

STRATEGIC BUSINESS CHALLENGES IN CLOUD SYSTEMS

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ABSTRACT

For the past few years, the evolution of cloud computing has been potentially becoming one of the major advances in the history of computing. But is cloud computing the saviour of business? Does it signal the demise of the corporate IT functionality entirely? However, if cloud computing has to achieve its potential, there is a need to have a clear understanding of various issues involved, both from the perspectives of the providers and the consumers related to the technology, management and business aspects. Objective of this research is to explore the strategic business, management and technical challenges existing in cloud systems. It is believed that adopting a methodology and suggesting a corresponding architectural framework would serve as a potential comprehensive conceptual tool, which shows path for mitigating challenges and hence effort are put in bringing in by mentioning a suitable methodology and its brief description. It concludes that International Business Machine Common Cloud Management Platform is one way to realize the combined features of various models such as Hub & Spoke Model as a quality of Governance model; Gen-Spec Research Methodology design for semantic and quality research studies into one in the form of Reference Architecture. However in order to realize the full potential of the Customer-Respond-Adapt-Sense-Provider (conceptual) methodology for dealing with semantics, it is important to consider Internet of Things Architecture Reference Model where in the resources are translated into Services.

KEYWORDS

Cloud Business Challenges; Cloud Business Estimates; Cloud Computing; Cloud Deployment Models; IBM CCMP; Realizing CRASP methodology.

1. INTRODUCTION

For the past few years, the evolution of cloud computing has been potentially becoming one of the major advances in the history of computing. However, if cloud computing has to achieve its potential, there needs to have a clear understanding of the various issues involved, both from the perspectives of the providers and the consumers of the technology. While a lot of research is currently taking place in the technology itself, there is an equally urgent need for understanding the business and management related issues surrounding cloud computing and its probable mitigating solutions. Stakeholders in cloud computing include not only customers and providers but also enablers and regulators [1].

A cloud computing strategy is about enabling business agility. Cloud computing can improve flexibility, scalability and cost management. Businesses that are best able to realize the potential will be able to establish a cohesive business strategy as cloud computing can transform the organisation towards enterprise oriented functioning strategy with cost savings, optimized

business processes [2] and improved controls and offers to develop new revenue streams, mission critical service offerings and superior brand recognition [3].

2. OBJECTIVE

The Objective of this research effort is to explore the strategic business, management and technical challenges existing in cloud systems. It is believed that adopting a methodology and architectural framework would serve as a potential comprehensive conceptual tool, which shows path for mitigating challenges and hence effort are put in bringing in by mentioning a suitable methodology and its brief description.

3. CLOUD DEFINITION AND CLASSIFICATION

Cloud computing is an evolving paradigm. The NIST definition characterizes important aspects of cloud and is intended to serve as a means for broad comparisons of cloud services and deployment strategies. The services and deployment models defined from a simple taxonomy that is not intended to prescribe or constrain any particular deployment, services delivery or business operation. NIST defined cloud computing as a model for enabling ubiquitous, convenient, on-demand network access to 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. This cloud model is composed of five essential characteristics viz. (i) On-demand self-service (ii) Broad network access (iii) Resource Pooling (iv) Rapid elasticity (v) Measured Service; three service models viz. (i) Software as a Service (ii) Platform as a Service and (iii) Infrastructure as a Service; and four deployment models viz. (i) Private cloud (ii) Community cloud (iii) Public cloud (iv) Hybrid cloud [4].

Gartner defines cloud computing as “a style of computing where massively scalable IT-enabled capabilities are delivered ‘as a service’ to external customers using Internet technologies”. A simple common-sense definition of cloud computing could be said as “anything but my assets”; “anything but a PC”; “anything but a main frame” and as a movement of assets from bought and implemented on-site to hosted, owned and provided by someone else has merit [5].

4. CLOUD BUSINESS SERVICE MODEL PERSPECTIVES

Adopting Cloud business model depicts a phenomenon of thinking on the decision making towards owning an asset versus renting it.

