Service Level Agreements and Regulatory Frameworks Concerns in Cloud Computing: An Investigative Study of Small Organisations in Gauteng, South Africa

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Abstract- Cloud computing is considered as a fifth generation model and a dynamically evolving technology. Organisations in both developing and developed economies are considering the immense benefits that the model presents to address their business objectives. While the technology model is highly regarded as an alternative to in-house or premise-based technology, its adoption, administration, implementation and management are still a great concern. This paper addresses key considerations with regard to service level agreements (SLAs) and regulatory frameworks as great concerns in cloud computing, and further proposes viable solutions for a seamless implementation and management of the technology model. The study surveyed 52 organisations in Gauteng, SA to assess their level of concern about the service level agreements and regulatory frameworks in cloud computing. The study used a qualitative method and thematic analysis to analyse the findings.

Keyword- cloud computing, service level agreement(s), regulatory frameworks, legal issues, security and data privacy, hidden risks, liability and compliance, service metrics, cloud computing management.

I.   INTRODUCTION

Cloud computing as a disruptive technology is considered as a one of the technology models used for the ultimate purpose of benefiting a business in a more sustainable manner. Organisations around the world are considering the question of whether cloud computing should be used as an alternative solution to technology implementation but also whether the return on investment can be measured as part of cloud computing implementation. With this in mind, organisations have to deal with regulatory frameworks in cloud computing in order to comply with legal obligations in the deployment and implementation of cloud computing technologies.

Findings in the literature have indicated that organisations in both developed and developing economies are considering using cloud computing; however, the question that is unanswered in the literature is whether the technology model can be seamlessly implemented to the benefits of both providers and users through the use of service level agreements and in accordance with the local or global regulatory frameworks. This research addresses aspects related to SLAs and regulatory frameworks in cloud computing and proposes viable solutions for a full administration, use, management and implementation of cloud computing as a disruptive technology model with regard to return on investment for both the service providers and users of cloud computing.

II.   DEFINITIONS AND BRIEF OVERVIEW OF CLOUD COMPUTING TECHNOLOGY

In order to further assess the service level agreements and regulatory frameworks in cloud computing, it is important to present a brief overview of cloud computing technology. Defining cloud computing, there are many definitions of cloud computing as there does not seem to be consensus on its definition [10]. In order to highlight the key trends of the nature of cloud computing, the following definitions about cloud computing are highly regarded in the literature:

- Cloud computing is defined as a virtual pool of resources, which are provided to the users through the Internet [3]. "Reference [3] classified cloud computing as a fifth generation of computers in computing after mainframe, personal computer, client-server computing, and the web".
- Cloud computing has been referred to as an increasingly important virtualisation technology that uses the Internet and central remote servers to offer the sharing of resources that include infrastructures, software, applications and business processes to fulfil the elastic demand in the market environment [21].
- Cloud computing is also defined as a capability to access shared resources and common infrastructure, as well as offer services on-demand over the network while performing operations that meet changing business needs [13].
- Cloud computing is considered as a systematic arrangement of computer technologies, which is a kind of abstract concepts where users can use the resources available in the cloud without having complete control over them [18].
- Cloud computing is also known as a type of parallel and distributed system consisting of a collection of inter-connected and virtualised computers that are dynamically provisioned and presented as one or unified

computing resource(s) based on service-level agreements established through negotiations between the service providers and consumers [4].

- The National Institute of Standards and Technology (NIST) defined cloud computing as a model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources that can be rapidly provisioned and released with minimal management effort or service provider interaction [15].

Cloud computing being considered as one of the fastest and growing technologies, the definition by the National Institute of Standards and Technology (NIST) on cloud computing is perceived as the most suitable since it has been widely used in most studies.

II-A. Characteristics Of Cloud Computing Model.

The following are the characteristics of the model [12]:

- **On demand self-service**: Cloud computing consumers are capable of self-management and perform computing tasks with no interaction from service providers.
- **Measured service**: Cloud computing consumers only pay for what they have used. This feature allows consumers to acquire services on a subscription basis in a pay-as-you go fashion.
- **Resource pooling**: Cloud computing consumers are able to share computing resources through virtualised machines in a multi-tenant model. Multi-tenancy has been identified as an important element for this technology model [7], [10].
- **Broad network access**: Cloud computing resources are available through a network.
- **Rapid elasticity and scalability**: Cloud computing services are delivered in a flexible manner, and they are scaled in and out of to meet consumers' needs when required.

