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Research paper

Cloud Economics and Enterprise Strategy: A bird eye's view

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Abstract

Cloud Computing has enabled enterprises to focus on their core business by shifting their IT processes and operations on vendor managed public/hybrid clouds. Since the cloud offers numerous benefits such as: IT operational competence, flexibility, increased global reach, reduced cost, efficiency, customized applications and services making cloud computing the prime alternative in comparison to maintaining in-house operations. Migrating enterprises existing applications and services to a cloud if not properly managed may be susceptible to compatibility and orchestration-based risks. Cloud shifting may also lead to issues related to aligning enterprise strategy with IT and cloud services. This paper focuses on distinct aspects of Cloud Economics, aligning enterprise strategy with IT and Cloud Strategy and suggests the best methods to maintain Quality of Service and avoid Vendor lock-in and Service Level Agreement (SLA) based issues in the cloud ecosystem.

Keyword: *Cloud Computing, Cloud Strategy, Service Level Agreements..*

1. Cloud Computing for Enterprises

Cloud Computing which started a decade ago as a method to provide on demand computing power, storage, network, memory, etc. based resource provisioning with a utility type pricing structure has been continuously reforming and changing in terms of how, when and where applications and services are provided to cloud tenants [1]. The multiple models (i.e. Public, Private, Hybrid, Community, Federated, Multi-cloud, etc.) and services (Infrastructure as a Service (IaaS), Platform as a Service (PaaS), Software as a Service (SaaS), etc.) [2] are the result of increasing demand for services and resources in addition to data integrity and security requirements of the cloud in different sectors such as: Internet of Things (IoT), Government sectors, IT, Big Data, Education, etc.

Cloud Computing has continuously expanded itself successful considering a long-term strategy of matching and providing services based on tenant's demand. This strategy helps the cloud ecosystem sustain and rapidly grow. The Clouds global reach and accessibility of data irrespective of the location and time barriers has boosted organizational efficiency and capabilities. Other benefits may include: reduced IT staff requirements, reduced costs of investing in new hardware or upgrading old systems, IT maintenance down time, reduced time to recover from IT failures and more time to focus on core business activities.

Several types of cloud instances being offered by different cloud vendors gives an opportunity for tenants to pick services that best fit their business and computational needs. Tenants are given the flexibility to choose the region(s) for data processing, backups, identity and access management tools, storage types and drives, pricing schemes etc. These offerings and the convenience they offer keep tenants involved with the cloud ecosystem.

Enterprises will analyze the feasibility of investments based on the expected Return on Investment (ROI). The historic trend of enterprises adopting cloud computing is based on lowered IT, operational and maintenance costs with the appropriate computational needs and services being provided by the cloud model. Generally speaking, IT costs can be lowered by 40-60% in comparison to in-house processing where maintenance costs will contribute to the overall cost. Cloud costs for enterprises may further be reduced by smartly choosing a long-term contract (i.e. 3-5 years) with reserved instance type which is based on upfront billing but provides discounts in comparison to on-demand and on-spot instances.

While the cloud costs (i.e. migration costs, billing zones, application and service availability) and pricing schemes (i.e. fair/course grained) have individual benefits, there are various issues and limitations in the cloud ecosystem which are discussed in future sections. Major challenges which cloud tenants may undergo is aligning their enterprises business strategy, IS/IT strategy and cloud strategies together.

This paper focuses on several factors in cloud economics and business strategy and presents business and cloud models which highlight the issues involved and provides a systematic approach for enterprises cloud adaption. The paper in divided in the following sections: Section 2 discusses Enterprise Information Systems, their scope and alignment, Section 3 highlights cloud costs, pricing schemes and approaches for getting it right and Section 4 discusses Cloud Strategy for Business Transformation. Section 5 explains methods for successful cloud migration while Section 6 discusses Cloud Architecture Blueprints. Section 7 Evaluates cloud vulnerabil-

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ities and risk components while Section 8 discusses Cloud Quality Management and SLAs. Section 9 outlines the best methods for eliminating vendor lock-in, QoS and SLA based issues. Section 10 concludes the paper.

2. Enterprise Information Systems (EIS)

Enterprises have long been fully reliant on their in-house IT systems but as operations grow the costs of upgrading and maintaining conventional IT systems becomes a tedious and expensive role. Because of this a large number of enterprises have formed on-premises private clouds improving performance, efficiency and reduced operational costs but the cost of retaining permanent IT staff remains.

