Cloud Computing Trend Prediction using Precursor Events

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Abstract*:*
Technology forecasting shall greatly contribute to the cause of the technology managers and strategic planners for decision making which has strong impact on the growth and performance of enterprises. In recent times, cloud computing tools and processes driven by its paradigm is greatly impacting IT world, enterprises and Governments. The main objective of this paper is to sensitize various players about being judicious in investing heavily on technology systems only after studying and forecasting the growth trend.

A major part of technology forecasting literature is focusing on TF methods using mathematical models based on technical parameters. John Vanston from Technology Futures, Inc. reported that ninty persent of the Telecommunications forecast work was done using qualitative analysis and remaining using quantitative methods. Joseph Martino stated that history of disruptive innovations shows many precursor events. Identification of all precursor events is difficult and prioritizing them is a highly subjective exercise. Cloud computing is one of the disruptive technologies in the computing world. This paper attempts to investigate the trend of cloud computing using precursor events which are semi-quantitative and qualitative. The proposed methodology covers technical, business, economical, social and behavioral factors into consideration. Important factors of cloud computing application are identified and categorized, and then possible precursor events are identified through literature, reports and news. Cloud computing shows upwards trend in considered aspects.

Keywords: Cloud computing, trend prediction, precursor events.

1. Introduction

Predicting the software products and solutions and its growth trends is a strategically important issue for decision makers. The prediction is difficult due to the wide range of factors involved and the complexity of their interrelationship [1]. Paper [2] reported that development and growth trends in software engineering technology is constantly evolving and affected by a large number of composite factors. The factors are technical, economical, political, social and behavioral in nature. The relationship between technology change, society, political issues and economical issues is highly complex for analysis and study.

Cloud computing is one of the transformational technologies 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. Cloud computing has received increasing interest from enterprises since its inception [3]. Majority of literature on cloud computing is focusing on technical issues and / or drivers and constraints in cloud computing adoption. This paper attempts to identify the cloud computing trend using external events.

Hyun-Seung Oh reported that *"technological forecasting methods are tools which are used for planning and decision making in order to obtain insight on the future of a technology, group of technologies or undiscovered technologies, and their direction of change and advance over the longer time"* [4]. Generally, technology forecasting methods are classified into two main approaches, quantitative methods and qualitative methods. Nave methods, averaging methods, exponential smoothing methods, regression analysis, time series analysis and the Box-Jenkins methodology are quantitative methods. Quantitative methods can be sub divided into Time-series methods and causal methods. Delphi, Scenario etc are qualitative methods. Table 1 shows the categories of technology forecasting methods with the three most popular techniques, based on Google Scholar searches reported in paper [5].

Table 1: Technology forecasting methods categorized by M. Slupinsky (taken from [5])

Causal	**Phenomen-ological**	**Intuitive**	**Monitoring and Mapping**
Artificial Neural Network	Forecasting by analogy	Delphi	Environm-ental monitoring
Multi criteria analysis	Simple regression	Focus group	Stages of development
Systems perspective	Statistic modeling	Science fiction	SWOT forecasting

In literature majority of technology forecasting research is focused on technical aspects. There is need to investigate the technology forecasting using economical, business and

social factors. Paper [6] stated that history of disruptive innovations shows many precursor events. In [7], Martino listed precursor events in several technologies such as Automotive Fuel Injection, Electronic Engine Control, Electronic Ignition, Plastic Automobile Body Shells etc.

The main objective of this paper is identifying cloud computing growth trend using precursor event. To analyze cloud computing growth trends different factors affecting the same is identified and studied.

The rest of the paper is organized as follows: Section 2 and 3 are about cloud computing basics and related work respectively. Section 4 presents methodology used for trend prediction of cloud computing using precursor events. Section 5 is about cloud computing precursor events and prediction. Finally, the conclusions of our study are outlined in Section 6.

