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An Examination of Service Level Agreement Attributes that Influence Cloud Computing Adoption

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by

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for the degree of Doctor of Philosophy
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We hereby certify that this dissertation, submitted by Howard Hamilton, conforms to acceptable standards and is fully adequate in scope and quality to fulfill the dissertation requirements for the degree of Doctor of Philosophy.

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An Abstract of a Dissertation Proposal Submitted to Nova Southeastern University in Partial Fulfillment of the Requirements for the Degree of Doctor of Philosophy

An Examination of SLA Attributes that Influence Cloud Computing Adoption

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Cloud computing is perceived as the technological innovation that will transform future investments in information technology. As cloud services become more ubiquitous, public and private enterprises still grapple with concerns about cloud computing. One such concern is about service level agreements (SLAs) and their appropriateness.

While the benefits of using cloud services are well defined, the debate about the challenges that may inhibit the seamless adoption of these services still continues. SLAs are seen as an instrument to help foster adoption. However, cloud computing SLAs are alleged to be ineffective, meaningless, and costly to administer. This could impact widespread acceptance of cloud computing.

This research was based on the transaction cost economics theory with focus on uncertainty, asset specificity and transaction cost. SLA uncertainty and SLA asset specificity were introduced by this research and used to determine the technical and non-technical attributes for cloud computing SLAs. A conceptual model, built on the concept of transaction cost economics, was used to highlight the theoretical framework for this research.

This study applied a mixed methods sequential exploratory research design to determine SLA attributes that influence the adoption of cloud computing. The research was conducted using two phases. First, interviews with 10 cloud computing experts were done to identify and confirm key SLA attributes. These attributes were then used as the main thematic areas for this study. In the second phase, the output from phase one was used as the input to the development of an instrument which was administered to 97 businesses to determine their perspectives on the cloud computing SLA attributes identified in the first phase. Partial least squares structural equation modelling was used to test for statistical significance of the hypotheses and to validate the theoretical basis of this study. Qualitative and quantitative analyses were done on the data to establish a set of attributes considered SLA imperatives for cloud computing adoption.

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Chapter 1

Introduction

Background

If widely adopted, cloud computing is expected to have a significant impact on the information technology (IT) landscape and how enterprises invest in technology (Kim, Kim, Lee, & Lee, 2009). Cloud computing is a services-oriented paradigm which is providing a new IT platform for business and personal computing (Cusumano, 2010). Kim et al. (2009) argued that this type of computing is not new. They claimed that this is a reincarnation of previous approaches such as time sharing of the 1960s and grid computing of the 1990s. Cloud computing enables the business to reduce the recurring expenditures associated with managing and maintaining in-house IT infrastructure and the capital costs required to invest in IT (Garrison, Kim, & Wakefield, 2012).

According to Bardhan, Demirkan, Kannan, Kauffman and Sougstad (2010), services-oriented approach to the use and management of IT within the enterprise is the fastest growing paradigm. This is creating a new IT ecosystem driven primarily by technology services (Kim et al., 2009). In 2006, Rottman highlighted Gartner's projection that the rate at which companies will continue to outsource IT services is expected to grow exponentially over the next few years. Rold and Tramacere (2012) of Gartner Consulting also claimed that the acceptance of low-cost services such as cloud computing would begin in 2012. They projected that cloud services would begin to impact the outsourcing market by taking at least 15% of the market share and revenue for the key providers globally. This trend is expected to continue as business leaders look to cloud computing as a practical means of reducing capital outlays and transaction costs relating to technology investments (Garrison et al., 2012).

Armbrust et al. (2010) defined cloud computing as “the applications delivered as services over the Internet and the hardware and systems software in the datacentres that provide those services” (p.50). Vaquero, Rodero-Merino, Caceres, and Lindner (2008) suggested that service level agreements (SLAs) are necessary for cloud computing services. An “SLA is a binding agreement between the service provider and the service customer, used to specify the level of service to be delivered as well as how measuring, reporting and violation handling should be done” (Undheim, Chilwan, & Heegaard, 2011, p. 2). SLAs which are not appropriately defined and administered to meet the expectations of business users could inhibit adoption (Durkee, 2010). Durkee emphasized that cloud computing SLAs are associated with many issues that make them less meaningful. According to Durkee, SLAs prepared by the service providers are very opportunistic and are difficult to enforce, which could present an obstacle to the seamless acceptance of cloud computing services.

Garrison et al. (2012) agreed that there are benefits for using cloud computing, but believed that there are concerns which could inhibit the adoption of cloud services. They claimed that amidst the data security issues, there seemed to be insufficient understanding regarding the scope and implementation of the cloud services being offered between the cloud service provider (CSP) and the cloud service user (CSU). This suggests that there may be uncertainties surrounding cloud computing SLAs on the parts of the CSP and CSU. They argued that CSPs are to be trustworthy and that the services provided must meet the expectations of the user. This they believed is one of the success factors for cloud computing deployments.

The number of CSUs is expected to grow significantly as cloud computing develops (Badidi, 2013). Growth in the cloud computing landscape, according to Adomavicius, Bockstedt, Gupta, and Kauffman (2008b), could create additional challenges for business decision makers. The discussions about information security, interoperability, portability, and standardization are of high significance to the adoption of cloud computing (NIST Cloud Computing Program).

The remainder of this paper will highlight the problem that is intended to be addressed, define the goal of this proposed study, and outline the research questions and hypotheses that guided this study. The paper will also present a brief review of literature to support this research, outline the barriers and issues relating to this study, and discuss the approach that was used to conduct this research. Finally, the paper lists the milestones of this study and highlights the resources used to successfully complete this research.

Problem Statement

The specification of useful SLAs for cloud computing services has been a major challenge for cloud computing and its adoption **(**Begum & Prashanth, 2013; Dillon, Wu, & Chang, 2010; Durkee, 2010; Goulart, 2012b; Kumar & Pradhan, 2013; Qiu, Zhou, & Wang, 2013; Schnjakin, Alnemr, & Meinel, 2010; Undheim et al., 2011; Yaqub et al., 2014). Kumar and Pradhan found that cloud computing SLAs have become more complex, challenging, and difficult for regular business users to understand. While according to Durkee, cloud SLAs are fraught with issues which make them meaningless and ineffective. Goulart claimed that there are business users who expressed that they have never seen a supportive cloud computing SLA. Undheim et al. further claimed that cloud computing SLAs are not fitting for current requirements. The challenge, according to Dillon et al. (2010), is the development of cloud computing SLAs that will ensure that the customer experiences the highest quality of service.