Every enterprise may have different business processes and strategies to meet their set goals. Information System/ Information Technology (IS/IT) strategies are designed to align the business goals with the information system, otherwise the IS may fail to support the business processes at various levels.

Enterprises which implement IS/IT strategies to support their business model undergo feasibility studies, which may take from months to years in designing and deploying the right IS and anticipated to pay off in the longer run in terms of business efficiency and agility. A misfit IS may lead enterprises to heavy loss and operation inefficiencies [3][4]. Business Strategy and IS/IT alignment is a must to reach organizational goals. Most IS/IT systems fail due to two reasons: either the staff is unable to use it efficiently or the system fails to support the business needs. IS/IT alignment is a critical component for business success and being replaced by cloud offerings may expose such organizations to a wide range of risks in terms of IS/IT alignment, IS operations and security.

IS implementation types depend on the nature of the business, such as: banking, manufacturing, airline, etc. Each will have a different type of IS based on their business needs, cross functional processes, operations, cost and management. Cross-functional business processes may function at different levels but may also need to share common information to support strategic goals as shown in Figure 1.



Figure 1. Enterprise Strategic and IS/IT system

Enterprises migrating for Cloud Software-as-a-Service (i.e. Outlook, Gmail, Salesforce, Customer Relationship Manager (CRM), etc.) may benefit in terms of cost but may be susceptible to availability, monitoring, security and outage-based issues. Outages may leave employees unable to retrieve data from a CRM (i.e. functioning on a public cloud) leading to customer service issues. Inaccessibility of the CRM will affect the Decision Support System (DSS) and other IS (operating on private clouds) as they will be unable to generate reports when requested. In short, the cloud and IS/IT strategy need to be aligned with the core business strategy to meet the enterprises business goals.

2.1 Information Systems (IS)

Approximately 90% of investments made in IS and IT do not meet the expected target performance [3][4]. The authors in [5] and [6] discuss different approaches to evaluate the investments made in IS and IT such as: Return on Investment (ROI), Net Present Value (NPV), Internal Rate of Return (IRR), and the payback period. However, these measures merely depict the financial aspect. The latest information systems like Enterprise Resource Planner (ERP), CRM, DSS or Knowledge Management Systems (KMS) [7] provide wide intangible benefits which makes it hard to evaluate its full value for the tools it provides.

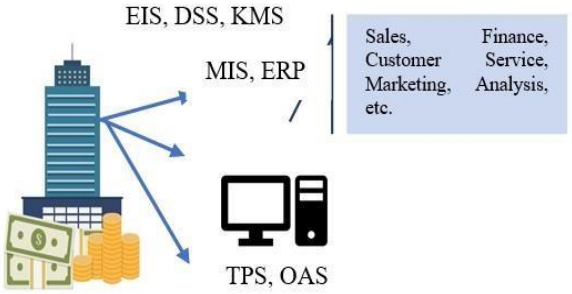


Figure 2. Information Systems used at different operational levels.

Figure 1 and 2 depict Information Systems used at different enterprise levels for operational, tactic and strategic decisions and may vary based on decision types [3] (i.e. Structured, Semi-structured, Un-structured). The IS (i.e. Transaction Processing Systems (TPS), Office Automation System (OAS), Management Information System (MIS), etc.) [3] requires alignment with the business strategy maximizing efficiency and competence. Implementing a cloud model to the existing IT infrastructure or outsourcing a section of its IT processes needs to be associated with the business and IS/IT strategy.

2.2 IS/IT and Cloud (Efficiency and Effectiveness)

IS/IT enterprise implementations are assessed based on their efficiency and effectiveness provided in achieving the strategic goals while preventing waste of a particular resources. Efficiency and effectiveness are often confused, both attributes measure different aspects of a business process. Efficiency is the degree of time and resources saved, whereas effectiveness measures the amount of goals achieved in a defined passage of time [8].

Based on a Microsoft 2016 independent study [9] *"the return on investment (ROI) of using the PaaS cloud results were striking: an ROI of 466%, with a reduction in the amount of IT time spent on maintenance at 80%, among other benefits which include: increased profits, faster deployments and time to reach market"*. The profit ranges may vary based on tenant's workload processing however the tenant may be saved from substantial reduction of nonvalue-added tasks, such as: server maintenance and updates, enabling enterprises to focus their IT resources on business innovation.