2. Cloud Computing

In 1961, a computer scientist, John McCarthy, predicted that *"Computation may someday be organized as a public utility."* But due to unavailability of required infrastructure and development models, cloud computing remains in conceptual form for approximately 30 years. Cloud computing is result of evolutionary development of several different technologies and has characteristics of many preceding operating models and technologies. Skilton describes cloud computing as "a technological change brought about by the convergence of a number of new and existing technologies." According to Louridas, *"cloud computing expresses technologies that are reaching maturity after many years of progress, aided by specific market forces."*

Cloud computing is the megatrend in the IT world which offers resources and services over the Internet. This new paradigm is quickly attracting a number of customers due to pay per use model, scalability, dynamic resource provisioning etc. Vaquero et al. [8] listed ten key characteristics of cloud computing – user friendliness, virtualization, Internet centric, variety of resources, automatic adaptation, scalability, resource optimization, pay per use, service SLAs, infrastructure SLAs. Ke Liu [9] summaries feature of cloud computing as- lower Cost, incremental scalability, reliability and fault-tolerance, service-oriented, utility-based, virtualization, SLA-driven, user-centric interfaces, on-demand service provision, QoS guaranteed offer, autonomous, pay as you go.

Cloud computing offers its benefits through three types of service or delivery models namely infrastructure-as-a-service (IaaS), platform-as-a-service (PaaS) and software-as-a- Service (SaaS). It delivers its service through four deployment models namely, public cloud, private cloud, community cloud and hybrid cloud.

Perception of different experts, providers and professionals about cloud computing is slightly differs. NIST cloud definition is: *"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."* The National Institute of Standards and Technology (NIST) published five essential characteristics of cloud computing [10] namely on-demand self-service, broad network access, resource pooling, rapid elasticity and measured service. The NIST cloud computing reference architecture presented in [11] is a natural extension to the NIST cloud computing definition. The NIST cloud computing Reference Architecture (RA) is a neutral, actor role-based conceptual model. It describes what of cloud computing instead of the how. There are five primary actors are, Cloud service consumer, Cloud service provider, Cloud broker, Cloud auditor and Cloud carrier.

3. Related Work

A. Software technology forecasting

This section describes the related work in software technology forecasting considering intrinsic and extrinsic factors.

Chen et al. [1] and [12] presented empirical study of programming language trends. As a case study authors considered 17 high level programming languages such as Ada, Algol, APL, Basic, C, C++, Cobol, Eiffel, Fortran, Java, Lisp, ML, Modula, Pascal, Prolog, Scheme and Smalltalk. In [2] and [13] trends of 15 different operating systems and factors that drive how they evolve is investigated. Statistical model is derived to analyze the trend and the relationships between different factors that characterize an operating system. According to the study, it is possible to predict if an operating system will succeed or fail. Paper [14] presented quantitative model of the evolution of software technology trends for different families of software products such as programming languages, operating systems, middleware systems and database management systems.

The presented investigation in [1] [2] [12] [13] and [14] are based on intrinsic and extrinsic factors. Authors identified six groups of extrinsic factors namely institutional support, industrial support, governmental support, organizational support, grassroots support and technology support. The factors are collected from survey. The statistics models were constructed to describe the relationships among these factors.

B. Factors affecting cloud computing adoption

The study [15] examines the technological, organizational and environmental factors affecting cloud service adoption. Key identified factors impacting cloud computing service adoption are as follows:

Table 2: Factors

Technological	Organizational	Environmental
i) Relative advantage	i) Increased collaboration	i) Security and legal issues

ii) Compatibility	ii) Increased traceability and auditability	ii) Perception of the term "cloud"
iii) Complexity	iii) Convincing IT managers	
iv) Trialability		

Paper [16] investigates cloud computing adoption drivers and its impact on organizational flexibility for the Indian Enterprises. Based on literature review and theoretical background, authors reported five factors, relative advantage, perceived usefulness, perceived ease of use, vendor credibility and attitude towards using technology.

