

Knowledge Management System in A Cloud Computing Environment

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Abstract: Information Technology has always been a concern for the enterprise/organization/firms of any size or magnitude. The concern could be from the point of view of both management and costs. But, the information technology industry has been under many changes, upgradations and shift in the past decade. Most importantly, factors like open-source software, hardware commoditization, workforce globalization, virtualization, and nimble IT processes have helped in the progress of the advancement of business models and new technologies. Firms/organizations/enterprises have been facilitated with a wide variety of choices with respect to how the business infrastructures can be operated, liabilities can be allocated to third-party providers and the provision of saving costs by the process of Cloud computing. Cloud computing as a whole has come to become an intrinsic part of business models and technology, making businesses adapt to new technology strategies for knowledge management. Suitably, the increasing demand for the adoption of cloud computing in industries, new market offerings like producing other cloud service and delivery models have been developed so that cloud computing encompasses all that an industry needs for its Information Technology needs for its effective functioning. This study desires to learn about cloud computing, the process involved in knowledge management and specifically identifying loopholes if any, so that result and action oriented conclusions can be drawn upon and they can be implemented to avoid any discrepancies in knowledge management in future. This paper would also help in the analysis of available cloud computing models in the market and potential future cloud computing trends that are likely to develop in knowledge management.

The analysis of cloud computing models has shown IaaS service delivery model is likely to keep losing market share to PaaS and SaaS models because companies realize more value and resource-savings from software and platform services rather than infrastructure. In the near future, we can expect significant number of market consolidations with few large players retaining market control at the end.

Key words: Knowledge Management, Cloud Computing, IaaS, SaaS, PaaS

Introduction:

Cloud computing is a new concept has gained popularity and need for more awareness. Many industries desire to learn about Cloud computing and its advantages to the industrial sector in knowledge management. Cloud computing is a computing paradigm that enables all-pervasive access to configurable system resources over the internet. Cloud computing offers services of a higher level which can be instantly provisioned putting minimal efforts in management. This model is the development of distributed computing, parallel computing, and grid computing. As cloud computing refers to applications provided as services using the Internet and the systems software and hardware in the data centers that deliver those services, it is an extension and coalescence of Utility Computing, Virtualization, Infrastructure-as-a-Service (IaaS), Software-as-a-Service (SaaS), and Platform-as-a-Service (PaaS).

In the cloud computing infrastructure, various premises or networks store the resources normally. They are remotely used by cloud users. In addition, the processing is done incidentally which infers that the data and other elements require to be imparted onto the cloud infrastructure or server for the required processing. Thereafter, the output is obtained after completion of the required processing. Usually, it might be desired or be made feasible for one to store information on remote cloud servers. The cloud based computing is efficient in effectively managing IT resources of industry.

Therefore, cloud computing has commenced rapid progress and development in the way organizations view their IT resources. From the point of view of a single system which consists of a single application and single operating systems, industries/firms have been resorting to cloud based computing for knowledge management. Here, the resources are profusely available and it provides the users with a broader range to choose from. In addition, the end-users are not obliged to have the knowledge of particular technologies while hosting their application because the service in absolute capacity is administered by the Cloud Service Provider (CSP). The users can avail services according to their need preferences and rates. However, there is no fixed time for availing the on-demand service by the users. On behalf of the user, CSP operates all the required complex processes. A full-fledged system is designed so that the required resources for effective implementation of user applications and management of the whole system are properly allocated.

There are many benefits of Cloud based Computing. Cost optimization stays one among the many benefits. The reason cost optimization being so important is because the principle of cloud computed is based on "pay as per use" concept. The other benefits of using cloud computing services carrying equal importance are ease of use, expanded mobility, optimum resource

utilization, application motility, etc. This implies that the users will be capable of accessing data all over at any time instantly without much hassle and squandering the underlying hardware resources that are quintessential or never have been used. Owing to the benefits it provides, cloud computing technology in the present context has taken cognizance of huge migration or a paradigm shift of many firms/organizations/industries from their traditional IT infrastructure to cloud based computing services.