Cloud vendors offer different QoS based metrics (i.e. scalability, availability, backup, etc.) empowering IT based performance efficiency which is required for enterprises to become proactive, agile and sustainable. IT strategy and Enterprise Strategy only work when they are designed to work and support each other in this globalized period with additional functionality provided by a cloud ecosystem and differentiated services making them market leaders. There are

different models depicting tenant's computational needs and consumption as shown in Figure 3.

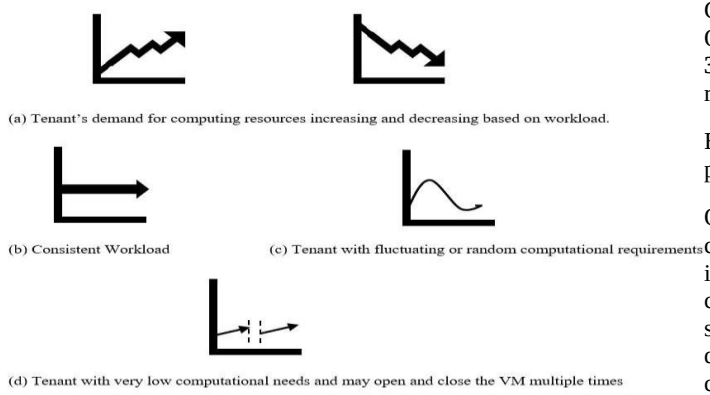


Figure 3. Computational demands [10]

Cloud tenants may vary in terms of computational needs and workloads, for example: banking tenants may have consistent computational needs across the year but high demands towards the end of the financial year as shown in Figure 3(a). Manufacturing or retail cloud tenants may have fluctuating computing requirements throughout the year, while small tenants may optimize the cloud on an interval basis as shown in Figure 3(d). Therefore, computational demands may be different for different tenants and will depend on the applications they are running on the cloud ecosystem.

Cloud consumption highly influences a tenant's operational costs. Workloads and computational demands need to be evaluated and assessed before entering the public cloud or hybrid cloud environments. There can be no doubt that cloud vendors will fully optimize their computing resources unlike in-house IT operational management.

In [11] the authors discuss different cloud pricing models, instances and offering in detail, a brief discussion on cloud computing costs is presented in Section 3.

3. Cloud Costs and Pricing

Cloud computing offers operational cost benefits, as shown in Fig. 3 tenants analyzing and implementing the right Virtual Machine Instances (VMI) and resources may optimize their public/hybrid cloud fully and save 10-20% more on IT based costs in comparison to those who implement Virtual Machines (VMs) with estimation. Assessing the right VM and instance type may save tenants on unnecessary resource costs. Cloud costs are based on the combo of resources optimized with distinct types of instances. Cloud instances offered by cloud vendors contain the following attributes [12][13]: type of operating system, 32 or 64-bit, computing power, memory, instance type, storage type, data processing region and length of contract.

3.1 Pricing Schemes:

Fine grained (minute-based pricing) and Course grained (hourly pricing)

3.2 Choice of Instance:

Reserved Instances (Pre-paid), On-Demand Instance (pay-as-you-go), On-Spot Instances (bid for extra capacity based on spot (current trending) price.

3.3 Types of Instances:

General Purpose, Compute Optimized, Memory Optimized, Storage Optimized, Graphic Processing Unit, etc.

3.4 Pricing: Cloud instances are billed based on the following criteria: instance type + chosen instance + pricing scheme.

Example: Pricing = General purpose + Reserved + Coarse grained pricing scheme.

Other factors which contribute to the billing factor are the data processing region, backup options, contract duration, extra packages implemented for security, virtual private network, identity and access management, log management, etc. The pricing schemes and services may vary from vendor to vendor and it is important to understand the various aspects of cloud pricing and billing costs before cloud deployment.

The SLA which is a mutually signed contract between a cloud tenant and vendor comprises of multiple Service Level Objectives (SLOs) to validate the promised cloud services. The SLA functions as a QoS metric, i.e. elasticity, performance, cost, etc., being provided by the vendor [13]. Table 1 presents a SLO example:

Table 1. Pricing Example

SLO	Performance Metrics
Memory	15 GB
Virtual Machine	4 Virtual Machines
Storage	1 TB SSD Storage
Ethernet	Varies per SLA contract
Approximate Cost	US$ 0.19 per hour

Now, if the vendor fails to meet the promised service levels as shown in Table 1, based on the SLA the tenant can claim free credit as the vendor has violated the SLA.