Furthermore, Begum and Prashanth declared that standard and benchmarked SLAs for cloud computing are still non-existent. Additionally, Schnjakin et al. (2010) argued that the issues with SLAs in multiple domain environments such as cloud computing are still not resolved. Yaqub et al. (2014) also claimed that current cloud computing SLAs do not meet business requirements and are usually non-negotiable, which leaves a gap in the SLAs that make them undesirable. Qiu et al. (2013) argued that the rate of business adoption of cloud computing services is severely lower than expected. They claimed that this is due mainly to the absence of clearly formulated SLAs and that several other attributes could be included in cloud computing SLAs.

The calls for meaningful SLAs have been extensively documented. Vaquero et al. (2008) believed that effective SLAs are required before companies will have high levels of trust in the cloud. Durkee (2010) advised that the dynamic nature of the cloud warrants the establishment of SLAs that contain sufficient details for cloud service engagements. Undheim et al. (2011) argued that a comprehensive SLA is required to resolve the challenges relating to dependability, reliability and data security in the cloud. Dillon et al. (2010) also suggested that SLAs be prepared with sufficient detail to meet the expectations of the user and should be easily assessed to enforce breaches. Kumar and Pradhan (2013) also emphasized that the SLA is an essential aspect of the cloud computing service and companies have been advocating for more complete SLAs. Although there are several theories relating to contractual exchanges, transaction cost economics seems very relevant to this problem (Liang & Huang, 1998; Williamson, 1979, 1981, 1985, 1998). Unfortunately, very little attention has been given in literature relating transaction cost economics with cloud computing SLAs and how it may help to develop more meaningful SLAs for cloud computing services.

Prior studies on cloud computing have given much more attention to general data security, SLA management, and SLA negotiation activities. Patel, Ranabahu, and Sheth (2009) as well as Bouchenak (2010) in their studies on cloud computing SLAs focused on the management of the SLA instead of specific attributes that would encourage adoption. Nawfal, Ali, Hamidah, and Shamala (2011) as well as Schnjakin et al. (2010) focused their attention on developing the requirements for a formal SLA language that would automate the definition, negotiation, and monitoring of SLAs. Again, the identification and specification of key attributes of cloud computing SLAs were not covered by their research.

Dissertation Goal

The primary goal of this research was to use a mixed methods sequential exploratory study to determine the attributes of cloud services SLAs that influence business adoption of cloud computing. This proposed research identified technical and non-technical attributes that add value to SLAs for cloud computing services and that influence the adoption of cloud computing. Technical attributes refer to components of the cloud computing SLA that require specific configurations in order to deliver quality services to the client. Non-technical attributes relate to supporting activities or items that may be included in the SLA to satisfy the parties of the agreement. This research determined which attributes of cloud computing SLAs businesses are uncertain about and which ones they believed need to be fully specified in order to make the SLA more helpful and effective.

It is anticipated that these attributes would better enable businesses to measure not only the service provider's performance with respect to the items in an SLA, but also the status of the relationship that exists between both parties. It was also intended that this study would be a step towards standardizing SLAs for cloud computing services which would help to improve the adoption of cloud computing on a wider scale. While this study did not address the detailed key performance indicators (KPIs) for cloud computing SLAs, it identified key attributes for SLAs that would influence the adoption of cloud computing.

Research Questions and Hypotheses

This study was guided by one central research question and six sub-questions.

Main Research Question and Sub-questions

RQ1 What are the attributes of cloud computing SLAs that influence business adoption of cloud computing?

The following sub-questions helped to answer the central research question.

RQ1.1 What are the attributes of cloud computing SLAs that are common among cloud service offerings?

RQ1.2 What attributes of cloud computing SLAs CSPs feel are impacting adoption?

RQ1.3 What attributes contribute to SLA uncertainty for cloud computing?

RQ1.4 What attributes contribute to SLA asset specificity for cloud computing?

RQ1.5 What is the impact of SLA uncertainty on the transaction costs for cloud computing SLAs?

RQ1.6 What is the impact of SLA asset specificity on the transaction costs for cloud computing SLAs?

Figure 1 illustrates the concept model that was used in this research. The model is based on the transaction cost economics theory (Liang & Huang, 1998; Williamson, 1979, 1981, 1985, 1998). It introduces four main factors that were used to study cloud computing SLAs: 1) SLA uncertainty which is comprised of technical uncertainty and non-technical uncertainty; 2) SLA asset specificity which includes technical asset specificity and non-technical asset specificity; 3) transaction costs which are the administration costs involved in activities relating to cloud computing engagements; and 4) intention to adopt which refers to the behaviour of potential business users towards adopting cloud computing services based on a specific SLA.

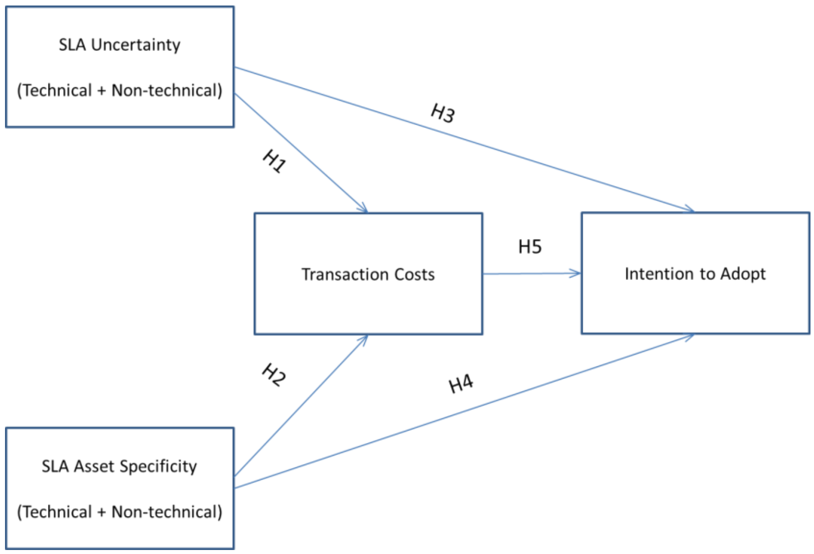

Figure 1. Conceptual model for cloud computing SLAs

Uncertainty and asset specificity have been identified by Williamson (1998) as two main constructs of transaction cost economics. Accordingly, uncertainty defines the level of uncertainty associated with commercial transactions. Williamson asserted that all complex contracts are incomplete and are subject to uncertainties and opportunistic behaviours. Uncertainty is responsible for many of the difficulties and failures in economic and commercial transactions (Aubert, Rivard, & Patry, 1996). Cloud SLA uncertainty represents the degree of uncertainty that exists in cloud-based service agreements and transactions.