Own it All	Lease It	Managed Hosting	Cloud Computing
Lowest Cost Reduce agility Slowest Provisioning Times No elasticity	Higher Cost Improved Agility Slow Provisioning Times 6+ months time scale Little to no elasticity	Higher Cost Improved Agility 24-hour provisioning Monthly timescales Minimal elasticity	Higher cost for static Lower cost for transient Highest Agility Immediate Provisioning High elasticity



Figure 1. A paradigm shift in conducting IT based business services [6]

A business is a capital asset, though it is more heterogeneous than land and real estate. A business is durable and reproducible. It takes time to build. It has features to which a capital accumulation model is applicable. Economically speaking, while supply view talks in terms of capital investments, the demand view talks in terms of derivatives and adjustments and then there is a difference between the adjustment of the technological asset and that of real estate assets. One advantage with Cloud business model could be that the new discovery of knowledge can open up new information or further development possibilities so that the demand for the original asset value can keep increasing [7].

While SOA has been widely adopted, several organisations have yet to fully understand how it can be fully leveraged to truly bridge the gap between business and IT. From a business perspective, the focus has always been on maximizing value for the organisation. To accomplish this, the organisation relies on IT to strategically automate business operations [8]. Cloud computing as a business model describes a broad movement to treat IT services as a commodity with the ability to dynamically increase or decrease the capacity to match the usage needs [49]. Cloud computing presents a compelling business model by leveraging shared infrastructure and economies of scale. It allows users to control the computing services they access, while sharing the investment in the underlying IT resources among consumers [9]. Cloud service models try to classify 'anything' that provider offer as a service (XaaS), where X means an arbitrary service (e.g. infrastructure, platform, software, storage...). A cloud service model represents a layered high-level abstraction of the main classes of services provided by the cloud computing model, and how these layers are connected to each other [10].

Cloud computing employs a service-driven business model. Cloud offer services that can be grouped into three categories: Software as a Service (SaaS), Platform as a Service (PaaS) and Infrastructure as a Service (IaaS). The definitions posted by [11] through techtarget.com web site are believed to provide value based knowledge content and are given here:

4.1. Software as a Service

Software as a Service (SaaS) is a software distribution model in which applications are hosted by vendor or service provider and made available to customers over a network, typically the Internet on demand. SaaS technologies support Web Services and Service Oriented Architecture and Ajax. SaaS is closely related to the Application Service Provider (ASP) and on demand computing software delivery models. While the ASP model follows the hosted application management model where a provider hosts commercially available software for customers and deliver it over the web, the Software On Demand model follow the software distribution model where provider gives customers network-based access to a single copy of an application created specifically for SaaS distribution. Customers get the advantage of getting freed from software administration, automatic and updates, patch management, version compatibility, global accessibility [11]. Examples of SaaS providers include Salesforce.com, Rackspace and SAP Business By Design [12].

4.2. Platform as a Service

Platform as a service (PaaS) is a cloud computing model that delivers applications over the Internet. In PaaS mode, a cloud delivers hardware and software tools (such as operating system support and software development frameworks) – usually those needed for application development making it available to its users in the form of a service. A PaaS provider hosts the hardware and software on its own infrastructure. As a result, PaaS frees users from having to install in-house hardware and software to develop or run a new application [11]. Examples of

PaaS providers include Google App Engine, Microsoft Windows Azure and Force.com [12], VMware, CloudFoundary [6].

4.3. Infrastructure as a Service

Infrastructure as a Service (IaaS) is a form of cloud computing that provides virtualized computing resources over the Internet. In IaaS model, a third-party provider hosts hardware, software servers, storage and other infrastructure components on behalf of its users [11]. The cloud owner is also called IaaS provider [12]. IaaS providers also host users' applications and handle tasks including system maintenance, backup and resilience planning. IaaS model offers highly scalable resources that can be adjusted on-demand. This makes IaaS well-suited for temporary or experimental or workloads. IaaS environments are characterized by automating administrative tasks, dynamic scaling, desktop virtualization and policy-based services. This model promotes and works on pay per use @hourly, weekly or monthly basis or it could be based on amount of virtual machine space used by the customers. The users' workload gets affected as a cascaded result when IaaS provider experiences the downtime [11]. Examples of IaaS providers include Amazon EC2, GoGrid and Flexiscale [12].

5. CLOUD BUSINESS SERVICE DEPLOYMENT MODELS

Four deployment models viz. Public cloud, private cloud, hybrid cloud [50] and community cloud are listed by NIST [15]. Some of the corresponding commercial products are also mentioned here [51].