4. Cloud Strategy for Enterprise Transformation

Public and Hybrid Cloud computing may be an attractive alternative for datacenters and on-premises computing but may leave the enterprise susceptible to various risks such as: data security and privacy, data governance risk and control (DGRC), etc. Enterprises may require a cloud strategy for implementing the cloud model successfully, since aligning business operations with IS/IT and cloud is critical to the enterprises success as discussed in Section 2. Cloud vendors have published their success stories of enterprises, retailers and startup companies migrating towards the cloud, but the transition may not be as easy as defined.

The cloud ecosystem does assist in moving the legacy systems into the modern cloud architecture providing support for rewriting new requirements allowing the applications to run, scale and expand in the cloud. With a wide range of support for cloud application programming interfaces (APIs) [14] and compatibility toolkits [15], migrating old systems on new platforms has become easier but the challenge lies with SLAs leading to vendor lock-in situations which is discussed in detail here. The authors highlight an example of an enterprise which has shifted to the public cloud platform.

Example No. 1, Condé Nast International (CNI) is a known multimedia publishing firm and was undergoing problems associated to outages, hardware failures and scalability [16] due to which it migrated its IT operations to Amazon Web Services which took 90 days. CNI now experiences better services by 15% and provisions of restored services in situation of down-times [16]. Though CNI gained performance efficiency, it is still subject to 0.1% down-time, which may occur during their busiest periods leading to unsatisfied

customers and business loss. CNI [16] may not be sensitive about the region where its back-ups are maintained, whereas many organizations are subject to legal and national laws and may not agree to keep backups of their data at cross-border locations.

Example No. 2, Sagitto:*"Sagitto [9] combines field-portable spectroscopy and machine learning (ML) to help tenant's measure processes cost-effectively, building predictive models using Azure ML which are tailored based on tenant's applications and stored within the Azure cloud platform. Azure permits tenants to retain ownership of their data and the models with the assurance of accessibility".* Azure processes tenant's data on its own build datacenter, though Azure does sub-contract tenant's application and services to third-party sub-contractors in geographical regions where it does not have its datacenters built leading the tenant into security issues such as: Privacy breach and DGRC.

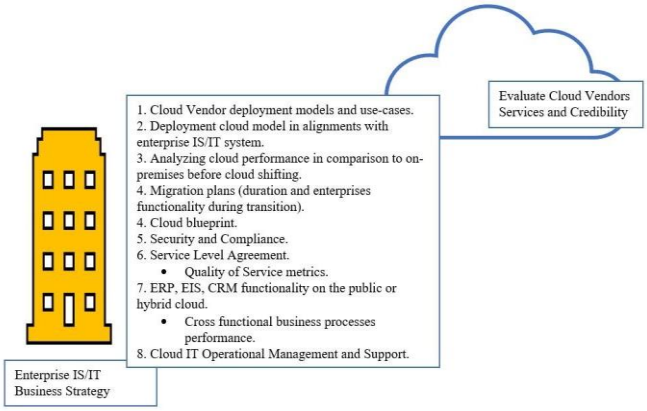


Figure 4. Enterprise Strategy for Cloud Migration.

4.1. Cloud Enterprise Transformation Model

Figure 4 depicts a strategy checklist for enterprises or startups migrating towards the cloud ecosystem mitigating the common threats. The enterprise must assess its applications, resources, architecture and computation needs in contrast to the vendors capability and services. This allows a roadmap to be developed of how the applications may operate during the transition and methods to control these applications in a public or hybrid cloud environment. The enterprise may involve its current IT staff to assess the opportunities and risks of moving their core business processes and functionalities to assure smooth transformation. Since the entire/half operational workload (public/hybrid) may be processed at the vendor's region, the QoS metrics such as availability, down-time, upgrades, scalability etc. need to be closely monitored.