Cloud Options

Several firms/organizations/industries are concerned about issues related to privacy and security. If the security of any firm's database is breached, it could cost the firm huge loss and potential damage as its sensitive information, trade secrets and details of dealings and transactions could become open. For customers of this kind, there are two cloud options which firms can adopt:

- 1. Private Clouds:** Private clouds provide tighter security and additional levels of control that are not provided by the public cloud services because every private cloud is created exclusively and specially for each organization based on the organization's demand and preferences and can be located both on-site and more importantly off-site.
- 2. Hybrid Clouds:** Often organizations select hybrid cloud models that let them take advantage of the cost saving utility-like pricing of public clouds for things like the company website for instance while maintaining a private cloud for applications and content more sensitive in nature or subject to regulatory guidelines.
- 3. Public Clouds:** The public cloud resources, such as servers and storage are owned and run by a third-party cloud service provider. The services are provided over online networks. Relying on the public cloud, all software, hardware, and other aiding infrastructure is occupied and administered by the cloud provider. The same storage, hardware and network devices with cloud "tenants" or other firms / organizations / industries are shared. Availing services and managing respective accounts are accessed using a web browser. Therefore it is mandatory that a valid internet connection must be installed. Deployments of Public clouds are often used to deliver services such as online office applications, web-based email, storage, and testing and advancement environments.

Cloud Computing Models

Cloud Providers provide services that can be grouped into three categories.

- 1. Software as a Service (SaaS):** A complete application in case of SaaS is provided to the user, owing to a service based on demand. A single precedent of the service performs on the cloud following which various end users/customers are serviced. From the customers' perspective, there is no requirement for forthright investment in software licenses or servers, whereas for the provider of cloud based computing services, as only one application requires to be introduced & sustained, the costs are directly reduced. SaaS, at present, is being provided by giants such as Salesforce, Google, Zoho, Microsoft, etc.
- 2. Platform as a Service (PaaS):** In the case of PaaS, a layer/cover of software or environment for further advancement is enclosed & provided as a service. Based on this, there is a scope for other higher levels of service being assembled. The end user in the case of PaaS has the independence to create and launch his own applications which would operate on the service provider's framework/infrastructure. The scalability, administering and governing requirements of the applications have to be met. The same need can be fulfilled when PaaS providers choose to provide a pre-defined combination of application servers and Operating Systems such as Ruby, restricted J2EE, LAMP platform (Apache, Linux, PHP, and MySQL), etc. Some of the most familiar and commonly used PaaS are Force.com, Google's App Engine, etc.
- 3. Infrastructure as a Service (IaaS):** IaaS offers fundamental storage and computing abilities as a form of regulated services over the internet and networks. Storage systems, data centre space, servers, equipment used for networking, etc. are pooled and facilitated to tackle pressurizing workloads. The end user would generally use the software which he developed on his own. Amazon, GoGrid, 3 Tera, etc are some of the common forms of IaaS.

The process of Cloud computing

As observed, Cloud computing is an online network based processing system where software applications, computing infrastructure, information capabilities, and business processes and collaboration are dispatched to computers, laptops and other devices like tablet PCs and smart phones using the internet as per the required demand. Applications provided as services using online networks in the data centers that deliver those services, an appendage to the three computing models, Infrastructure-as-a-Service (IaaS), Software-as-a-Service (SaaS), and Platform-as-a-Service (PaaS) are used and they play a pivotal role in understanding the process of cloud computing in knowledge management.

To understand the way cloud based computing works, it is important to decipher its process. The figure below explains the process of cloud computing. The process is as follows:

First, an end user or a customer who wishes to avail the cloud computing services stores the physical hardware and software onto the cloud where all his data is stored. A new user is required to create an account on the cloud server so that he is able to access it anywhere, at anytime.

Once the account is created, an individual, firms / organizations / industries are required to store the data in their mobile devices, computers, laptops, tablets and other devices using utility softwares (for example, web browsers).

After the data is stored, the user’s applications, personal and professional data, files, etc are deployed in the cloud for further sustained storage.

As cloud computing is an internet based program, the cloud saves the data on its server safely. It is password protected with all other security systems in place.