Table 1. Examples for the NIST Service and Deployment Models Matrix [6] [51]

	SaaS	PaaS	IaaS
Public Cloud	Salesforce.com, QuickBooks Online, Office 365	Google AppEngine, Microsoft Azure, VMware Cloud Foundry.com	Amazon EC2, Rackspace
Private Cloud		Apprenda, Stackato	VMware, Hyper-V, OpenStack, CloudStack
Hybrid Cloud		Custom Cloud Foundry	Custom, Rackspace
Community Cloud		NYSE Capital Markets Community Platform	NYSE Capital Markets Community Platform

5.1. Public Cloud

A cloud service provider makes applications and storage resources available to the generic public over the Internet on a pay-as-you-go basis [15]. The benefit of offering public cloud is for the purpose of eliminating the initial capital investment on infrastructure and shifting the risks associated with it to infrastructure providers. Lack of fine-grained control over data, network and security settings are some of the lacunas, which hampers the effectiveness in many business scenarios [12]. A growing number of companies are providing public cloud computing services such as Amazon, Google, Microsoft, Rackspace and GoGrid. These cloud providers offer a variety of options in pricing, performance and feature set [16]. For example, the Amazon Elastic Compute Cloud (EC2) allows users to rent virtual resources to run their own applications. EC2

runs within Amazon's network infrastructure and data centers. It allows customers to pay only for what they use with no minimum fee [15].

5.2. Private Cloud

A cloud infrastructure is operated solely for a single organisation's internal use by itself or run through outsourcing manner operating by third party [17]. Private Cloud refers to internal datacenters of a business or other organisation, not made available to general public [18]. A Private cloud offers the highest degree of control over performance, reliability and security [12]. But then up-front capital cost matters here. For example, Microsoft Azure enables customers to build the foundation for a private cloud infrastructure using Windows Server and System Centre family of products with dynamic data centre tool kit [15].

5.3. Community Cloud

The cloud infrastructure is provisioned for exclusive use by a specific community of consumers from organisations that have shared concern. It may be owned, managed and operated by one or more of the organisations in the community, a third party or some combination of them and might exist on or off premises [4]. For example, the Google GovCloud provides the Los Angeles City Council with segregated data environment to store its applications and data that are accessible only to the city agencies [15].

5.4. Hybrid Cloud

The cloud infrastructure comprises two or more clouds among private, public or community [15]. For example, In India, by building a hybrid cloud bridge between Eucalyptus (Private Cloud) and Amazon Web Services (Public Cloud), customers gain the flexibility where to run workloads ensuring reliability, scalability, high availability of citizen centric e-Governance services [19].

6. CHALLENGES IN CLOUD COMPUTING

Some of the business, technical and management challenges are discussed as below:

6.1. Business Challenges

IT departments face several business challenges today, which include the following: High capital and operating expenditures and overhead caused by resource needs; low responsiveness to business needs due to complex IT operations; complex configuration difficulties; inefficient resource use in dedicated physical infrastructures, resource pool customization; resource scaling; longer deployment times; difficulty in integrating elements of cloud with other operating elements in the data centre that might demand higher operating expenses [20].

6.2. Technical Challenges

IT departments face several business challenges today, which include the following:

Data Lock-in; resource exhaustion; Unpredictability of performance; Data transfer; Bottlenecks; Bugs in large-scale distributed cloud systems [15].

6.3. Management Challenges

A survey conducted by Accenture identified the following challenges [21] [15]:

Table 2. Cloud Management Challenges.

Sl. No.	Management Challenge	Challenge Description	Mitigating Solution
1.	Trust in data security and data privacy	Safeguarding data (i.e. data security) and privacy as the top most challenge	Using domestic cloud facilities; adopting new security applications such as encrypted file systems and data-loss prevention software; employing hybrid clouds so that key data is hosted and managed internally and by improving data governance.
2.	Managing the contract relationship	Customizing the compliance based cloud standards to the specific needs to the client might involve indirect breaches. Then managing compensation to such breaches of service level agreement becomes a challenge. It could reflect as service liability to the provider. As a result of inadequate understanding of client's enterprise level requirements, cloud service providers show uncertainty in service compliance, which matches client requirements	Use the collaborated efforts of multiple cloud providers for achieving enterprise solutions; engaging a service integrator to perform cloud service management and contractual functions.
3.	Technology and Institutional Lock in	The usual practice of cloud business vendors is to create a lock-in in terms of providing specific branded technologies and branded management consultancy offers in order to encounter the business competitors and to avoid the customer switching play.	However offering specialist services and service integration capabilities can help meet these challenges
4.	Organizational inertia/Cultural Resistance.	Command and control over business services kind of culture might create an organisational inertia and cultural resistance and hence become service delivery bottlenecks in terms of time, which might lead the cloud customer to feel impatience and experience unsatisfied services with respect to breaching service level agreements.	Adopting transparency, explicit declaration & evidence based formal communication during cloud service transaction in addition to proper planning, contracting and management service, and clarity in service level agreement specifications (through providing suitable examples beside every relevant polymorphic terminology used in service level agreement)
5.	Command and Control Strategy	On one side command and control strategy helps to achieve the desired outcomes, it might give an opportunity to develop and evolve the strategic level breaching attitudes against the compliance to the enterprise standards thus reflects Loss of governance.	