4.2. Business Models

Business models such as: Strengths Weaknesses Opportunities Threats (SWOT) [17], Porter's Value Chain [18], Porter's Five Forces model [19] and Balanced Scorecard [20] play a vital role in developing and designing a successful strategy considering the enterprises internal and external factors, competitive and differentiation advantage, and features assisting in aligning the IT system to reach their strategic goals. These models can also be used to analyse the opportunities and threats the cloud environment may offer making the enterprise pro-active towards the possible risks that may occur against the benefits the cloud offers.

Other QoS and risks management-based models may also be deployed such as: Total Quality Management, TickIT, IT Infrastructure Library (ITIL), Lean, Six Sigma, Capability Maturity Model Integration (CMM-I), etc. depending on enterprises operations [21]. ITIL framework has been widely implemented for IT service management (ITSM), aligning IT investments and operations with business goals by IT service providers, since it focuses mainly on the IT processes and functions. The cloud as a technology does not change the goals of ITIL, however, it changes the methods of service delivery. ITIL comprises of the following phases: IT Service Strategy, IT Service Design, IT Service Transition, IT Service Operation, IT Continual Service Improvement. Each of these phases incorporates different business, project management and business models in its framework, such as: Kano Model, Balanced Scorecard, Project Management Institute (PMI) Project Management Body of Knowledge (PMBoK), Projects in Controlled Environment (PRINCE2) [21], eSourcing Capability Model, etc. for aligning business and IT/Cloud strategy but one model may not fit every type and size of enterprise and thus a combination of models may be required to evaluate and asses the Cloud SLA QoS.

5. Cloud Migration: Test, Migrate and Transform

Enterprises must firstly assess which applications or services should be moved on the public/hybrid cloud and which applications will be restricted in-house. Applications which are migrated may require changes in their code and the platforms it may be compatible to run on. Some applications may require changing their nature from computational needs, IaaS, to SaaS, PaaS and IaaS as tenants look for convenience and flexibility which can be costly and difficult to achieve with in-house IT systems.

Cloud vendors are constantly working on easy transitions and migrations to the cloud with toolkits assisting in moving Terabytes of Data and applications onto the cloud. Cloud shifting is generally performed by cloud vendors in three-phases [10]: test, migrate and transform.

5.1 Test

Vendors assure testing cloud performance and systems in-house before migrating them to the public/hybrid cloud for creating trust. Identifying the cloud Key Performance Indicators (KPIs) and benchmarking them against the expected performance levels and the promised SLAs may assist the enterprise in analyzing the real cloud benefits and credibility. Testing multiple vendors before migrating is an optimal solution to evaluate the best cloud services and avoid vendor lock-ins.

5.2 Migrate

Migration must happen post tenant assurance about the public clouds operational efficiency. Applications which are compatible and easy to integrate are moved onto the cloud, since complexity based with highly operational or legacy applications may be subject to high availability and compatibility and will shift in stages to avoid delays to the business-critical processes. Migrating specific applications may also affect the performance as certain tools share application dependencies which need to function well even after migrations such as: CRM and ERP or DSS.

5.3 Transform

A transformed system is anticipated to provide efficient insights on a single console to display: Insights, visibility, control, monitoring, logs, scalability, throughput, network customization, backups, overall systems performance, etc., making IT operational management possible and easy. Enterprises should look at the broader scope of the public cloud. With the availability of a wide range of vendors, services and multi`-cloud offerings, the current migrations must

support future deployments to different architectures (i.e. multi-cloud) to maximize the ROI.

Post migration applications which were once maintained in-house, may now require cloud support teams in case of technical issues. Each time a support team is called in, it may increase monthly billing costs. Nothing in a cloud environment comes for free, enterprises need to make sure their IT staff are well-trained before migration completes to avoid these additional costs.

6. Cloud Architecture Blueprints

Enterprises go through a series of prototypes and beta tests before implementing IS/IT solutions in the organization, followed by employee training, however, trusting a cloud vendor to do the same for providing similar solutions and disaster recovery plans does not always apply. Cloud vendors may offer architecture blue prints depicting network connectivity, storage, backups, performance, operating system, etc. Figure 5 represents a cloud architecture blueprint which makes it easier for an enterprise to understand IT operational management in the cloud.

Public cloud vendors may provide architecture blueprints to be implemented as a solution for the tenant's enterprise architecture, but generic blueprints may not fit every enterprise and must be assessed for comparison with the enterprise's existing architecture blueprint. Another aspect is that enterprises may opt for different disaster recovery, applications, backup solutions and regional datacenters for operating business which may require customized cloud architecture blueprints.