II-B. Services And Deployment Models In Cloud Computing.

1) Delivery Models In Cloud Computing: The delivery models in cloud computing are presented as follows: Software–as-a-Service (SaaS), where the model takes into consideration the use, the management and maintenance of application software, operating systems, as well as resources; Platform-as-a-Service (PaaS), where the cloud computing service provider is in total control of the system software and computing resources; Infrastructure-as-a-Service (IaaS, where the model offers a set of virtualised computing resources such as capacity, memory, network bandwidth, processing power in the cloud [1].

In addition to these three main delivery models, other forms of cloud delivery models known as the X-as-a-Services (XaaS) are developing on regular basis [23], [17].

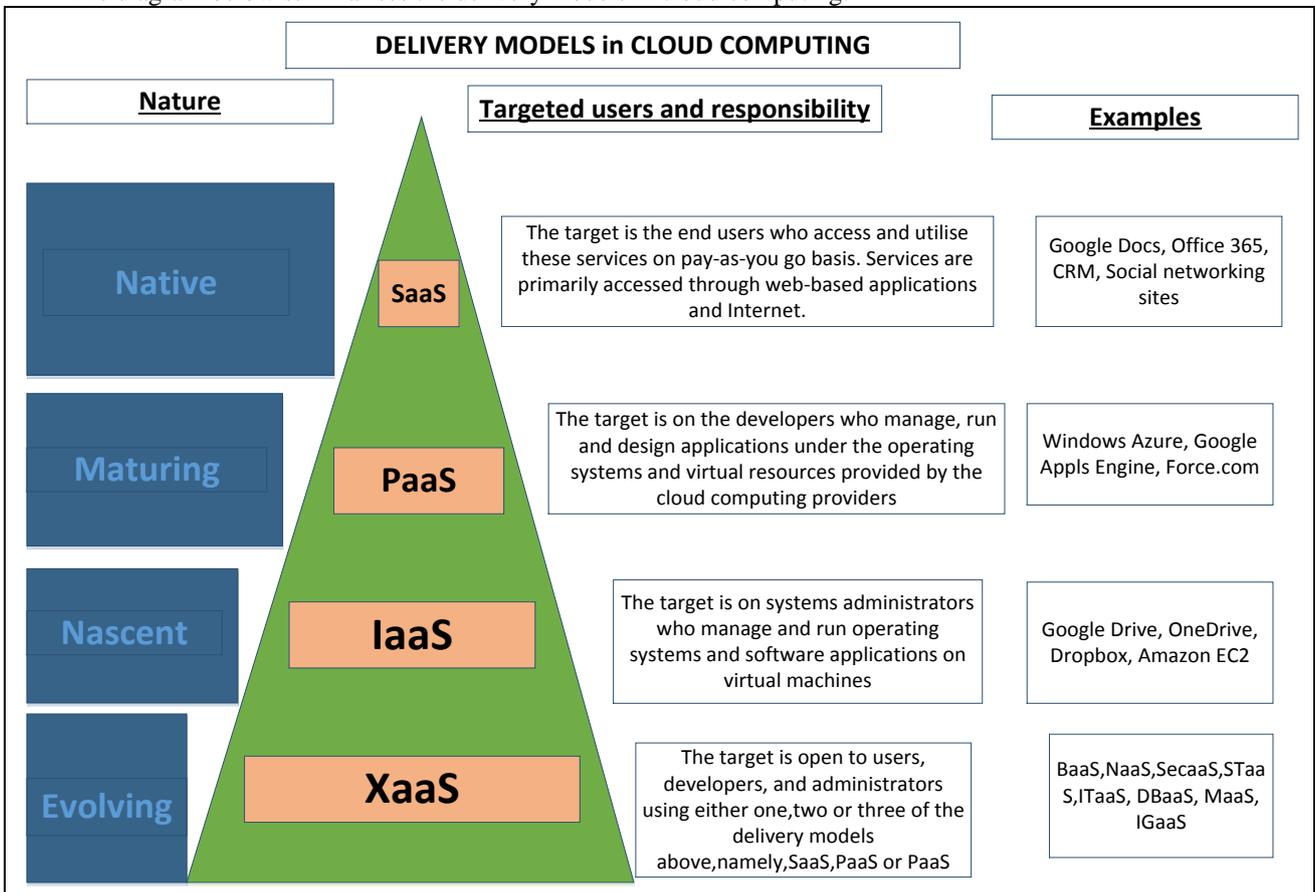The diagram below summarises the delivery models in cloud computing:

Fig 1: Delivery models in cloud computing [14]

2) Deployment Models: Cloud computing can be deployed in the following formats, namely,

- **Public Cloud:** Services are made available to the general public through the Internet. The deployment location is usually offsite. Examples of service providers include: Amazon EC2, Sun Cloud, and Google Apps Engine.
- **Private Cloud:** Computing services are exclusively managed by one organisation. The deployment model location can be either onsite or offsite. Examples of service providers include: Rackspace, Microsoft, Eucalyptus, and VMware.
- **Community Cloud:** Computing resources are shared by organisations with a similar mission or policy requirements. The deployment model location can be executed either onsite or offsite. Examples of service providers include IBM and EC2.
- **Hybrid Cloud:** This is a combination of two or three models. The combination is standardised and managed as a single unit and then deployed as a unique entity. The deployment model can be executed either onsite or offsite. Examples of service providers include the likes of Microsoft.

III. BACKGROUND OF SERVICE LEVEL AGREEMENTS (SLAs) IN CLOUD COMPUTING

This section has two sub-sections: the first subsection presents an overview of the service level agreements, and the second subsection discusses the SLAs' complexities in cloud computing and related aspects such as long-term sticker shocker in the cloud, auditing/monitoring and risk management, as well as contracting issues in the cloud.

III-A. Overview Of Service Level Agreements (SLAs) In Cloud Computing.

Service level agreements can be defined as parameters required by both the consumers and the service provider to highlight issues of service quality and request, feedback mechanisms to encourage and discourage request submissions [4]. They should be a starting point to establish a foundation for cloud computing adoption and effective migration [9], [24].

The importance of addressing the issue around service level agreements is critical due to the complexity of cloud computing as a disruptive technology. In order to address issues around the use, adoption and implementation of cloud computing, a framework backed by service level agreements will be required. In addition, to ensure quality of data and service being provided, key issues should be identified, a clear management of those risks should be in place and an effective service level agreement should be drawn up that is well understood by both the user and the service provider (SP).

SLAs need to be flexible and should contain intuitive metrics to monitor compliance, which can assist in making outsourced decisions, and selecting a service provider [6]. Besides SLAs being there to identify parameters of operations in the cloud for example, SLAs also provide measurement of performance to satisfy consumers' needs and provide acceptable benchmarks in cloud that could facilitate the adoption and migration of realistic applications into the cloud [4]. There is a lot that is known in the literature about the perceptions of large organisations in developing economies on the service level agreements in cloud computing. There is little that is known in the literature about small and medium organisations in South Africa regarding the implementation of the service level agreements in cloud computing.

The service level agreements should be considered as the cornerstone in the adoption, use and implementation of the cloud computing technology model [16]. The challenges posed to-date still lie on how the service should be measured, and what the contract agreement should be constituted of.

1) SLAs' Complexities In Cloud Computing: Some of the challenges identified in establishing effective SLAs go beyond the complexity of cloud computing, and include the level of awareness among users to ensure that they receive required services from cloud computing service providers.

While SLAs have a great standing in resolving issues around penalties, agreement, legislation and privacy, no country has implemented a true cloud so far due to complex legal issues and various implications around privacy, security and right to information [11], [16]. Nevertheless, SLAs become a starting point in the implementation process and a clear interpretation of the SLAs will play a long way in the adoption and management process.

The lack of collaboration between the service provider and the consumers is said to make the implementation of cloud computing technology model even more challenging [5]. A good understanding of what is needed with a clear negotiation or concession can drive a successful implementation of cloud computing adoption [5]. The implementation of a true service level agreement is sometimes complex when it comes to the design, development and implementation of policies that should be clearly understood by both parties [1]. There is a need in this study to discuss issues with regard to service level agreements in cloud computing, and propose viable solutions to facilitate the adoption and implementation of the technology model.

Other issues closely related to SLAs in cloud computing bringing a high level of complexity include vendor long-term sticker shocker in cloud computing, auditing/monitoring and risks in cloud computing, data retention/destruction in cloud computing, privacy breaches management, compliance metrics, trust management, and contracting issues in the cloud. With regard to the scope of this paper, only few of these issues will be addressed.