The study conducted by Chang et al. [17] focuses on the adoption of cloud computing technology among the Vietnamese companies. This research combines the two technology adoption models: DoI [50] and TOE framework [18] to identify the determining factors affecting the cloud computing adoption. Eight identified factors are as follows: (a) Top management support (b) Formalization (c) Infrastructure availability (d) Organizational size (e) Technological complexity (f) Relative advantage (g) Competitive pressure (h) Trading partners' pressure.

The study presented in [19] investigated the factors that influence organizational leaders in developing countries to adopt cloud computing technology. Cross-sectional survey with 16 questions made to measure four influencing factors namely, cost effectiveness, reliability, security-effectiveness, need for cloud computing.

The study [20] aims at exploring the significant factors affecting the adoption of SaaS for vendors and enterprise users of Taiwan. Analytical framework is proposed containing two approaches: TAM and RST data mining. The study indicates that factors including social influence, perceived usefulness and security & trust influence adoption of SaaS for Taiwanese vendors and enterprises. The purpose of the paper [21] is to investigate the factors that affect the adoption of cloud computing. Relative advantage, top management support, firm size, competitive pressure, and trading partner pressure characteristics have a significant effect on the adoption of cloud computing.

Tsai and Hung [22] proposed two-stage diffusion model based on system dynamics for prediction about the diffusion of cloud computing. The results indicate that service quality, the degree of maturity of infrastructure, price and the degree of technological maturity are the main factors affecting the diffusion of cloud computing. Technology maturity is modeled as function of no. of personal getting engaged in R&D and investment on R&D. Authors suggested that multiple methods of technology prediction should be applied for cloud computing diffusion.

Many studies focus on cloud computing adoption using diffusion of innovation, technology-organization-environment (TOE) framework etc. The investigations are done for specific region based on customer / employee feedback.

4. Methodology

This study investigates the cloud computing growth as a function of following factors.

cloud computing growth = f (technological improvement, relative advantages, customer perceived concerns, market structure, social factors, market need)

Technology improvement

technological improvement = f (patents, papers, investment, standards organizations, vendor support)

Relative advantage

relative advantages = f (cost, ease of adoption, ease of use, reliability, availability)

Perceived concerns

perceived concerns= f (security, cost, legal issues, lack of standards, service level agreement)

Market structure

market structure = f (number of providers, market share)

Social factors

social factors= f (academic support, government support, expert opinions)

Market need

market need= f (change in customer demand, social / global problems)

The hypothesis for the research work is stated below.

Hypothesis: Cloud computing shows positive trend.

- Select the parameters to measure the outcome of the hypothesis.
- Identify the qualitative and semi-quantitative precursor events.

A precursor event is any observable event in technology, economy, politics or society which will cause subsequent future event(s). Precursor events focus on the events that will trigger future events related to cloud computing.

Strengths of methodology: Proposed methodology covers technological, business, economical and social aspects of the cloud computing.

Limitations of the methodology: Implications of emergence of new alternative technologies for cloud computing are not considered in this paper. Literature reported that impact of change in Government policies / political decision on technology adoption is high and rapid. These events are beyond the scope of this paper.

5. Cloud Computing Precursor Events and Prediction

Martino [23] reported that a precursor event is a leading indicators method of forecasting future technology and it

is frequently used by technological forecasters. The technology forecaster utilizes a wide range of data sources to assure that no significant precursor event is unnoticed. Precursor events are quantitative and qualitative. The method of analysis of precursor events is qualitative. So, the forecaster can say nothing about the timing, or the probability of the technological change being tracked [23]. Making a point forecast of the "time to go" once a precursor event has been observed is impossible [23].

This paper focuses more on Extrinsic factors which are identified using precursor events.

Cloud computing growth can be measured with respect to

- Technical improvement
- Customer concerns
- Market growth
- Government support
- Opinions of enterprises or it's representatives

Precursor events are identified and categorized as per the selected measures.