According to Williamson (1981), asset specificity is the extent to which investments in particular transactions are specialised. Williamson (1998) stated that special purpose technology is an example of an item with high asset specificity while general purpose technology is the reverse. Williamson (1998) emphasized that contractual complexities will arise with high asset specificity and the need to adjust to uncertainties. Williamson (1981) also alluded that highly specialised items are associated with more problems and complications. Therefore, it is in the best interest of the provider and the client to design agreements that encourage mutual benefits and continuity. For the purposes of this research, Cloud SLA asset specificity is the degree to which the relevant components of the cloud SLA are required to be fully specified in the agreement.

The research questions were answered through a two-phased mixed methods sequential exploratory study. The first phase being a qualitative study that answered the questions posed in RQ1.1 and RQ1.2. The other questions were answered using a quantitative study and the concept model in Figure 1. The methodology chapter discuss these phases in more detail.

In phase one, the contents and structure of SLAs for major cloud service providers were reviewed to identify a plausible set of attributes for cloud computing SLAs. These attributes were then verified through interviews with a sample of CSPs or cloud computing experts. Once the set of attributes was finalised, they were used to develop a survey instrument that was administered to businesses (users and non-users of cloud computing services) to obtain their perspectives on which attributes they considered important in the context of the factors shown in Figure 1.

In phase two, an instrument with 7-point Likert-type scale questions was used to measure the strength of the interviewees' perceptions for the quantitative research questions in RQ1.3 to RQ1.6. The survey used this instrument to administer closed ended questions on the attributes that were finalised from interviews with CSPs and analysis in phase one. The scale represents how strongly the respondents felt about each attribute in relation to uncertainty and specificity in the context of cloud computing SLAs. Sub-question RQ1.3 helped to determine the technical and non-technical attributes of cloud computing SLAs that business users have uncertainties about.

RQ1.4 helped to determine business perception of which technical and non-technical attributes of cloud computing SLAs should be specified in the SLA. RQ1.5 and RQ1.6 assessed the impact of uncertainty and asset specificity on the transaction costs for cloud computing SLAs. The transaction cost factor was included as a mediator and helped to determine how uncertainty and specificity influenced the costs involved in managing cloud computing SLAs.

The analysis made inferences based on the strength and statistical significance of business perceptions. Statistical analysis using SmartPLS and SPSS were used to determine the statistical validity of the model. A final set of attributes for cloud computing SLAs were established at the end of the analyses.

Hypotheses

The following alternate hypotheses were used to test the significance of attributes and factors highlighted in Figure 1 to the intention to adopt cloud computing.

H1 High SLA uncertainty will negatively impact transaction costs.

H2 High SLA asset specificity will negatively impact transaction costs.

H3 High SLA uncertainty will negatively impact the intention to adopt cloud computing.

H4 High SLA asset specificity will positively impact the intention to adopt cloud computing.

H5 High transaction costs will negatively impact the intention to adopt cloud computing.

Partial least squares (PLS) were used to test statistical significance of the hypotheses and determine the model-data fit. PLS was also used to evaluate the validity of the theoretical framework and concept model.

Relevance and Significance

Establishing appropriate SLAs is one of the most essential activities when considering adopting cloud computing services (Kalyvas, Overly, & Karlyn, 2013). Durkee (2010) claimed that some CSPs offer an unattainable level of availability in their SLAs together with an annual discount if the service level was not reached. According to Durkee, cloud computing SLAs provide for compensation if the agreement is breached by the CSP. However, the CSUs are faced with service-loss for which they may be compensated, but which may not be sufficient when compared to the aggregated costs of lost business. In addition, Kishore et al. (2003) emphasized that in contractual relationships, trust is more important than incentives. Durkee also identified that cloud computing users are not aware of the amount of unavailability they can accept for their business, which forms part of the problem with cloud computing service agreements.

The concept of the cloud suggests that critical information systems (IS) and IT functions may be acquired, but the client may not necessarily know the physical location where data is being stored or processed or exactly where the application is being hosted (Smith, 2009). While companies are able to perform continuous risks assessment and audits into their resident IT and IS, this may not be the case when they begin to roll-out critical IT processes in the cloud (Gilbert, 2010).

The cloud permits various types of technology solutions, business processes, and business entities to co-exist and co-operate using the same IT resources (Bardhan et al., 2010). The multi-tenancy approach of the cloud is also contributing to the source of the problem that creates the data security, standardization and interoperability, governance, business policy and SLA concerns which could threaten the cloud computing market (Armbrust et al., 2010; Brynjolfsson et al., 2010; Vaquero et al., 2008). The problem is further exacerbated by the fact that many businesses are looking at reducing the transaction costs of IT capital intensive investments and cloud computing is positioned as a suitable option. Therefore, there will be a high demand for services-oriented solutions and business users need to be aware of the concerns and the solutions required to minimize their effects (Bardhan et al., 2010).

In order to resolve the problem and ensure that the goal of this study was achieved, this research examined cloud computing, in the context of service science and as a disruptive technological innovation. Bardhan et al. (2010) identified 14 research directions in their study on services management and service science. Some of these research directions highlighted in their study are relevant to this research.

The first research direction posited by Bardhan et al. (2010, p.14) proposed that researchers study the commoditization of hardware, software, and business processes by focusing on on-demand computing, cloud computing, and infrastructure service providers. In their seventh proposed research direction, they highlighted that researchers should study service science relationship and productivity metrics strategies with clear focus on contract specification (Bardhan et al., p. 22). They argued in this regard that metrics, models and methodologies are required to guide decision makers on IT services issues; in particular those relating to pricing and contract design. This further signified that SLA specification and design are relevant for current research. This study adds value to SLA specification by identifying and suggesting attributes that could enhance the usefulness of service agreements between the CSPs and CSUs.