2) Long-Term Sticker-Shocker In Cloud Computing: This section discusses the long-term sticker-shocker in cloud computing. As one of the challenges and concerns in cloud computing, the long-term sticker-shocker is among one of the hidden risks in the adoption, administration and management of cloud computing [7]. "Reference [7] indicated that organisations need to be aware of the long-term sticker-shocker in cloud computing". When contracting to cloud computing, the user needs to be aware of the changes that can happen in the course of the contract, that can affect severely the delivery of the service. Some of the anticipated changes in the process can be about the computation, communication, and infrastructure or technology integration.

While the cost of integration has been reduced under this new technology model, the user can find itself facing charges on integration that might not allow him to pull easily from the contract [19]. This further raises two important issues in cloud computing, namely, cloud awareness and the content of the service level agreement.

Information about the long-term sticker-shocker has been reported with great concerns by most of the IT decision-makers [8]. The sticker-shocker could be also explained when the user wants to transfer new computing resources from a public or community cloud [8]. Sticker-shocker is also reported to occur when more specific units of the organisation are transferred from a hybrid cloud deployment model with data distributed among public/private clouds [8]. The effect of a long-term sticker-shocker can be increased in instances where both the resource pooling, as well as the rapid elasticity characteristics of cloud computing are not ordinary measured as compared to in house-based technologies, which raises further concerns [8,18].

In addition, other hidden risks associated with the long-term sticker-shocker are reported to force consumers to remain with the provider while enduring the expenses [8]. These hidden risks include:

- The cost for enhancing new products in the cloud such as re-design.
- Redevelopment.
- Customisation or even security enhancement.
- Providing new features.

These arguments provide valuable insights on the long-term sticker-shocker in cloud computing. There is a need in this study to ascertain the level of awareness of organisations in Gauteng regarding the sticker-shocker, and propose a viable solution.

3) Auditing, Monitoring And Risk Management In Cloud Computing: With the notion of cloud computing nature being blurred to many users, the efficiency of data verification and integrity in cloud computing remains a great challenge to many users. Measures should be put in place in order to monitor and verify data integrity in the cloud.

A number of schemes have been proposed to effectively address challenges associated with auditing and monitoring of data in cloud computing. A good example by [23] proposed a scheme that assigns audit tasks to a single third party, which is a trusted and authentic entity that manages data audits. "Reference [20] proposed instead a multiple third party scheme that uses synchronous audit sessions from different users that can handle a third party auditor simultaneously". This is only one among the various measures that can be addressed in the service level agreement document.

4) contracting issues in cloud compting: Though cloud computing technology model has made it easy for users to contract by offering low barriers to entry and opportunities to scale contracts in future depending on the users' needs, contracting issues are still a great concern in cloud computing.

In the same light, though the intentions of service providers might be seen as genuinely good like forcing users to click wrapping agreements, accepting licences or signing terms and conditions, the potential for concerns in cloud computing is still very high [1]. Studies indicated that the level of responsibility is not clearly defined for contracting agreements in cloud computing. With this in mind, there are direct and indirect losses or damages with little responsibility and liability from the licensors. This paper proposes a clear and distinct approach to addressing such challenges.

IV. REGULATORY REQUIREMENTS IN CLOUD COMPUTING

After discussing the service level agreements and its related issues, this section discusses regulatory frameworks and its related aspects. The legal and practical liability of data is another cloud computing's greatest concern that needs to be addressed by cloud computing providers and consumers. With data being distributed around the globe, issues around data recovery, data restoration, migration mechanisms, data ownership, data retention, liability of data in cloud computing, applicable laws, data portability, applicable data protection law, data transfer or cross-border transfer, regulations and legislations just to name a few, should be understood by consumers [16].

Thus, the aim of this paper is about proposing viable solutions and suggestions in addressing the concerns with regard to regulatory requirements.

IV-A. Regulatory Frameworks And Requirements In Cloud Computing.

1) Regulation And Legal Aspects In Cloud Computing: There is a need to explain aspects related to laws and regulations, as well as possible ramifications in the development of cloud computing adoption, usage, administration and management. Regulatory and legal uncertainties can present serious challenges to cloud computing implementation and growth in this current state. Regulatory and legal uncertainties have serious implications and ramifications in the manner data is managed, owned, stored and controlled [24].

Data residing in various locations around the globe raises again issues of security and control, which create uncertainties in the type of laws or policies that should be administered to protect consumers' rights. While the protection of consumers' rights should be highlighted in the SLAs agreed upon with the service provider, [19] noted that this is still a great concern since the location of data tends to take precedence on jurisdiction.