To retrieve the data from the cloud server where the data has been stored, the Cloud Service Provider (CSP), administrator of cloud based computing services provides three models related to cloud computing namely, Infrastructure-as-a-Service (IaaS), Software-as-a-Service (SaaS), and Platform-as-a-Service (PaaS). Infrastructure-as-a-Service (IaaS) encompasses storage servers, virtual machines, networks, load balancers, etc. Software-as-a-Service (SaaS) helps access Data servers, Application servers, web servers, development environments, etc. Platform-as-a-Service (PaaS) help the end users or customers access E-mail, documents, CRM, Online games, SCM, etc. The end users can use any of the models based on their convenience level. Therefore, once the data is loaded onto the cloud, the application servers start the function of storing the customers’ data and it is dissipated to the end users using online networks causing replication of data following which the services are delivered to the end users.

By using cloud storage, the end users are not required to store the data on their own storage drives (internal and external). Rather, they can have full access from any location in the world, open any file and download it onto any device, including tablets, laptops, or smart phones. In addition, an end user can also edit files or documents, such as Word PowerPoint presentations, spreadsheets or documents simultaneously with multiple other users, causing no traffic and making it accessible to work or view their data.

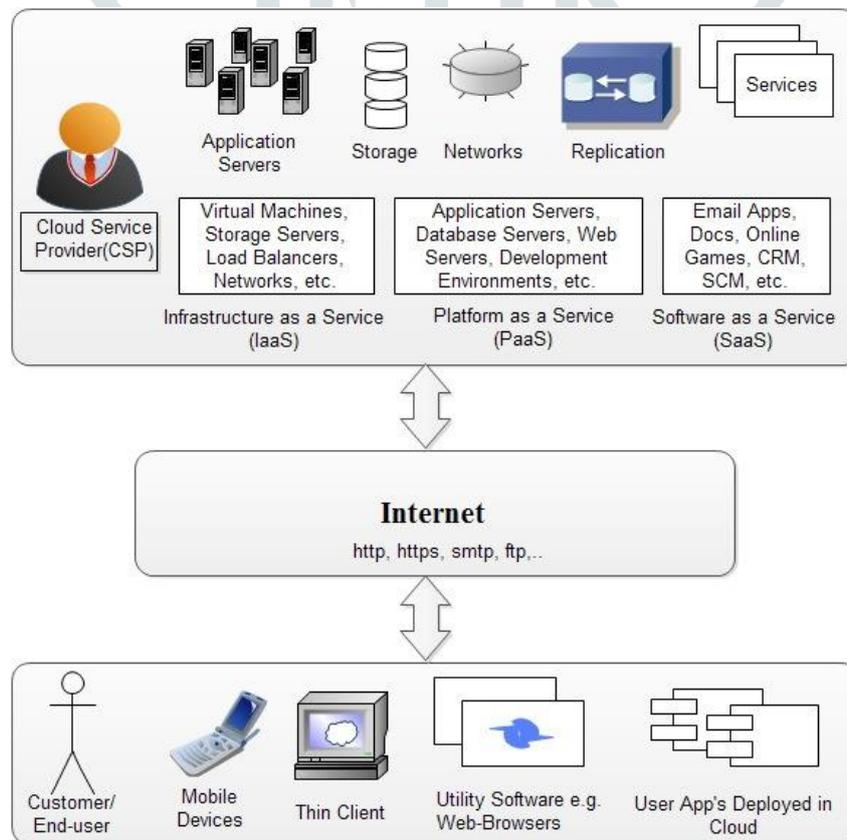


Figure 1: Process of cloud computing

Adoption Factors of Cloud Computing

The adoption factors constitute external and internal factors that influence the adoption process of cloud computing.

External Factors

The factor from out of the social environment in which the firms function and by which its cloud computing adoption process is impacted is comprised of the external factors sector.

The external factors are as follows:

- 1) Cloud providers,
- 2) Cloud service broker,
- 3) Government regulations,
- 4) Competitors,
- 5) Business partners, and
- 6) IT industry standards institutes.

Different levels of inter-organizational and environmental uncertainties surround the adoption process of cloud computing. Importance of government regulations has been given emphasis on at the various national and international levels. Even though the government attempts to facilitate the process of cloud computing adoption at various levels in a secure manner, lack of proper formulation of government policies and regulations can hinder firms from adopting the cloud for various other reasons. Regulations such as the Gramm-Leach-Bliley Act (GLBA), Sarbanes-Oxley Act (SOX) for corporate accounting data, and the Health Insurance Portability and Accountability Act (HIPAA) were enacted before cloud computing gained popularity and its uses became known to the individuals and firms, and it is certain that they might be insufficient in facilitating its adoption at all levels. But, some countries have started to enact laws with a specific focus on cloud computing, such as cloud computing strategy by the Australian government and the Health Information Technology for Economic and Clinical Health (HITECH) Act and cloud first policy in the USA. The inconsistency and no adequate execution of international government regulations is another concern that must be addressed as no widely agreed data privacy policy among all governments exists.