From a security point of view, similar blueprints may lead the tenants vulnerable to hacking instances, since cloud computing offers multi-tenancy. Having the same blueprints among different tenants may mean that if one tenants data is compromised, the other tenants with similar blueprints may also be susceptible to similar attacks.

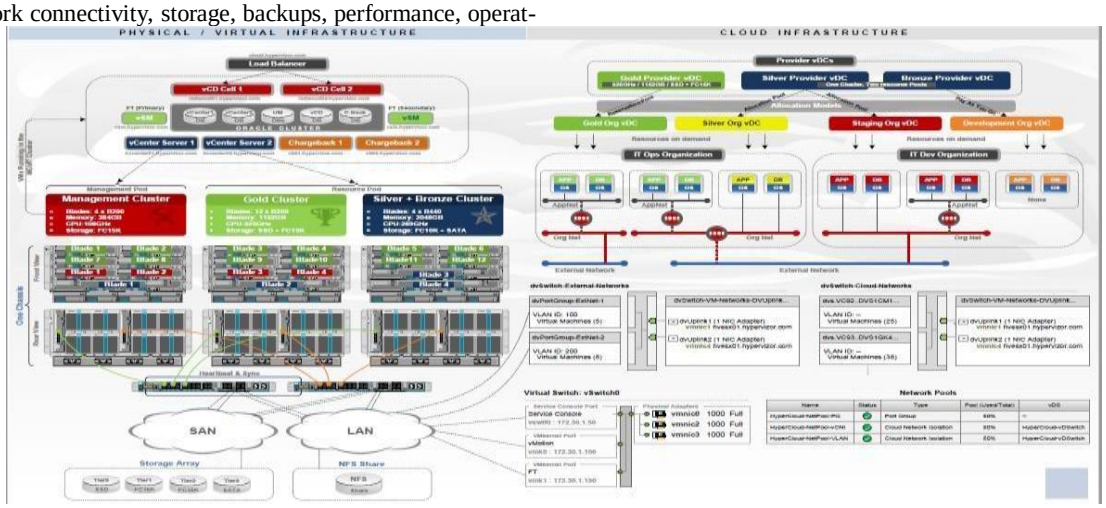


Figure 5. Private cloud architecture blueprint [22]

Enterprises may require cloud certified architects or training for existing employees on the new ecosystem as the cloud IT roles and services vary from conventional IT administration. Once applications are moved on to the public cloud/hybrid premises they will require changes and updates based on the current system. All customizations made for SaaS will be require PaaS deployment. Rebuilding and shifting applications (i.e. SaaS to PaaS) may improve the overall performance and provide a competitive edge but it massively increases the level of difficulty as the entire system needs to be redesigned again.

7. Evaluating vulnerabilities and risk components

Cloud computing models are vulnerable to various risks discussed in [23][24], some of which are mentioned here: Insecure interfaces and APIs, weak credentials, uncontrolled resource provisioning, VM snapshots, backup and migration issues, Cloud Cartography, Denial of Service (DoS), cloud tenant's data manipulation [25], etc.

Giant cloud vendors who have been in cloud services for more than a decade have taken measures to protect tenants from major threats by implementing security-based tools available in the cloud portfolio. Although each of these tools may be subject to extra pricing and different SLAs which may force the tenants to buy the solutions or accept the risks factors.

8. Cloud Quality Management and Service Level Agreement

A public cloud vendor guarantees their services to cloud users through a mutually agreed contract called a Service Level Agreement (SLA) as shown in Figure 6. This cloud is evaluated on various QoS performance metrics such as: service uptime, elasticity, resource provisioning, network performance, upgrades, time to respond services, operational cost, etc. None of the public vendors promise a 100% service uptime or availability which means the cloud users are subject to compromise for the QoS metrics mentioned above [25]. The purpose of an SLA is to deliver a foundation for the planning and objective evaluation of operations performance and to establish clear procedures for problem resolution. Performance targets are accompanied by standards or criteria for success and specific measure.