Furthermore, Bardhan et al. (2010) emphasized the significance of studying cloud computing and its effects on specific types of businesses. They also believed that the development of services-oriented IT innovation together with the transition from in-house IT infrastructure to acquiring services will be beneficial to IS researchers. They are of the opinion that studies should focus on behavioural, economic, technical, and organizational issues. They argued that this requires knowledge of the complexities associated with service trade-offs and the related decision making regarding value, risk, and cost. Bardhan et al. also claimed that there has been limited study in this area assessing the service quality risks associated with technology services similar to those provided by cloud computing. The results of this proposed study have helped to establish standard SLAs that could inform users and potential users of cloud computing services of the minimum service quality to expect when engaging in related transactions.

Brynjolfsson et al. (2010) claimed that in relation to computing in the cloud, business model challenges such as complementarity, interoperability, and data security will impact the stability of the cloud computing market. Furthermore, Brynjolfsson et al. claimed that computing is in the midst of an explosion in innovation and co-invention. They opined that a complete migration to cloud computing by replacing corporate resources with services provided by the cloud while business processes and governance remain the same will result in disaster, and the full benefits of the new paradigm will not be realized. This, therefore, supports the need to establish SLAs, consistent with the requirements of both parties, that will ultimately result in better relationships and trust between parties engaging in cloud computing services.

The results of this research have provided reasonable generalization about the findings. The use of a systematic research methodology and the application of an appropriate information system theory provided the premises for the generalization of the results that has been made. This research was based primarily on the transaction cost theory proposed by Williamson (1979, 1981, 1985). The primary constructs that were applied in this research are uncertainty, asset specificity, and transaction cost. This research assessed the applicability of transaction cost theory to the cloud computing context by looking at these constructs and how they may assist in the identification of SLA attributes for cloud computing.

The classes of asset specificity that were relevant to this study and that guided the use and definition of SLA asset specificity included knowledge, time, site, human asset, and physical assets specificity. These helped to define the technical and non-technical SLA asset specificity that were required for this research. According to Williamson (1981, 1985), there are three main types of asset specificity: site specificity, relating to the location; physical asset specificity, which refers to the definition of specific attributes for physical assets; and human asset specificity, which specifies requirements for human assets. Choudhury and Sampler (1997) also proposed information specificity and suggested that it is comprised of knowledge specificity and time specificity. They outlined that knowledge specificity refers to specific knowledge about the use and acquisition of information while time specificity relates to timeliness of the use and acquisition of information.

The existence of uncertainty will impact the definition and specification of the non-technical and technical attributes of the cloud computing SLA. Specifying complete contractual SLAs can be more costly for transactions that are complex and have a high degree of uncertainty (Aubert et al., 1996). Therefore, SLA uncertainty has helped in determining and specifying SLA attributes in this study.

This original work is poised to add value to the knowledge base on cloud computing, information security, and the specification of cloud computing SLAs. SLA asset specificity and SLA uncertainty have been introduced by this research. This study also proposed a solution to the problem identified in an effort to meet the primary goal of this research. To the best of knowledge, this concept model relating transaction cost to cloud computing SLAs and intention to adopt cloud computing services has not been presented in the knowledge base on IT and IS.

Barriers and Issues

Cloud computing requires a significant level of effort to review and study. This research took an inter-disciplinary approach that pulled from several knowledge areas such as economics, organizational behaviour, IS, psychology, law, and sociology. This research included a detail study of cloud computing, contracts and SLA formulation by examining the technologies and configurations used to provide cloud computing services. The formulation and specification of SLAs can be a very complex process (Eisenhardt, 1989; Macher & Richman, 2012; Williamson, 1981) which also presented some challenges for this study. The meetings with CSPs was challenging because the interviews were held with high level executives who in many instances had very tight schedules. It took a longer time than expected to have the interviews with the CSP. Administering the survey was also challenging and required substantial amount of effort and time to follow up with potential participants. Again, the target group was the management and executive levels so completing the online instrument depended on whether the potential subject had the time in their schedule to complete the survey.

Extrapolating knowledge about cloud computing and SLAs required an extensive review of literature and content on these subjects. This research also required advanced knowledge of analytic tools so that the appropriate inferences could be made. Tools such as SmartPLS (Ringle, Wende, & Becker, 2015) and SPSS were used to assist in the analysis of the data. Advanced knowledge of quantitative techniques became very useful and was applied during the analysis and reporting of the findings and results.

Assumptions, Limitations and Delimitations

Assumptions

The following assumptions were made about this study:

1. The cloud computing SLAs have similar attributes for various types of services such as platform as a service (PaaS), infrastructure as a service (IaaS), and software as a service (SaaS);
2. Businesses would be willing to participate in the research by completing the online survey instrument;
3. CSPs would be available for the interviews and would be willing to share their SLA documents for review; and
4. SLA documents are available for review.

Limitations

This research had the following limitation:

1. Cloud computing is relatively new and there may be domains in which many commercial businesses are not aware of its models, services, benefits and concerns, which may impact the response to the study.

Delimitations

The following were the delimitations to this study:

1. This research focused on only business or commercial users and non-users of cloud computing;
2. This research concentrated on identifying key attributes of cloud computing SLAs instead of detail metrics and KPIs;
3. PLS with 97 observations were used in order to make this research manageable. Ideally, a much larger sample and the use of covariance structural equation modelling (SEM) could produce results that are more generalizable.

Definition of Terms

Asset Specificity – This term originated from the transaction cost economics concept by Williamson (1985). Asset specificity refers to "the extent to which the value of an asset is restricted to specific transactions" (Choudhury & Sampler, 1997, p. 28).

Bounded Rationality – By reason of bounded rationality, contracts are incomplete and contain gaps, errors, and omissions due mainly to the fact that it is challenging for one to think about everything that need to be included in an agreement (Williamson, 1998).

Cloud computing Services – The services that are deployed through the cloud computing infrastructure are referred to as cloud computing services. The main services include SaaS, PaaS, and IaaS.

Cloud Service Providers (CSPs) – These are cloud computing experts or providers who sell services through their cloud computing infrastructures.

Cloud Service Users (CSUs) – These are users of one or more cloud computing services.