A. Cloud computing technology improvement

Cloud computing technology improved in measured in terms of number of patents, number of papers, hype-cycle, stability and vendor support.

i) Number of patents: For analysis we are taking the two different patents USPTO and Espacenet. Patent data is started from the year 2009. From year 2009 to 2014 patent count is increased very rapidly. In year 2014 patent numbers are high. Hence cloud computing is in the growth phase of the technology life cycle as per the TLC characteristics. In 2016 total patent number reached 25,870.

ii) Number of papers: Paper data is taken from the IEEE and ScienceDirect papers. Cloud related papers found from the year 1996. In 1996 cloud related papers are only two, but in the 2016 cloud related papers are more than 37,292.

iii) Hype-cycle: Hype-cycle is one of the popular methods for investigating technology change. According to Gartner, hype-cycle means graphical presentation about maturity, adoption and business application of a technology.

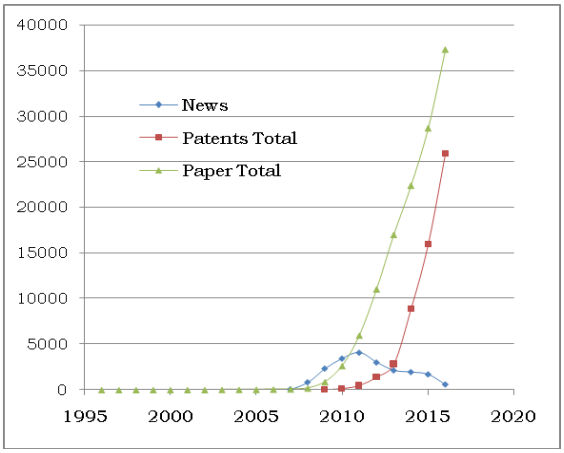

Fig. 1. Hype-cycle and life cycle curve of Cloud computing

In year 2007 cloud computing was at the bottom of the trigger phase. In next four years it shows rapid movement and reached peak of inflated expectations in year 2011. In year 2013 cloud computing is reached bottom of disillusionment phase and in year 2014 entered into slope of enlightenment phase. Upto year 2008 the growth in number of papers published is slow. After year 2009 the growth is exponential. Results shows that cloud computing entered in the growth phase of life cycle before reaching the peak of inflected expectation in hype-cycle [24].

iv) Stability: Standards / Associations / Organizations

No clear standards or lack of standards [25][26] is one of the constraints in cloud computing adoption.

From the study of 12 standard organizations / associations, it has been observed that the major issues covered by the standards are security, SLA, cloud computing architecture/model. Also, the standard organizations/associations and their proposed standards are increasing from the introduction of cloud computing.

Table 3: Issues and Association or Organization

Issue	**Association or Organization**
Authentication and Authorization	NIST
Confidentiality	NIST
Integrity	NIST
Identity management	NIST, OASIS
Security	NIST, ISO, CSA, DMTF, OCC, ETSI, OMG-CSCC, SNIA, OASIS.
Availability	NIST
Risk assessment	ISO
Control objectives	ISO
Interoperability	ETSI
Portability (Data/ Software)	DMTF, ETSI
Reversibility	ETSI
Mitigation of risks and vulnerabilities	TM Forum
Service level agreement	NIST, ISO, DMTF, ETSI, OMG-CSCC, SNIA, TM Forum
Cloud computing architecture / model	NIST, ISO, DMTF, OCC, OGF, OMG-CSCC, CCIF, OASIS, TM Forum.
Cloud storage architecture/model	SNIA

v) Vendor support: Public cloud service providers are reducing prices constantly. Price reductions are often targeted at services. In 2012, most price reductions were in storage services while in 2013, most price reductions were in compute services [27]. Because of an increase in competition, cloud service providers are reducing the cost of services. For example, from

2008 to April 1, 2014, Amazon has reduced the cost 42 times for the Amazon Web Services (AWS) [28].