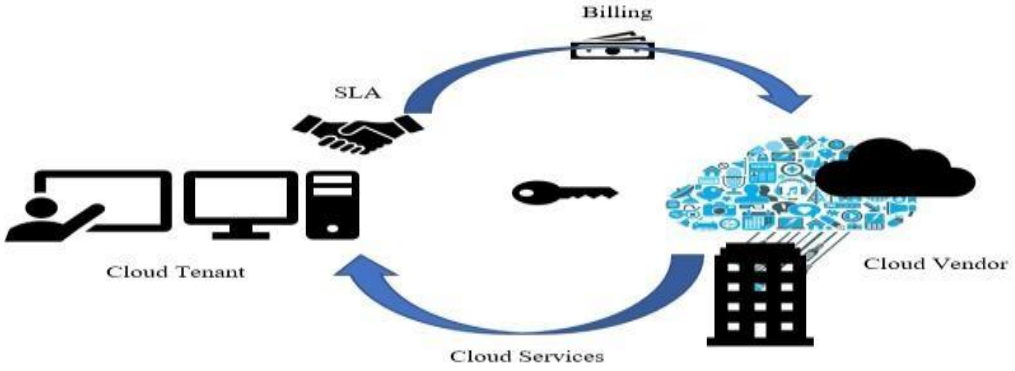


Figure 6. Tenant Vendor Service Level Agreement [8]

Some organizations prefer to implement the Hybrid cloud model so that they keep control of their sensitive data and process their non-critical data on the public cloud. Public clouds offer multi-tenant environments which may be susceptive to data breaches, privacy and malicious network-based attacks, outages, etc. The hybrid model offers superior data protection for enterprises keeping business critical data inhouse.

SLA describes the IT service, documents service level targets, and specifies the responsibilities of the IT service provider and the tenant. A single agreement may cover multiple IT services or multiple customers. It is responsible for guaranteeing that all ITSM processes, Operational Level Agreement (OLA) and supporting contracts are appropriate for the agreed service level targets. SLM monitors and reports on service levels, holds regular service appraisals with tenant's, and identifies obligatory improvements.

Maintenance and application performance complaints arising from enterprise tenants are an outcome of unaligned IS/IT and cloud strategy. IT operational management is full of complexity and security issues and enterprises face challenges in getting the IS right in the first place, migrating these business critical IS to the cloud may contribute to complexity and IT operational management issues until a firm strategy is deployed connecting the two different architectures.

Table 2 categorizes SLAs based on availability, however this SLA may need to be further classified as the enterprises tenant cloud model grows in the federated or hybrid multi-cloud architecture. The majority of the vendors offer 99.95% for IaaS, PaaS and 99.9% for SaaS architecture services however each additional application for IAM, Security, VPN, Log Management, etc. may be subject to a different SLA.

As an example: if tenants 99.999% based application replies on network, storage or database applications which is subject to 99.95% availability, the outcome SLA will be equivalent to 99.95%.

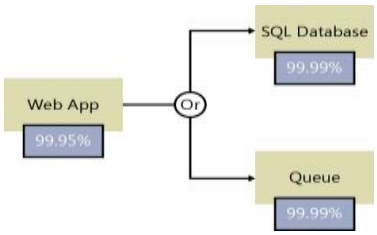


Figure 7. Service Level Agreement [10]

Considering a system that uses a web application and a SQL database, as depicted in Figure 7, a queue is used to hold pending updates in case of database unavailability. Since each cloud service has a respective SLA the cumulative SLA will be as follows [10]:

"Database or queue = $1.0 - (0.0001 \times 0.001) = 99.99999\%$

Web app and (database or queue) = $99.95\% \times 99.99999\% = \sim 99.95\%$".

Table 2. SLA Availability based on different cloud models

Cloud Model	Downtime/week	Downtime/month	Downtime/year
SLA Examples			
IaaS (99.99%)	1.01 minutes	4.32 minutes	8.67 hours
PaaS (99.95%)	5 minutes	21.6 minutes	4.38 hours
SaaS (99.90%)	10.1 minutes	43.2 minutes	8.67 hours
Best SLA (99.999%) [10]	6 seconds	25.9 seconds	5.26 minutes
Weak SLA (99.0%) [10]	1.68 hours	7.2 hours	3.65 days

These SLAs may need to be further classified in situations of federated and multi-cloud architectures

9. Best methods to mitigate vendor lock-ins, QoS and SLA based issues

9.1 Plan the migration

Mapping the vendor cloud strategy with the enterprise business and IS/IT strategy, finding out the differences and limitations. A clearly defined strategy will overcome the majority of the cloud limitations.