Contract – a document that describes the terms and conditions under which an engagement between a principal and an agent is binding.

Intention to Adopt – In the context of this study, intention to adopt is the behavioural perspective of business users or potential users that they would use or not use cloud computing services.

Non-technical Asset Specificity – The specification of an attribute in the cloud computing SLA that does not necessarily relate to a functional aspect of the cloud computing system is referred to as non-technical asset specificity. For example, specifying that a 'Definition of Terms' attribute is needed in the cloud computing SLA.

Non-technical Attributes – Attributes specified in the cloud computing SLA that are not related to a functional aspect of the cloud that is being engaged. The 'Compensation for breaches' attribute in the cloud computing SLA is an example of a non-technical attribute.

Non-technical Uncertainty – this term was introduced by the study to mean uncertainties in cloud computing based SLAs in relation to non-functional components of the agreement. Example of this include uncertainties with SLA attributes that provide support services to the client and provider such as compensation due to breaches, who to contact if there are issues with the service, and definitions of SLA components.

Opportunism – the intentional act of representing information or access to it in a biased manner so as to gain advantage over the other agents involved (Choudhury & Sampler, 1997).

Service Level Agreements (SLAs) – an agreement between client and provider (or CSU and CSP) highlighting the minimum responsibility of the service provider to guarantee quality service to the client.

SLA Asset Specificity – SLA asset specificity has been introduced by this study and refers to explicit specification of certain attributes in the cloud computing SLA document.

SLA uncertainties – refers to the general uncertainty within the cloud computing SLA and include both technical and non-technical uncertainties.

Structural Equation Modelling (SEM) – is a methodological assessment technique that is used to test for statistical validity of theoretical model and how it fits research data. It allows relationships among multiple dependent and independent constructs to be modelled simultaneously contrast to other models such as linear regression that can only model a single level of construct at once (Gefen, Straub, & Boudreau, 2000). Examples of SEM include PLS and LISREL.

Partial Least Squares (PLS) – is a type of SEM that models structural paths simultaneously (Chin, Marcolin, & Newsted, 2003).

Technical Asset Specificity – The specification of an attribute in the cloud computing SLA that relate to a functional aspect of the cloud computing system is referred to as technical asset specificity. For example, specifying the 'Availability' attribute is needed in the cloud computing SLA.

Technical Attributes – Attributes specified in the cloud computing SLA that are related to a functional aspect of the cloud that is being engaged. Including the 'Availability' attribute in the cloud computing SLA is an example of a technical attribute.

Technical Uncertainty – this term was introduced by the study to mean uncertainties in cloud computing based SLAs in relation to functional aspects of the cloud computing infrastructure. Example of this include uncertainties with SLA attributes that provide technical services to the client such as the amount of cloud storage space, network performance, and availability of the cloud.

Transaction Cost – In the context of this research, transaction costs refer to the costs associated with the activities involved in establishing a cloud computing services arrangement between an agent and a principal. It includes the costs for developing the SLA, costs of management and enforcement, costs for compensation due to breaches, and costs involved in drafting the agreement.

Uncertainty – This refers to the disturbances to which commercial transactions are subject (Williamson, 1998, p. 36).

Summary

Cloud computing is becoming pervasive and is likely to be the next generation technological innovation that will transform how citizens and businesses interact, socialise, and conduct commercial activities. This type of computing removes the capital expenditure for IT investments through a utility based, on-demand, and pay-as-you-go form of investment. Already, cloud computing is expected to be the most popular type of IT and IS outsourcing in the future. It is anticipated that cloud computing services will save businesses several folds, particularly in capital IT and IS outlays. Despite, however, the many documented benefits of this form of computing, several concerns still hinder the complete adoption of its services by businesses.

The concern regarding the appropriateness of cloud computing SLAs has been widely documented. The concern intensifies as more commercial users gradually decide to use cloud computing services. Companies are demanding more meaningful cloud computing SLAs. This could help to transition cloud computing as the preferred infrastructure for companies to put their critical and core IT and IS. The primary use of cloud computing services seems not to be for core systems, but instead more of the support systems. This seems to suggest that commercial users are not yet fully comfortable to make the full transition to cloud computing infrastructure.

This chapter presented the problem that the research was intended to solve and outlined the direction that the study took in order to meet its goal. Six research questions and five hypotheses were formulated in this research. The theoretical framework, based on transaction cost economics, was also used to illustrate the model on which the research was developed. SEM, specifically PLS, was the main data analysis technique used to execute the quantitative analysis on the data and test for model-data fit. The study was a mixed methods sequential exploratory study using a two-phased approach.

Chapter 2

Review of the Literature

Overview of Cloud Computing Literature

Cloud computing is still in its initiation stage (Dillon et al., 2010; Leavitt, 2009). According to Mell and Grance (2011) of the NIST, cloud computing is an evolving paradigm. Vaquero et al. (2008) also claimed that cloud computing is still being developed, likening it to be following trends similar to grid computing. Many opportunities and challenges have been cited about the technology as companies slowly decide whether to transition their technology functions to the clouds (Armbrust et al., 2010).

Justifying the decision to invest in IT is of high strategic importance for many businesses today, but has become more complex because of constant innovations in the IT landscape (Adomavicius, Bockstedt, Gupta, & Kauffman, 2008a). According to Durkee (2010), cloud computing is positioned to become the next timesharing of the 1980s delivering shared infrastructure service to enterprises. Durkee argued that high computing infrastructure costs and specialized skills needed to sustain the IT operations within the business were the primary forces driving timesharing initiatives 30 years ago. He also claimed that these same forces are propelling the increased demand for cloud computing today. According to Durkee, the major attributes of cloud computing that are satisfying the needs of businesses include on-demand access, elasticity, pay-per-use, connectivity, resource pooling, abstracted infrastructure, and little or no upfront financial commitment.

Several articulations of cloud computing as commoditization of hardware, software and business processes have been made (Armbrust et al., 2010; Bardhan et al., 2010; Greenberg et al., 2011). Bardhan et al. as well as Brynjolfsson et al. (2010) viewed computing-as-utility as a business model. They compared cloud computing with other utilities such as electrical grids and water supply. Though the utility model presents a great analogy and clarity on the business paradigm supporting a shift to service orientation, there is an urgent need to understand the real opportunities and challenges of cloud computing (Brynjolfsson et al.). This study will seek to identify SLA attributes for cloud computing that will impact the behavioral intention to accept cloud computing services.