7. CLOUD BUSINESS TAXONOMY AS A METHODOLOGY PERSPECTIVE

Marxist-Leninist philosophy is the methodological foundation of all sciences, including medicine. Doctors of all specialties can be provided with a unique universal outlook and scientific methodology of knowledge. Knowing foundations of dialectic materialism is important for a generic doctor by taking guidance from the general laws of the development of nature and society, without which a doctor inevitably follows the path of prejudice that is often subjective and superficial concepts concerning individual phenomenon with which the doctor comes in contact in practical and scientific activity. It means, the conclusions for various problems studied and deductions based on the results of an extensive experiment or practical observation may bear a metaphysical or idealistic nature. So, the mission of any science including medicine should not be limited by the description of facts or their constancy alone. Knowledge consists of not of facts but of the results which stem from them. Dialectic materialism is a unique reliable weapon in deriving the perception of truth, scientific worker and doctors can systematize, develop and understand the regular bond between the individual facts and then correlated them. Through knowledge, a skilful utilization of the laws and categories of materialistic dialectics and their disclosure in the process of studying concrete science are of great importance on the activity of a doctor. It helps doctor to lie on the correct path for searches and investigations and also on the uniquely correct conclusions and deductions based on observations [22].

Taxonomy is an important phenomenon, which can be treated to be used as a methodology in providing a solution approach. A fundamental problem in many disciplines is the translation of classification of objects in a domain of interest into taxonomy. Developing taxonomy however is a complex process [23].

Zach defined Business Taxonomy as the “controlled vocabularies used to describe or characterize explicit concepts of information for the purpose of capture, manage and present” [24]. Taxonomy can thus best be described as a hierarchy created according to data internal to the items in that hierarchy [25]. The significance of having or defining taxonomy is not just for the sake of classification but also for the purpose facilitating the find-ability. Taxonomy is expected to reflect the key characteristics of Usability, reusability, intuitive and natural (e.g. the reflected output and manifested results of Google Search Engine) [24]. It is a tree that reflects the kind-of pattern.

For example, earlier methods of performing research included visiting library, searching the racks based on the keywords maintained through index cards, which are arranged either based on alphabetical manner or based on library accession number for the purpose of obtaining the desired content from the journal or books sources. Following this traditional process used to consume approximately 15% to 35% of the time for searching the information and 40% of the corporate users reported that they can find the information they need to do their jobs on their intranets [26].

The web has now become the primary source of information for many people. The web and especially major web search engines are essentially tools in the quest to locate online information for many people. Over 80% of web searchers use web search engines to locate online information or services [27].

It is evident that Google kind of search engines are used for the purpose of retrieving a high proportion of relevant, precise, good quality result set oriented and unique documents [28]. The library data bases do not allow to type long search phrases however might fetch the better quality relevant content from the cluster of relevant journal from relevant databases. But then subscription amount to such library research databases matter right? The preference of using Google kind of search engines over library databases is not only from the subscription based restriction point of view but also from the view point of capability of fetching the relevant content

based on typing the long search phrases [29]. It is evident from the research conducted by [30], why online search based research is highly significant for fetching the user-centric solutions for scholarly research as compared to do traditional way searching for them by physically accessing the library premises. This survey revealed the factors for users' preferences as: convenience (84%); easier to use (87%); faster (90%); cost effective (71%) and reliable (63%) than traditional library access based searching. Bughin et al. (2011) [31] reported how internet technologies provide better search value benefits and its comparable economic value across few countries. Thus electronic resources save time in looking up for information and retrieving information based on providing relevant keyword search. So the summary finding of positive and negative sides of using such electronic resources among student community is mentioned in [32] document. ICT resource do not only save time in searching process of the content but also allow reduction in learning time [33].