"Reference [19] claimed that governments around the world have a duty to facilitate the implementation of cloud computing by developing regulations within their jurisdictions and by stepping in as national regulators". From a survey conducted by the Business Software Alliance (BSA), it was reported that most of developed and emerging economies have policies in place to deal with issues around cloud computing that are already benefiting the implementation and management of cloud computing with regard to privacy, information security, cybercrime, and intellectual property.

There is little that has been done in SA to implement an effective regulatory framework in order to accelerate and facilitate the adoption and usage of cloud computing [9]. A survey conducted by the International Telecommunication Union (2012) explains that there is still quite a lot that needs to be done with regard to regulatory and jurisdiction issues in developing economies, and this paper only proposes viable solutions to address the concerns.

2) Regulatory Frameworks On Cloud Computing In South Africa: The privacy and protection of a user's right is considered as a government priority in the first instance, and privacy is a constitutional right in South Africa [9]. A solution to resolving complexity issues of data privacy and information security can be successfully achieved through binding agreements with foreign countries [9].

Consumers can find this an area of concern in the adoption and migration to cloud computing since the South African constitution is still working on the Protection of Personal Information (POPI) Bill in order to protect their rights in the cloud [9]. An effective and comprehensive bill in the legislation will play an important role in resolving issues around regulation and jurisdiction of data, and provide a basis for organisations in South Africa to explore more on the use of cloud computing.

Other issues closely related to regulatory issues discussed in this paper include applicable laws, liability and data transfer or cross-border transfer issues in cloud computing.

3) Applicable Laws: With regard to applicable laws, cloud computing consumers find themselves in extreme difficulties when it comes to the application of the current laws governing services in cloud computing. Issues of a great concern are far from being addressed especially when one should establish who is in control of the legislation that should take precedence for data in cloud computing, and current applicable laws.

The solution to aspects related to applicable laws have to be understood in relation to the legislation with reference to the data controller and data processor [5]. "Reference [22] referred to a data controller as the entity that defines the purpose and the means of the processing on one hand, and on the other hand a data processor as being the dumb performer or the entity that uses data".

In any case, it is important to establish a clear line between the entity responsible for data and the actual data subject with regard to applicable laws governing the use, administration and management of data in the cloud.

4) Data Transfer Or Cross-Border Transfer Issues In Cloud Computing: With data transfer in cloud computing constituting a nightmare for many consumers, service providers find themselves pushed to the extreme with little to provide an adequate level of data protection. Only few countries might have laws and regulations in place to address issues of data or cross-border transfer in the cloud. An ideal approach to resolving data transfer in cloud computing should depend on the policy enforcement measures being in place and enforced in the SLAs [5].

5) Liability Issues In Cloud Computing: Liability issues in cloud computing are considered as a critical issue when regulatory and legal agreements in cloud computing are concerned. "Reference [22] explained that liability in cloud computing becomes a problem in instances where there is an interruption of information access or data availability, the non-compliance with privacy rules and content of the information with regard to data being processed, unavailability of materials or sources when required by third parties, violation of copyright and intellectual property rights just to name a few".

A number of elements were identified to assist the consumers to establish a successful legal action [22]. "Reference [22] argued that in the event of the following events, the consumers should not hesitate to take action:
- Frequent occurrence of a quantificable damage to data,
- Illegal acts that can be proven in a court of law,
- Causality between the act carried out and the resulting impact and consequence,
- Any form of intent or gross/light negligence".

With this in mind, the challenge remains apparent in the event where the vendor refuses to accept any form of liability for either one of the issues mentioned above. "Reference [20] suggested that cloud insurance might be another possibility for resolving such challenges". Most importantly, the service level agreements should be in a position to address such issues.

V.   RESEARCH METHOD AND DATA ANALYSIS

The study sampled 52 organisations in the Gauteng province to explore further aspects related to service level agreements and regulatory concerns in the management and implementation of cloud computing as a technology model. The study followed an interpretative approach and used a qualitative analysis method.

The study used content analysis to gather data from surveyed organisations. Qualitative data had to be turned into meaningful information and evidence using thematic analysis. Content analysis is a detailed and systematic examination of contents of a particular body of materials for the purpose of identifying patterns, themes or biases [2]. The technique also identified characteristics from the contents in human communications.

The findings established two content categories, namely, the service level agreement and regulatory frameworks. Each content category was further explored and themes were derived. The following section discusses the content categories and their related theme codes.