What follows in this review will present definitions of cloud computing, describe the benefits of cloud computing, briefly highlight some concerns, describe SLAs in relation to the cloud, present cloud computing SLA attributes that have been gleaned from SLA documents and literature, and briefly describe the theoretical foundation for this study.

Definitions of Cloud Computing

In the search for an all-encompassing definition of cloud computing, several technologies have been reviewed for similarities and relationship to cloud computing. Service-oriented computing, utility computing and grid computing are three primary technologies that are compared with cloud computing (Armbrust et al., 2010; Dillon et al., 2010; Leavitt, 2009; Vaquero et al., 2008). It is clear that while these technologies have similar goals that are worth noting, cloud computing seems to be taking on definitions of its own. Bundled with these definitions, is the fact that, the elaborated benefits proclaimed by many publications are accompanied by major concerns that could avert the acceptance of cloud computing on a wide scale.

In 2008, Vaquero et al. declared that cloud computing continues to develop but its definition remains unclear. Over the last five years, however, several definitions of cloud computing have surfaced (Armbrust et al., 2010; Dillon et al., 2010; Mell & Grance, 2011; Vaquero et al.). Mell and Grance provided a comprehensive definition of cloud computing for the NIST. They stated that:

> Cloud computing is a model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction. This cloud model promotes availability and is composed of five essential characteristics**,** three service models, and four deployment models. (p. 2)

The essential features defined in the NIST definition included on-demand self-service, broad network access, resource pooling, rapid elasticity, and measured service. SaaS, PaaS, and IaaS are the three service models identified in this definition. The deployment models include private, community, public, and hybrid clouds. Dillon et al. (2010) used this same definition proposed by the NIST but also included an additional deployment model called data storage as a service (DaaS).

Vaquero et al. (2008) also sought to give an all-inclusive definition of cloud computing which also takes into account many of the core features of the definition put forward by Mell and Grance (2011). Vaquero et al. outlined that:

> Clouds are a large pool of easily usable and accessible virtualized resources (such as hardware, development platforms and/or services). These resources can be dynamically reconfigured to adjust to a variable load (scale), allowing also for an optimum resource utilization. This pool of resources is typically exploited by a pay-per-use model in which

> guarantees are offered by the Infrastructure Provider by means of customized SLAs. (p. 51)

While Vaquero et al. (2008) implicitly included some of the primary features of cloud computing highlighted by Mell and Grance (2011), they also looked at the cloud in relation to grid computing. Armbrust et al. (2010), Dillon et al. (2010), as well as Vaquero et al. argued that cloud computing and grid computing are two different concepts, though they share similar objectives to provide technology services at lower costs and ensure availability of services through the utilization of excess capacity in existing data centres. Vaquero et al. further argued that virtualization is forms the basis of cloud computing as it provides the capability for on-demand sharing of resources and security by isolation.

Another essential feature of the definition by Vaquero et al. (2008) is the inclusion of SLAs. Vaquero et al. asserted that SLAs are critical to cloud computing as this enables enforcement to meet the quality and level of service stipulated in the contractual agreements between service providers and clients.

Armbrust et al. (2010) argued that "cloud computing refers to both the applications delivered as services over the Internet and the hardware and systems software in the datacentres that provide those services" (p. 50). Mell and Grance (2011) as well as Vaquero et al. (2008) emphasized the service models SaaS, IaaS, and PaaS as being important considerations when defining cloud computing. Armbrust et al. however, believed that SaaS and utility computing are the core for the definition of cloud computing. They argued that the datacentre hardware and software define the cloud. They also believed that the size of the datacentre matters when determining a cloud. As a result, they do not agree that some private clouds meet the requirements of cloud computing.

Public clouds are those that offer a pay-as-you-go service to the general public while private clouds are operated by businesses and are usually internal datacentres providing computing facilities to the entity (Armbrust et al., 2010). According to Armbrust et al., cloud computing does not include small or medium sized datacentres that are operated privately. The datacentres must be large enough to benefit from the economies of scale that the cloud paradigm is projecting. Armbrust et al., therefore, did not include private clouds in its definition of cloud computing because they believed they are not large enough to be classified as such.

Leavitt (2009) claimed that cloud computing is relatively new but argued that it will change at a rapid pace as it advances and larger companies begin to exploit and adopt it for critical applications. This evolution may help determine the features of cloud computing and further refine the definition of the cloud.

Benefits of Cloud Computing

Cloud computing is rapidly becoming a revolutionary technological innovation (Dillon et al., 2010). Some of the benefits that are being used to promote the cloud include elasticity, risks transfer, and conversion of capital expenditure (CapEx) to operating expenses (OpEx) on a pay-as-you-use basis (Armbrust et al., 2010; Dillon, 2010).

The ability of clouds to provide short-term usage on demand through what is called elasticity is one of the merits highlighted by Armbrust et al. (2010). They argued that consumers of cloud services are able to scale up or down the demand for computing resources. This makes the cloud elastic due to the possible on-demand resizing that can be self-provisioned (Armbrust et al.; Mell & Grance, 2010). This type of resizing, according to Armbrust et al., transfers the risk of under or over utilization of technology. They highlighted this as one of the economic benefits of using the cloud.

Cloud vendors market the technology as OpEx instead of CapEx (Armbrust et al., 2010). There are no upfront costs in some instances. The consumer only needs to pay as they use the service. This according to Leavitt (2009) should result in cost savings to the consumer and is included as another benefit of cloud computing.

Leavitt (2009) claimed that availability, application integration and support, and flexibility are other testimonies of the benefits of cloud computing. Leavitt argued that the cloud is operated by large service providers with several huge equipment and many levels of redundancies which will provide high availability for cloud customers. In addition, through the use of non-proprietary protocols such as simple object access protocol (SOAP), Web services description language (WSDL), and extensible mark-up language (XML), the cloud provides a platform that encourages support for legacy applications and integration of various types of systems. Leavitt also claimed that some cloud vendors provide the flexibility to users through modest or no contracts that give the user the added advantage of obtaining more resources when required.