The precursor events listed below focus on

- Improvement in existing cloud computing services
- Launching new cloud services

Table 4: Events identified as potential Precursor Event and their weakness / challenge

Events identified as potential Precursor Event	**Deal with the cloud weakness / challenge**
IBM brings security intelligence to the cloud	Cloud solutions are not secure enough
CloudLock expands cloud security offering for Salesforce with CloudLock selective Encryption and Apps firewall	
Ensim launches Intel security cloud service brokerage	
IBM launches cloud service that helps design sophisticated electronic systems	Comfort level of IT staff with cloud
Oracle cloud platform was enriched by nearly 24 new services for developers, IT professionals, end users and analysts to achieve, to expand and more easily integrate cloud applications	
Business consulting firm Accenture had released an enhanced version of its Accenture cloud platform, designed to improve its ability to help with the governance and control of cloud applications.	
Software AG has launched an online shop for development components in a bid to make cloud application development easier for enterprises.	
Ormuco launches hybrid cloud solution for middle market and large enterprise organizations.	Interoperability i.e. difficulty in integrating cloud solutions
Google launched preemptible Virtual Machine, a new cloud service that allows to use computing resources at low costs.	Cost reduction.
Many world class reputed universities and colleges are offering cloud computing to their graduate and post graduate students.	

B. Relative advantage

Cloud computing driven data centers and services are helping organizations to leverage multiple business attributes. In our pervious paper [29] we have summarized the strengths and weaknesses of cloud computing. Cloud computing is beneficial with respect to it's alternatives in many respects, namely cost effective, availability, reliability, flexibility, ease of acquiring and maintaining technology systems and scalability.

C. Customer concerns about cloud computing adoption

Customer concerns for any product / technology affects the adoption decision. The Table 6 summaries customer concerns about adoption of cloud computing. The data has been collected from various survey reports.

Table 5: Issues / Concerns and Perceptions of respondents

Issues / Concerns	**Perceptions of respondents (from survey reports)**
Security	On an average approximately above 50% of respondents in surveys, perceive insufficient data security is the concern that becomes hurdle for adoption of cloud computing in the organizations. This is the top issue addressed by all the surveys.
Reliability	Reliability is not the major concern among the top concerns in the adoption of cloud computing.
Availability / Access to information	Respondents concern about the access to information and risk of data availability.
Legal issues / Regulatory compliance / information governance	On an average approximately 35% of respondents think contractual obligations, open compliance and legal issues, meeting regulation and information governance are impediments preventing cloud uptake. Survey from Accenture Institute for High Performance Research (2010) and Deloitte and CIOnet, (2011) show legal issues are in the top list of concerns.
Integration with existing systems or cloud solutions	On an average of 40% of respondents say due to difficulty in integrating different cloud solutions or integration with existing systems.
Vendor lock-in	According to perceptions of executives, they are very much concerned about technical constraint such as vendor lock-in and contractual matters. On an average approximately 30% of respondents say commitment to one partner is an impediment preventing cloud uptake.
Lack of skills	Lack of skills or shortage of IT staff and skill sets may impede the adoption of cloud computing at the organizations. But this issue is not a much concern according to the perceptions of respondents.
SLAs	Appropriate provisions for business risks need to be covered through SLAs. Penalties such as chargeback from

	service providers need to be associated with SLAs.
Lack of industry standards or Lack of clear cloud strategy	Executives, especially where the state plays a strong role in guiding the economy, say governments should establish cloud security, data privacy and technical standards, as well as support the certification of cloud service providers. On an average near about 50% of respondents say cloud computing solutions must be able to meet enterprise and/or industry standards.
Loss of control	Lack of control comes in the list of top concerns. On an average 36% of participants perceive risk of losing

	governance over the physical infrastructure and control over data is becoming the hurdle for adoption of cloud computing at the organizations.
Licensing issues	Very less participants think about the unclear licensing is the concern.
Migration of legacy applications	Respondents perceive lack of clear strategy or help from key vendors in adapting their applications to cloud computing platforms.
Cost or budget constraints / No financial benefit	Reported by four survey reports.

Table 6. Customer concerns about cloud computing adoption.