An important external factor such as the IT standards institutes is also considered as an important factor in dealing with firms' worries about the interoperability and security of cloud solutions. Although there are issues with the firms about less knowledge of cloud computing, concrete efforts have been tried to develop security standards. Also, Cloud providers have to necessarily comply with industrial standards and government regulations to gain reputation, and trustworthiness among their present and potential firm users. They are also required to be transparent in providing detailed information to firms about risks and possible benefits of adopting cloud computing.

In the market, competitors play an important role in incentivizing firms urging them to adopt cloud computing for gaining a considerable market share, operation efficiency, market visibility, and new business opportunities. There is less number of studies that progress on exploring the role that cloud service broker or the so-called service integrator plays in facilitating the adoption of cloud computing. It is observed that business partners perceive benefits from adopting cloud computing. It has considered as an important motive toward its adoption. Another very important effect of the influence of business partners is that they may require a firm to adopt cloud computing the condition being if they want to remain in collaboration or partners with them.

Internal Factors

The internal factors constitute the firm's internal capabilities and characteristics that impact its adoption processes. These factors are:

- 1) Top management,
- 2) Willingness to invest,
- 3) Employees' IT skills,
- 4) Organizational culture, and
- 5) Firm size.

The firm's willingness to invest in cloud computing and adopt it both organizationally and financially is considered a vital indicator for the adoption of cloud computing. Willingness to adopt can surely be impacted by social influence as firms would adopt cloud computing as its managers could opine that cloud computing is effective and can enhance the firm's status among its social system. Adoption of Cloud computing is interdependent on the role of top management because there exists a relationship between top management innovativeness including accepting and adopting new technologies and the willingness to adopt cloud computing. IT knowledge of the Top management, competing for nature, and capability of facilitating the optimal organizational climate in terms of adequate human and IT resources, budget, and time is a mainspring to the adoption of cloud computing.

Also, Organizational culture can be said to have an influence on the firm's opinion on cloud computing adoption. For firms that have full control over their data and are used with an on-premise approach, it might not be easy for them to accept that their data will be fully controlled by the cloud provider. Hence, firms would further require ensuring of compliance of cloud computing solutions with the internal restrictions. Firm size also is a significant factor that influences the adoption of cloud computing. It is obvious that a firm that is spread over many countries need to adopt cloud computing because the IT resources and other sensitive data would require protection and secure storage. A survey conducted in Taiwan exhibited that large firms are likely to adopt cloud computing. On the other hand, a survey conducted in India showed that SMEs can be at an advantage after the adoption of cloud computing because large firms would have sufficient resources to fund and avail on-premise solutions. Another survey reported that huge firms are more likely to test and be analytical of adopting cloud computing services, whereas SMEs can be more flexible to adopt cloud computing. Another study showed that SMEs might be less concerned and price-oriented about performance, whereas large firms with an aim to balance costs against security, reliability, and performance, they might adopt cloud computing after critical analysis.

Benefits of Cloud Computing

Cloud computing has gained importance and value in the market as it helps individuals and firms to store data and access it from all over the world. Individuals and firms would require organizing their applications, with an aim to explore the architecture models offered by Cloud Computing. Some of the benefits of cloud computing are listed below:

- 1. Cost Reduction:** Cloud technology attributes extensively to reduced costs. Recurring and initial expenses incurred are much lower than the expenses incurred during traditional computing. The cloud infrastructure is not purchased and its billing model is based on pay as per usage which results in reduced maintenance costs.
- 2. Increased Storage:** In the present, Cloud providers offer huge and advanced Infrastructure. This helps in the maintenance and storage of large sizes of data. As the cloud can scale dynamically, sudden workload pressures and shocks are efficiently and effectively managed without any issues. Sharing of resources is relied upon in cloud based computing in order to accomplish economies of scale and rationality.
- 3. Flexibility:** As the business conditions are changing on almost a daily basis and updations related to the functioning of business in the market follow, enterprises are adopting cloud on a rapid scale. But, to keep the cloud effective in its usage and not to disappoint its customers, the service providers of cloud computing focus on bringing applications to the market and its end users quickly. This is achieved by deploying optimal building blocks which are necessary for development.