9.2 Business and Cloud Model

Though a vendor may implement well-known standards, it may not completely match the enterprises functionality and business processes. Customizing the architecture of cloud services to an enterprise's core competency and cross functional business processes will enhance performance and fix gaps in IT operational functionality. Incorporating ITIL in the enterprises business model may assist in evaluating the KPIs.

9.3. Skilled staff and estimating right costs

Hiring cloud certified and skilled employees to overcome cloud operational management issues in parallel with cloud training for existing IT staff. Cloud skilled staff may be aware of different cloud environments and capable of operating multi-clouds architectures and moving operations to different vendors clouds (if required in future).

Depending on the workload and computational demand (i.e. consistent, fluctuating, random, etc.) assess and evaluate the right size, type and duration of the instances for cost efficiency. Having historic performance of IT based applications available, such as: OS type, memory, storage space and number of drives, etc. assist in evaluating the right size of application's database, and its data types. This will help in the correct instance decision, thereby saving costs.

9.4. Cloud migration and Blueprints

Different applications and information systems are used at different enterprise levels, the best method is to move and test one application at a time to prevent IT operational disruption. Legacy applications may not be cloud friendly since they are hard to customize, so it is best to keep such applications in-house. Vendors must provide blueprints of previous applications shifted on the cloud for visibility and control.

Marking KPIs such as: Low, Medium, High impact factor based on the applications cloud performance in comparison to in-house processing will benchmark actual cloud capability in contrast to the SLA. Cloud migrations are susceptible to failovers, outages and availability issues. Options for business continuity, disaster recovery and online backup may be made to reduce the possibility of cloud-based risks during/after cloud migration.

9.5. SLA QoS metrics and Cloud Governance Risk and Control

Incorporating attributes from IT Quality Management frameworks to get a firm SLA. This may assist in overcoming the exclusions issues with SLAs violation in situations of cumulative SLA assessments or excessive leverage of services.

Security protocols must be evaluated carefully as there are hundreds of services offered by cloud vendors and each service has volumes of documentation. Each enterprise may have separate sets of SLAs and business critical processes, so mapping its processes and setting thresholds (i.e. low, medium, high) against performance, needs to be done by the enterprise's operational management team.

10. Conclusion

Cloud alignment with business and IS/IT strategy can pose issues with architecture complexity, integrity, access management, security, standards, operational methods and services but it still eliminates IT capital expenditure. Convenience such as: agility, resilience, innovation, on-demand compute, storage and network resources, rapid application development, etc. is also offered. Hence, enterprises are looking for solutions to overcome and mitigate cloud-based risks due to its many positives.

The most important phase is the assessment of the cloud vendor's offerings and mapping it to the enterprises business processes and functionality. This may include mapping cloud costs, IT operational management, application performances and integrations, business models, quality control methods, key performance indicators, compliance, jurisdiction, etc. Relying on vendor SLAs may lead to low operational services at the enterprise end or service disruptions.

System cost is always a core factor and the cloud offers both cost savings and convenience of resources for enterprises [11]. Cloud vendors offering different pricing schemes, instance types, length of contracts and availability of instances leads to confusion for new cloud entrants. New financial metrics may assist in breaking down cloud pricing and SLA complexity. It is wise to understand cloud functionality before moving applications into the cloud, otherwise the decision may not lead to cost benefits and the enterprise may find them locked-in to an expensive SLA with a vendor. The SLA assists in sustaining and aligning cloud offerings with enterprises. Since cloud computing models are lack standardization, the only way to gain enterprise competence and transformation is by aligning the cloud model with the enterprises strategy. Doing this may also reduce complexities that develop post migration and assist the enterprise in moving towards the future multi-cloud opportunities.

The authors have discussed strategies and a best method in this paper for cloud tenants to avoid the business impact categories such as: financial, IT operational, compliance, performance, architecture, security and risk during cloud migration. These categories may consist of multiple attributes which must be benchmarked and assessed as having low, medium, and high-impact on the business. The outcome score of the evaluated categories may reflects the relative difficulty of migrating applications to each of the cloud platforms such as: IaaS, PaaS and SaaS, and assessing the financial benefits of the application. These metrics will also enable the application performances to be examined under different workloads and pre-empt the IT operations management to scale or plan resource management accordingly. Finally, these metrics may assist in evaluating the amount of business risks in terms of outages, new cloud policies and compliance.

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