Thus the even the Ph. D oriented academic researches which were planned to consume 5 years is now reduced to 3 years. But with the Google kind of Search Engines, web information dissemination and access has become easy and hence most of the universities across the world are mentioning that their Ph. D programs can be completed by scheduling them to be with a minimum duration of completion to as low as two years (e.g. University of Lincoln; Ph. D. programs in Singapore; Trinity College, Dublin; University of Southampton etc.).

Taxonomy consists of three fundamental different parts: (i) Representation, which consists of nominal, reproducible statements; (ii) Ordering, which is a logical, verifiable science and (iii) Nomenclature, which is largely guided by practical application [34].

So, the normal Google search engines can now be enhanced with semantic search capabilities for fetching the context-driven result set based on the long keyword phrases given.

“Enterprise information access technologies are maturing and now offer better indexing, querying, presentation and drill-down of results. However, the real value of information access technologies is the upfront and ongoing efforts needed to establish effective taxonomies, to index and to classify content of all kinds in order to provide meaningful results [48]. By itself, the search function has limited value” [35]. The dynamic summaries feature of such semantic interface engines enhance search results by highlighting the evidence found during the classification process- that is – the preferred term, synonyms and related topics are highlighted in the search results [35, p. 12].

The recent manifestation and realization of such web based activities have been available in the form of web services to the user. Web services provide a new model of the web in which sites exchange dynamic information on demand. This kind of change is especially important for the e-business community, because it provides an opportunity to conduct business in a faster way and more efficiently. Indeed, the opportunity to manage supply chains dynamically to achieve the greatest advantage on the market is expected to create great value addition and increased productivity. However achieving automatic management of supply chain opens new challenges viz. (i) web services should locate other services that provide a solution to their problem (ii) services should interoperate to compose complex services [36]. Given, the dynamic environment in e-businesses, the power of being able to find web services on the fly to create business processes is highly desirable. A key step in achieving this capability is the automated discovery of web services [47]. Though UDDI can enable to provide the dynamic capability of automated discovery of web services, however lack of semantics in the discovery process less effective even though the UDDI based interface can be used for keyword and taxonomy based searching. The key to semantic discovery of web services is to have semantics in the description itself and then using semantic matching algorithms to find the required services. Ontologies have been identified

as the basis for semantic annotations that can be used for discovery [37]. It means while the use of taxonomy focuses on the controlled vocabulary that refers to its structural arrangement, the term knowledge base relates to both structure and data; then the term ontology is related to controlled vocabulary, relationships, process and methodology [38]. Thus structures, processes, relationships, methodology, data and interface constitute to contribute in fetching the mostly desired semantic information.

8. CONCLUSION

Thus Hub & Spoke Model as a quality of Governance model [39]; Gen-Spec Research Methodology design for semantic and quality research studies [40] are then becoming prospective frameworks, which are having potential to explain the phenomenon of dialectic materialism concept, where dialectic materialism can be treated as a representation of object from which a number of dialects of objects can be instantiated (as forms based on taxonomy) for reflecting expressions with their corresponding specific bounded values.

For example CRASP management methodology developed by [41] in passing is based on the basic premise of strategic sense-and-respond paradigm can also be made applicable to real-world security with a modified view by including both customer perspective and provider perspective to the generic business model suggested by [42]. The objective of adopting CRASP methodology is to offer the satisfying features such as security, suability, flexibility (adaptability) and cost efficiency [43]. Underlying the trend toward this sense-and-respond technology is the identity of giving IT systems a deeper understanding of the semantics [44].

IBM CCMP (Common Cloud Management Platform) is one way to realize the combined features of all the above mentioned models into one in the form of Reference Architecture (i.e. CCMP RA). CCMP RA is a cross-IBM effort for an RA enabling cloud economics by optimizing resource and labour utilization, and delivering the foundational cloud management infrastructure for both private and public clouds [2] and in specific it could refer to IBM Reference Architecture for Business Management [45].

However in order to realize the full potential of the CRASP (conceptual) methodology [41] which includes the concept of dealing with semantics, it is important to consider IoT Architecture Reference Model where in the resources are translated into Services. Resources are software components that provide some functionality (it could associate with sensors and actuators). Services provide the link between the IoT aspects of a system and other, non-IoT specific parts of an information system, like e.g. various enterprise systems; IoT related services and non-IoT services can be orchestrated together in order to form a complete system [46].

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