V-A. Content Analysis (Category A): Service Level Agreement.

The findings extracted from this content **category (A)** revealed these related themes: compliance, benchmarking, quality of service, interpretation of service, as well as improved decision-making. SLAs are reported to constitute an important aspect in the provision of service, as well as an important metric in cloud computing [6].

The research findings on this content category were discussed in the literature section. These findings supported key considerations in the provision, administration, as well as management of cloud services. The findings also indicated that some of the most complex issues in cloud computing could be easily resolved using SLAs as a standard document to facilitate the provision and management of cloud services.

While consumers might have perceived the importance of using SLAs, the service level agreement has been extensively reported as a concern in cloud computing [16]. "Reference [16] indicated that there has never been a true implementation of cloud due to the complexities and various interpretations of the contract and service level agreement". In addition, [16] reported that contracts in the cloud were usually open to various interpretations by both the consumers and users, which had always led to a no true implementation of a service level agreement in many instances.

The patterns also suggest that consumers acknowledged the complexities associated with running business operations in the cloud, therefore considered service level agreement as the basis for a true administration, usage, implementation and management of cloud services.

V-B. Content Analysis (Category B): Regulatory Frameworks.

The findings extracted from this content **category (B)** revealed these related themes: regulatory, legal, policy integration and governance. These findings were discussed and supported in this study. Regulatory and legal issues were a great concern to consumers when it comes to the way data was controlled, managed and protected around the globe [24]. "Reference [24] also explained the challenges that regulatory and legal issues presented when it comes to the management, accessibility, control mechanisms, and ramifications or implications associated with data in cloud computing".

"Reference [24] further explained that the challenges posed by regulatory and legal issues in cloud computing were caused in many instances by the location of data, which tended to take precedence on jurisdiction". In addition, [24] reported that organisations that adopted cloud computing, mentioned regulatory and legal issues as a great concern.

With regard to policy integration and governance, the two aspects constitute important requirements that should be aligned and established as part of good service levels in cloud computing [4]. "Reference [4] reported that the policy integration and governance have become a concern in cloud computing in the manner in which they were implemented.

These findings were discussed in this literature. Concerns from the consumers' perspectives were reported in understanding and interpreting policies in a language that could be understood and interpreted by everyone [4], [16]. Policy and integration were reported to become a stumbling block for many users in the adoption, administration and management of cloud computing [4].

VI. RECOMMENDATIONS AND CONCLUSION

With the two key areas of concerns in cloud computing, namely, service level agreement and regulatory requirements, various literature have indicated that these two areas work hands-in hands. The challenges experienced with the legal frameworks are exacerbated in instances where the service level agreements have not been clearly defined to support the adoption, administration, management and use of cloud services.

In all instances of adherence and governance for cloud services, only a few guidelines would assist to address the challenges associated with the regulatory frameworks well-backed in a well-established and explicit service level agreement contract document.

"Reference [20] proposed an ideal formulation taking into account the structure of data in the cloud, the assessment of data governance, the function of data governance, the negotiation process to be undertaken, as well as the level of data governance between the consumers and service providers".

First, in order to resolve the issue of compliance with regard to SLA(s) and regulatory frameworks in cloud computing, there is a need to understand the structure of data belonging to the organisation that will be used in the cloud. This implies the level of responsibility from the owners (consumers) of data in the organisation seeking the service of cloud providers. With this in mind, it is imperative to understand the challenges associated with the type or structure of data to be made available in the cloud.

Second, a suggestion is to make an assessment of data to be hosted in the cloud. A feasibility study should be conducted by the users about the nature of data, the location, applicable laws in compliance with the organisational policies and standards, and eventual implications as critical considerations.

Third, the establishment of data governance mechanisms should be critical to addressing disputes related to the structure of data with regard to legal, compliance, liability, as well as misinterpretation of agreements by both the users and cloud providers. A concise formulation of a governance mechanism should be guided by the organisation standards and internal policies in place.

Fourth, with cloud computing being a disruptive technology, there is a need for constant negotiations between the users and cloud service providers. The negotiations for the type of service or quality of service to be provided need to be well planned and well documented in the SLA(s) as part of the agreement contract.

Fifth, the level of data governance should be well understood by both the users and service providers. With direct and indirect implications, the level of data governance if well explained and documented in the SLA(s) should comply with the current legislations and regulatory frameworks in place to address challenges if any.

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