Problems in Cloud Computing

Cloud computing attracts users urging them to avail the services because it encapsulates scalability of resources and has great elasticity. In addition, it uses the tag line 'pay-as-you-use' and promises to provide the services at relatively low prices. Hence customers are able to reduce their expenses at a significant rate by migrating to cloud services, by storing and hosting onto it. Although this avoids risks involved in storage in physical form and reduces expenses in terms of manpower and finance, it brings lots of new risks and challenges. The numerous issues and challenges are listed below:

- 1. Data Protection:** Data Security is an important factor that warrants scrutiny. The security issues could severely affect cloud infrastructures. Security itself is conceptualized in cloud computing infrastructure as a distinct layer (Dukaric & Juric, 2013).

Hesitance to purchase an assured business data security program from vendors still exists among many individuals and firms. The main fear is a leak of data confidentiality and privacy of consumers. In many situations, the location of actual storage is not known. In the already mentioned existing models, firewalls and other security systems across data centers prevail that protect all types of sensitive information. But in the cloud model, enterprises depend on the service providers as the service providers are responsible for maintaining data security.

- 2. Data Recovery and Availability:** Operational teams are important in runtime governance of applications and managing service level agreements. All business applications have Service level agreements that are strictly administered and followed. In production environments, operational teams support Data Replication, optimum clustering and fail over, System monitoring (logs monitoring, transactions monitoring, and others), Disaster recovery, Maintenance (Runtime Governance), and Capacity and performance management. The damage and impact could be severe if any of these services are under-served by any of the cloud providers.

- 3. Regulatory and Compliance Restrictions:** Government regulations do not permit customer's personal data and other sensitive information to be disclosed in the public, state or country. To ensure the same level of security, it is required that cloud providers establish a storage site or a data center specifically in a country. Such higher levels of infrastructure cannot be feasible in some cases due to involved costs, etc. To achieve this is a big challenge for cloud providers.

Other problems in cloud computing include Data Theft and hijacking, Data integrity, Infected Application, data Loss, and Security on Vendor and User Levels.

Cloud Computing encompassing knowledge management as a service:

Knowledge management encompasses various disciplines like Information Technology, Information Science, Informatics, Management theory, economics, Artificial Intelligence, organizational behavior, epistemology, social science, cognitive science, semantic web, expert system, neural networks, etc. Knowledge management influences attitudes, human behavior, philosophies, capacities, models, operations tool and technology. Cloud computing can help handle the knowledge management process and it is required that the research in the human resources area and knowledge resource centers assist in creating, processing, storing and transferring the knowledge from one place to the other.

Knowledge management currently has become a central management point across the world. Globalization of economy and Information Technology has facilitated opportunities to have an increased emphasis on societal and personnel intellectual resources in the knowledge management sector. Knowledge management remains in its nascent stage. Knowledge management is a strategy where the knowledge managed, stored, recorded and processed within an industry is treated as an asset. Increased

growth in technology, increased complexity and broad and easy access to data and information creates a wider scope for knowledge management in the world of Information Technology.

Works of Delic and Riley (2009) entail the concept of combining the benefits of Cloud Computing and Enterprise Knowledge Management (EKM). Here the knowledge relating to the enterprises can be made available on a Cloud Computing based system.

Cloud based services, in context to the knowledge management platform, are increasing day by day. Many players have entered the arena, and are providing assorted services. A few are discussed as follows:

Major players providing Knowledge Management (as a service)

1. Salesforce Knowledge Management

Knowledge management software being provided as a service through salesforce.com makes it accessible to review, capture, access and catalog information. This shall help the agents to find and access when they need the information. Knowledge management system by Salesforce includes -

- A private and public knowledge base
- Solution administration
- Multilingual solutions
- A solution encyclopedia
- Solution ratings
- Intuitive browsing and searching
- Suggested solutions
- Solution workflow.

