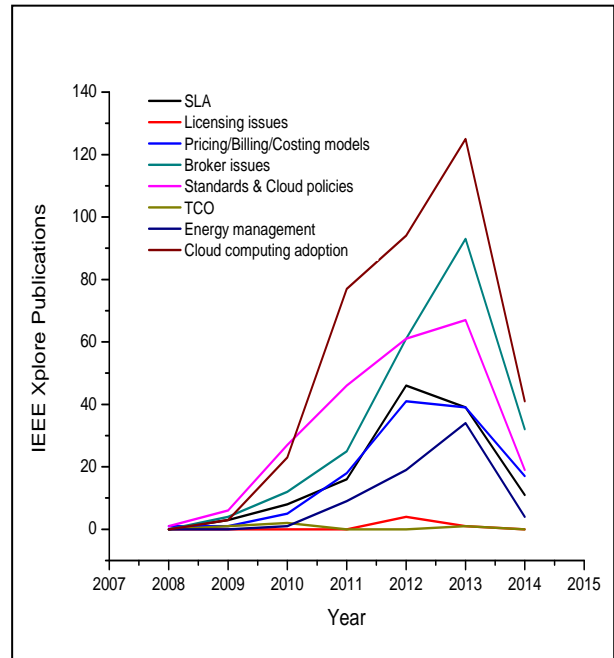


Fig.9. Research trend of Cloud Computing - Business Aspects in IEEE Xplore.

The research issues in cloud computing under business aspects category are given in Table 5.

Table 5. Research trend of Cloud Computing - Business Aspects

Business Aspects	References
Service level agreement (SLA)	[44, 53, 56, 57, 76,77]
Licensing issues	[44,53,57]
Billing / Pricing models	[1, 78,79]
Broker issues	[80]
Standards and Cloud policies	[54]
Total cost of ownership (TCO)	[81]
Energy management	[64,65, 74]
Adoption	[3, 7, 61, 82, 83, 84, 85, 86, 87, 88]
Organizational loss of control	[56]
Lock-In Challenges	[56, 57]
Legislation	[1]
Privilege abuse	[33]
Cost Efficiency	[57, 58]

Research trends of cloud computing - business aspects in IEEE are shown in Fig. 9. These trends indicate for each year, number of publications happened in each research area coming under the business aspects category.

Table 6 illustrates the percentage of cloud computing research studies (IEEE Xplore publications) carried out in the technical and business aspects categories. Percentage ratios from 2008 to 2014 (November end) indicate that the technical research dominates the business research.

Table 6. Comparison between Technical and Business Aspects Research Studies (IEEE Xplore Publications)

Year	Technical Aspects (% of Study)	Business Aspects (% of Study)
2008	88.89	11.11
2009	89.53	10.47
2010	89.54	10.46
2011	86.30	13.70
2012	84.75	15.25
2013	85.18	14.82
2014	88.77	11.23

B. Gartner Strategic Technology List

Gartner group is an icon to its corporate clients however it has only limited attention by academics. Every year Gartner publishes list of top 10 strategic technologies available at [89]. The strategic technology list is prepared based on hype-cycles, surveys, client inquiries and ongoing research. Trend of cloud computing is analyzed using Gartner strategic technologies from year 2004 to 2014.

Cloud computing and/or its enablers are present 33 times out of 110 in Gartner strategic technology list from year 2004 to 2014.

In 2005 and 2008 Gartner strategic technology list contains two technologies whose name is not cloud computing but the underlying philosophy is similar to cloud.

- Static and Unshared Island, Real-Time Enterprise (RTE) Infrastructure (2005)
- Web Platform & WOA (2008)

Year 2013 and 2014 shows cloud computing technology in different forms.

- Personal Cloud (2013) – The personal cloud will entail the unique collection of services, Web destinations and connectivity that will become the home of their computing and communication activities. Users will see it as a portable, always-available place where they go for all their digital needs.
- The Era of Personal Cloud (2014) – The personal cloud era will mark a power shift away from devices toward services.
- Hybrid IT and Cloud Computing / Hybrid Cloud and IT as Service Broker (2013, 2014) –Emerging as IT organizations to help improve the provisioning and consumption of inherently distributed heterogeneous and often complex cloud services for their internal users and external business partners.
- Cloud/Client Architecture (2014) – In the cloud/client architecture, the client is a rich application running on an Internet-connected device and the server is a set of application services hosted in an increasingly elastically scalable cloud computing platform. The client environment may be a native application or browser-based; the increasing power of the browser is available to many client devices, mobile and desktop alike.
- Web Scale IT (2014) – Web-scale IT is a pattern of global-class computing that delivers the capabilities of large cloud service providers within an enterprise IT setting by rethinking positions across several dimensions.

VII. CONCLUSIONS

Cloud computing is one of the transformational technology in the computing world. Cloud computing driven data centers and services helping organizations to leverage multiple business attributes like cost, reliability, ease of acquiring and maintaining technology systems are in ascend.

This paper forecast cloud computing technology and cloud computing industry in India using strengths, weaknesses, opportunities and threats as a tool. Cloud computing provides good solutions to increase productivity of organization in many respects such as cost effectiveness, reduction in efforts and time etc. The major limitations reported by many researchers are regarding security, privacy, compatibility and interoperability. The research trends in IEEE Xplore show that many researchers are working on weakness and threats arise from technical problems. Results show that increasing

efforts are required to improve the business issues from different aspects such as service level agreement, licensing issues, adoption framework, pricing and billing issues etc.

Cloud computing technology has received very good support from governments, giant software and hardware companies, researchers and customers. This analysis shows that cloud computing has upwards trend and it will influence enterprises in coming years.

Cloud technology is changing rapidly due to market competition and in near future it shall metamorphosis into personal cloud, cloud/client architecture, hybrid cloud computing and IT. We also envisage newer solutions will be emerging in securing information in cloud computing enabled Data Centre's through virtualization.

Future work need to be investigating to identifying best fit of cloud computing technologies in E-governance and business sectors like, Energy, Education, Micro finance and Health care.

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Authors' Profiles



Amol C. Adamuthe received Master of Technology in Computer Engineering from Dr. B. A. Technological University, Lonere, MS, India in 2008. He is currently an Assistant Professor at Rajarambapu Institute of Technology, Sakharale, Sangli, MS, India. His technical fields today are technology forecasting, cloud computing.



Vikram D. Salunkhe is pursuing his M.Tech at the Department of Computer Science and Engineering at Rajarambapu Institute of Technology, Maharashtra (India). His research interests include cloud computing and technology forecasting.



Seema H. Patil is pursuing her M.Tech at the Department of Computer Science and Engineering at Rajarambapu Institute of Technology, Maharashtra (India). Her research interests include cloud computing and technology forecasting.



Gopakumaran T. Thampi received the degree of Ph.D. in Technology from Mumbai University, MS, India in 2004. He is currently a Professor and Principal at Thadomal Shahani Engineering College, Mumbai, MS, India. His area of interests are related to business process re-engineering in the realm of engineering education, integration of enterprise softwares like ERP, CRM & cloud technology and integration of hardware & software technology in enterprise setting for cost and quality arbitrage in global market. He is author of three books. He has guided 6 Ph.D., 8 M. Phil and more than 20 M.E. students.

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