Concerns with Cloud Computing

Amidst the benefits, there are several concerns with cloud computing (Armbrust et al., 2010; "NIST Cloud Computing Program"). Armbrust et al., Dillon et al. (2010), Hayes (2009), Leavitt (2009), as well as "NIST Cloud Computing Program" have been very explicit in their views about the issues that could impact the adoption of this innovation. Some of the issues highlighted by prior research include data security, reliability, definition of SLAs, cloud lock-in, cost of communication, regulatory audit requirements, software licensing, portability, interoperability, and access control (Armbrust et al.; Dillon et al.; Leavitt; NIST Cloud Computing Program; Wittow, 2010). The Information Systems Audit and Control Association

(ISACA) and IT Governance Institute (ITGI) in their 2011 Global Status Report on Governance of Enterprise IT (GEIT) disclosed that information security concerns are the primary reasons cited by enterprises for not using cloud computing (ISACA & ITGI, 2011). Edwards (2009) also outlined that while companies will realize useful benefits from cloud applications, there are still major issues with information security that must be addressed.

Information security in the cloud is one of the most publicized concerns affecting higher acceptance of the cloud computing paradigm (Dillon et al., 2010; Takabi et al., 2010). According to Takabi et al., the nature of the cloud increases the issues with information security, such as trust management and policy integration, secure service management, privacy and data protection. Takabi et al. argued that for cloud computing to be successful, the information security issues must be resolved. They argued that third parties managing the security of data and applications in the cloud may create further challenges with information security. In addition to this, they emphasized that due to the multi-tenancy nature of the cloud, the sharing of physical resources in this environment is also viewed as a risk to the services hosted in the cloud.

There are concerns about the confidentiality and privacy of data and information that will be processed or stored in the clouds (Armbrust et al., 2010; Dillon et al., 2010; Hayes, 2008; Leavitt, 2009). These concerns include malicious attacks on the cloud, release of data due to a third party being subpoenaed thus creating confidentiality and privacy issues, multi-tenancy approach, data loss, and lack of control over the infrastructure that hosts the data and systems. Dillon et al., Hayes, as well as Leavitt also highlighted the concern about reliability. They claimed that because the cloud is solely dependent on Internet technologies, there could be reliability, performance and latency problems. In addition, Armbrust et al. believed that there could be availability and business continuity issues. They argued that though the cloud itself may have some amount of internal redundancy, the CSP may still be a single point of failure. The SLA in this regard is expected to set the minimum level of service the cloud user is expected to receive from the CSP. However, SLAs developed for cloud computing seemed to have been lacking components that would make them more appropriate (Durkee, 2010). Alhamad, Dillon, and Chang (2010) claimed that business users of the cloud may not adopt cloud computing services if privacy and security guarantees are not provided by the CSPs and enforced by the cloud computing SLAs.

Armbrust et al. (2010) as well as Smith (2009) also argued that there are questions about confidentiality and audit requirements for information and systems hosted in the clouds. Kant (2009) claimed that one of the considerations when thinking about hosting enterprise applications in the cloud is data management and IT regulatory compliance obligations. Kant declared that for this reason, some countries prohibited businesses from using the cloud to store several categories of data. Therefore, regional legislation must be considered in some cases when considering cloud computing. Hoberman (2010) also claimed that the cloud does not make data management easier and that cloud computing will not resolve data governance and management issues. Accordingly, Ruth (2010) suggested that cloud computing is not for everyone.

Smith (2009) argued that there are many companies that are not willing to host their internal data external to their own company. This he believed may be partly due to the concern that data may end up being co-hosted with other companies' applications. This for many companies is not allowed, especially when it is either not clear or known what processes are being executed by the co-hosted applications. This detail is usually not specified in the SLAs or other documents provided to the user. Gilbert (2010) also supports the view that the co-existence of data generates greater information security risks to companies using cloud services. He outlined that one of the attributes of the cloud is that several customers' data and applications may co-exists. According to Gilbert, if one company is a subject of virus or hack attacks, this will compromise the integrity and availability of data for other companies in the same environment.

Viega (2009) argued that the cloud user has little control over how the provider secures the infrastructure. He argued that the user will only need to assess the data security controls based on what the provider will disclose about its procedures. This creates some uncertainty about what is being delivered. Viega said developers may need to implement additional measures to guard against users of the same cloud infrastructure intercepting transmissions within the network.

An important observation made by Dillon et al. (2010) is that companies still seemed to be keeping their core systems in-house. Dillon et al. claimed that the main functions that are being migrated to the cloud include basic IT management and personal applications. They also argued that storage and collaborative applications are expected to be the principal users of the cloud in the near future. Smith (2009) emphasized that there are still bugs in cloud computing that still needs to be resolved. He claimed that there have been instances when an entire cloud is made unavailable for hours or days which put the client in an unfortunate position. Amazon S3 and Google were unavailable for several hours in 2008 (Yan, 2010). In addition, Yan also agreed that other security issues relating to data transfer bottlenecks and legal jurisdiction exists which could create problems for cloud computing.

Furthermore, shared infrastructure such as cloud computing comes with its own concerns (Brynjolfsson et al., 2010). Cloud computing allows limited control over the data and the management of information security to the client (Brynjolfsson et al.; Undheim et al., 2011).

Smith (2009) professed that companies are concerned about the physical location of the data that are being stored in the cloud. Brynjolfsson et al. argued that cloud computing will reduce control for the users and will present new information security risks not experienced by countertypes of cloud computing models. Accordingly, they state that customer data, trade secrets, and classified government information are usually subject to rigorous requirements and auditing standards for regulatory and law enforcement purposes. Though Gilbert (2010) identified cloud computing as one of the most important developments in IT since the past 60 years, he also claimed that relinquishing control of critical information assets to CSPs creates considerable legal issues. This include: access, availability and performance; customization and integration with existing technologies; compliance with regulatory agreements; security of the information; and switching from one CSP to another. Gilbert argued that public clouds provide very little negotiating power relating to specific provisions such as limitations to the location of the data or the use of subcontractors. He argued that the data will be subject to the laws of the environment where the data is located which may not necessarily be what the clients require.