1. BMC 365 and SharePoint Online

Office 365 permits to do operations like web conferencing, email, calendars and documents from anywhere in the world. It encompasses business-class security. Office 365 is easy-to-use and works with cloud-based management tools from a single location. IT staff can set up new user accounts with the help of the administration user interface. Therefore, it provides control access to features and most importantly helps to see the status of all Office 365 tools and services in real time.

Microsoft SharePoint Online is an integral part of Office 365. It provides out-of-the-box facilities and helps immensely in executing Knowledge Management as a Service for most of the needs of the enterprises. Microsoft SharePoint Server technology when delivered as an online service facilitates for the cloud to work for the enterprise. SharePoint Online assists in creating and building sites to share information and related documents with customers and colleagues.

2. Office Knowledge Management (as a Service)

BMC facilitates an influential knowledge content that helps service desk analysts to find solutions to their problems along with providing access to the users who have adequate resources. BMC Remedy IT Service Management Suite encompasses the BMC Knowledge Management as a Service. This service provides and delivers cloud-enabled self-service, service desk, basic knowledge management capabilities and inventory hosted on the Cloud Platform.

3. Igloo Software

Igloo is a web-based platform for colluding at work. It is a digital workplace that gives the customers the privilege to find answers, locate information, share files, solve problems, and develops expertise and access to the customers' collective knowledge, and partners, virtually anywhere in the world. The benefits are listed below:

- Collaborate and cooperate through blogs, forums, wikis, polls, and events
- Find what is urgently required through activity streams & search
- Communicate through integrated messaging, presence & status
- Build rich user profiles to develop expertise & knowledge
- Share, organize & manage documents & multimedia.

4. SpringCM Solutions

SpringCM provides a strong cloud services platform which is mandatory and accessible software for businesses worldwide. The services provided by SpringCM make it easy for cloud adopters to collaborate around content, share documents, deliver better business outcomes, and streamline business processes. A wide range of data and information – from the documentation, content management, and sharing of files to automated workflows, collaboration in cloud technology at a broader range is facilitated.

Conclusion

According to Cloud Security Alliance (CSA), over 70 percent of the world's businesses operate on the cloud. Considering the influence of cloud computing on individuals and industries, the future enterprise applications are going to be completely dependent on it. In addition, its technological transformations and business benefits are ushering services towards a new age of storing data and its transmission. Despite its growth, concerns relating to cloud computing still remain. The benefits are in excess to the drawbacks and the model is worthy of further development and exploration.

When a user of cloud services from CSP utilizes cloud based computing, organizations are not required to have high technical potential with respect to platforms and infrastructure. But, Cloud Service Users are essentially required to have knowledge and expertise on the functionality, operation and servicing / provisioning on the basis of the customer preferences.

Regulations with respect to cloud computing are required to be framed in order to ensure the safety of the customers. The basic requirements for tightening security including the technical issues related to cloud computing should be discussed. The security issues can cause impacts on a sociological and technological basis – the technological inconsistency leads to a security breach in cloud computing might, in turn, leads to significant sociological impacts.

An in depth study exhibited how and in what way the conversion of the current KMS to the Cloud environment has helped individuals and industries in maintaining and storing any kind of data on the cloud. It has several benefits, such as improved business processes, cost savings, customer satisfaction, and better knowledge management and representation. Other application areas such as Collaborative KMS, Customer Knowledge Management Information Systems (CKMIS), Knowledge as a Service (KaaS), and Enterprise Knowledge Management (EKM) was discussed.

The governments at present are concerned about information technology, cloud computing, and related issues for many reasons. Many countries follow regulations that prohibit the sharing of data which is stored on physical machines located outside the country. Those firms that violate laws are accordingly penalized. If any firm stores confidential or sensitive data on the cloud, the cloud provider must show and prove that it never shares data outside its geographical area for any reason. Regulation of best practice must be formulated and implemented. The issue of an application operating on the virtual machine being capable of accessing the sensitive data or not is addressed by many countries. Therefore, there arises a need to formulate a new law for firms to effectively utilize the resources which change the application infrastructure rather than adding features to it.

Apart from requirement of regulations being formulated, security issues in cloud computing are sensitive and a critical matter to be addressed.

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