Reports / Concerns	Accenture Institute for High Performance Research Report (2010) [30]	Deloitte and CIOnet (2011) [31]	1105 Government Information Group Research Study (2010) [25]	IDG Enterprise (2012) [32]	Microsoft-Technet IT Pro Cloud Survey Results [33]	IBM Academy of Technology Survey, October (2010) [26]	Capgemini (2012) [34]	KPMG's 2010 Cloud Computing Survey (2010) [33]
Security	86%	20.5 %	55%	70%	18%	14.3	41%	76%
Reliability	84%					11%		
Availability / Access to information	-	20.5 %		40%		11%		25%
Legal issues / Regulatory compliance / information governance	81%	17%	37%	37%	8%		18%	51%
Integration with existing systems	83%				14%		33%	40%
Vendor lock-in	79%	11%			7%		26%	25%
Lack of skills						9%		
SLA	83%							
Lack of industry standards	82%		43%	32%		12%		
Loss of control	79%	14%	33%		11%	8.1%		
Licensing issues		7%				8.5%		
Migration of legacy applications			31%					
Difficulty in	79%			34%				

measuring ROI of cloud solutions / uncertainty around ROI								
Lack of executive or user support	73%		44%					
Resistance by IT managers and staff	73%			business leader - 12% employee - 9%				
Cost or budget constraints / No financial benefit		9%	36%				27%	24%

D. Market growth

- Enterprises are shifting from traditional software to cloud computing.
- There is increasing investment by enterprises and government for cloud computing research and / or adoption.
- Collaborations, acquisition and mergers of different cloud service providers.

Table 7: Events identified as potential Precursor Event

#	**Events identified as potential Precursor Event**
1.	IBM announces $3 billion research initiative to tackle Chip grand challenges for cloud and Big Data Systems
2.	HP to spend $1 billion on cloud computing R&D
3.	Cloud to command 90% of Microsoft's R&D Budget (investment in cloud R&D $8.6 out of $9.6 billion)
4.	Intel's results reflect move to cloud computing. Data center chips had an operating profit of $2.1 billion, up 9 percent.
5.	Bharti Airtel partners Amazon for cloud services.
6.	Red Hat shift from client-server to cloud computing.
7.	AliCloud, the cloud computing arm of Chinese internet giant Alibaba, has announced the opening of its second data centre in Silicon Valley.
8.	As extensively leaked PC and server outfit Dell announced it will be acquiring storage giant EMC for $67 billion to create a leading player in the data centre and cloud industries.
9.	Enterprise IT giant IBM has announced it will be acquiring object-based storage software and appliances vendor Cleversafe to boost its storage and hybrid cloud offering.
10.	German technology giant SAP has pledged an $150 milllion investment in Australia in order to build up its service offerings to government clients and establish a Canberra cloud datacentre.

E. Market structure

Two parameters are considered for market structure.

(i.) Number of providers: The worldwide number of cloud service providers has been increased from 87 in year 2008 to 1296 in year 2013 [36]. This trend shows the significant increase in the number of cloud service providers. The cloud computing service providers are also increasing in numbers everyday [37] as the numbers of cloud users are increasing day by day [38].

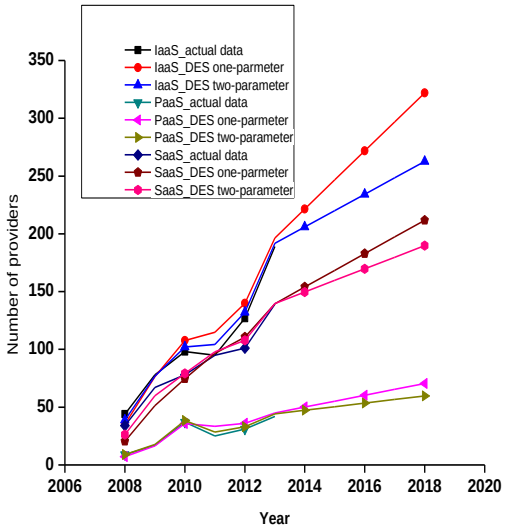

Fig. 2. Results of forecasted values of cloud providers using best fitted double exponential smoothing (Taken from [39])

Paper [39] presented results of medium-term forecast of cloud computing providers using exponential smoothing methods. The growth in number of PaaS cloud providers is very slow as compared to IaaS and SaaS.

(ii.) Technology / product development: Research and development in cloud computing in applications and solutions is very fast. The cloud service providers deliver different services for various requirements by the business. Some of the cloud services are listed below:

Table 8: Cloud Services

• Infrastructure as a Service	• Platform as a Service
• Software-as-a-Service	• Storage-as-a-Service
• Database-as-a-Service	• Information-as-a-Service
• Process-as-a-Service	• Integration-as-a-Service
• Security-as-a-Service	• Management / Governance-as-a-Service
• Testing-as-a-Service	• Desktop-as-a-Service (DaaS)
• Telepresence-as-a-Service	• Disaster-Recovery-as-a-Service (DRaaS)
• Network-as -a-Service (NaaS)	• Anything-as-a-Service (XaaS)

F. Government support

Table 9: Identified as potential Precursor Event

Events identified as potential Precursor Event
Japan, Australia and the United States take the lead as the countries with the most cloud-friendly policies and laws.
UK government has launched an Enterprise capital fund to lend over £40m to high-growth cloud computing and SaaS companies in UK.
The UK Government G-Cloud is an initiative targeted at easing procurement by public-sector bodies in departments of the United Kingdom Government of commodity information technology services that use cloud computing.
For the development of Cloud, Chinese government invest plan is for $1 billion.
In 2012, China has initiated around 100 cloud related projects which include building national data centres.
US Government IaaS Spending to Reach $5.4 Billion by 2017.
Australian government's vision is to employ cloud computing in order to meet a wide variety of the government's demands.
Cloud computing is top priority of half of Asia pacific companies.
Japan planned completion of nationwide cloud called Kasumigaseki Cloud by 2015.
Indian Government has started using Cloud to benefit masses and launched massive projects like Aadhar, National Population Register, National Rural Heath Mission, M-NREGA.
Government of India has embarked upon a very ambitious and important initiative – "GI Cloud" which has been coined as 'Meghraj'. The focus of this initiative is to evolve a Strategy and implement various components including governance mechanism to ensure proliferation of Cloud in government.
Rs 11.39 Cr. for cloud Computing- Tamil Nadu state India.
Swiss sign contract for private cloud services (Switzerland).

G. Opinions of enterprises or it's representatives

In recent times, cloud computing model is strongly influencing IT world and enterprises.

According to McKinsey Global Institute's (MGI) report [40], cloud computing is one among the twelve economically disruptive technologies.

KPMG and NASSCOM [41] identified, cloud computing are one of the six converging technology trends which will make a huge impact on enterprise, communities and societies.

Gartner defines "a strategic technology as one with the potential for significant impact on the enterprise in the next three years" [42]. Cloud computing and/or it's enablers are present in every Gartner strategic technology list from year 2004 to 2014. Year 2005 to 2010 and 2014 are strongly influenced by presence of cloud computing and it's enablers. Results show that cloud computing, virtualization and data centers are present for more than five years. Except 2004, 2006 and 2007, cloud computing and related technology is present in remaining eight years. The number of variations of cloud computing, virtualization and data centers is 12, 6 and 5 respectively. In year 2013 and 2014, two and four variation of cloud computing and related technology are present respectively. From year 2004 to 2014, cloud computing and it's enablers are present 33 times out of 110. Frequent occurrence indicates that these technologies are influencing enterprises from year 2004 and have disruptive potential [43].

6. Conclusions

Impact of larger number of factors and sub-factors makes the forecasting technology evolution and growth a complex problem. Large portion of literature focuses on technology forecasting using technical parameters only. This paper attempts to cloud computing trend forecasting as a case study using technical, business, economical, social and behavioral factors. In this work factors affecting cloud computing growth are identified and categorized. Precursor events are searched through literature, reports and news. A large number of precursor events are positive towards the growth of cloud computing. 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.

Different reports on cloud computing forecasting published by Gartner, HIS technology, Forrester, IDC and Cisco reported growth of cloud computing. This investigation is in line with these reports.

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