Communication cost is another concern highlighted (Dillon et al., 2010; Leavitt, 2008). It has been argued that due to the intensive reliance on the internet for access to the cloud, increased bandwidth may be required which could significantly drive up the cost of communication (Leavitt, 2008). This is especially so in cases where there are large databases to access through the clouds (Leavitt, 2008). It was also argued that bottlenecks could be created due to low speed connections to the cloud and high traffic in some instances (Armbrust et al., 2010). Initial uploads could also be a serious problem as huge volumes of data is expected to be migrated to cloud computing infrastructures. This could result in increased transaction costs for cloud computing. When this happens, the intent to adopt cloud computing may be adversely impacted.

Prior Studies on Cloud Computing and Service Level Agreements

Several studies have been conducted with emphasis on cloud computing and SLAs (Alhamad et al., 2010; Bouchenak, 2010; de Chaves, Westphall, & Lamin, 2010; Patel et al., 2009; Nawfal et al., 2011; Schnjakin et al., 2010). These, however, have not addressed the problem of this research. The earlier studies either focused on the general security of cloud computing or the management of the cloud computing SLA. de Chaves et al. (2010) focused their research on the security aspects of the cloud computing SLA. They claimed that cloud computing is a new paradigm which brings a new perspective on the design of service levels for data security in the cloud. They also identified several metrics for security based SLAs for cloud computing.

According to Goulart (2012a), there are many business benefits of cloud computing, but this does not nullify the importance of SLAs for its services. Goulart further argued that SLAs will become more important as businesses adopt cloud computing on a wide scale. Ahmad, Ahmad, Saqib, and Khattak (2012) claimed that several businesses are not willing to make the transition to the cloud because of the lack of trust in the CSP. They argued that the SLA in this context plays an important role for businesses to start using cloud services.

SLAs are expected to help resolve information security concerns relating to the appropriateness of the agreed service levels between parties engaging in cloud computing services. According to Undheim et al. (2011), a “SLA is a binding agreement between the service provider and the service customer, used to specify the level of service to be delivered as well as how measuring, reporting and violation handling should be done” (p. 2). Ahmad et al.

(2012) added that the cloud computing SLA formalises the expected service levels between the customer and the provider.

The dynamic nature of the cloud will require special considerations when specifying and managing SLAs (Morin, Aubert, & Gateau, 2012; Patel et al., 2009; Takabi et al., 2010; Undheim et al., 2011). According to Undheim et al., changing user requirements, resource conditions, and environmental elements are some of the attributes that should differentiate cloud SLAs. This they argued should be done with reference parameters such as dependability, performance, and information security.

Duan (2012) claimed that service contracts are relatively new, are interdisciplinary, and are good prospects for research. The SLA forms part of the service contract and is a means of guarding against poor performance, unavailability of service, and loss of data (Undheim et al., 2011). Dillon et al. (2010) as well as Vaquero et al. (2008) highlighted that SLAs will help ensure that the CSP honour agreed performance indicators.

Additionally, Kandukuri et al. (2009) claimed that a common way of preparing and managing the SLA for the cloud would make the cloud services more attractive to companies who would like to become users. Bodik, Goldszmidt, Fox, Woodard, and Andersen (2010) suggested that performance indicators be included in contractual service level objectives (SLOs). Patel et al. (2009) also looked at how SLAs can be managed for cloud related services and proposed a solution that uses the Web service level agreement (WSLA). They argued that by taking into account the unique structure of the cloud, the WSLA could be extended to meet the requirements of cloud computing.

Brief Review of Service Level Agreement Attributes

The SLA Documents of 10 CSPs were reviewed with the objective to list attributes and attributes of existing SLA contents. The CSPs SLA documents that were included in this initial content review included Google, OpSource, Windows Azure, Amazon, GoGrid, Hewlett Packard (HP), IBM SmartCloud, Joyent, Rackspace and VMWare. Table 1 highlights the attributes elicited from the SLA documents reviewed. Some of the attributes listed in Table 1 have also been supported by literature as considerations for inclusion in cloud computing SLAs and contractual engagements for cloud computing services. Flinders (2014) raised potential loss of control, availability and access to data, data security, data location, auditing and exits as popular concerns among businesses in their decision to adopt cloud computing. This offers support for many of the items listed as attributes in Table 1. The following will give a brief overview of each of the attributes highlighted in Table 1.

Table 1
SLA attributes from CSPs SLA documents and literature

Attributes	Literature/Content Reviewed
Availability	Amazon EC2; Dillon et al., 2010; GoGrid; Google Apps Service Level Agreement; HP; IBM SmartCloud; Joyent; Microsoft; OpSource; Rappa, 2004; Vaquero et al., 2008; VMware; Alhamad et al., 2010; de Chaves et al., 2010
Data integrity	Ahmad et al., 2012; Tripathi & Jigeesh, 2013; Yaqub et al., 2014; de Chaves et al., 2010
Confidentiality	Classen & McCaw, 2012; Tripathi & Jigeesh, 2013; Alhamad et al., 2010; de Chaves et al., 2010
Support response rate	GoGrid; OpSource; Durkee, 2010
Compensation for breaches	Amazon EC2; Durkee, 2010; GoGrid; Google; HP; IBM SmartCloud; Joyent; Microsoft; OpSource; Rackspace; VMware
Definition of attributes	GoGrid; HP; IBM SmartCloud; Joyent;

Attributes	Literature/Content Reviewed
	Rackspace; OpSource
Exclusions/limitations	GoGrid; HP; IBM SmartCloud; Joyent; OpSource; Rackspace; VMware
Network performance	GoGrid
Cloud storage	GoGrid; HP; IBM SmartCloud; Microsoft; Rackspace
Maintenance/emergency	GoGrid
Physical security	GoGrid
Physical location	Ahmad et al., 2012; Smith, 2009; Alhamad et al., 2010
Engineering support	GoGrid
Service Organisation Control Audits and Reports – SAS70/SSAE16/compliance/security certification such as ISO 27000	Brynjolfsson et al., 2010; Gilbert, 2010; Singleton, 2011; Tripathi & Jigeesh, 2013

Availability

Service providers seem to place significant importance on availability and guarantee an overall availability of approximately 99.9% (Google Apps Service Level Agreement; Vaquero et al., 2008). Availability from a security perspective addresses the reliability, usability, response time, and stability of the service (Dillon et al., 2010). Specific indicators for service availability could, therefore, include percentage uptime or downtime, proportion of the time the user is able to use the service, amount of time spent waiting for response (waiting time), and the number of request dealt with in a specific time (request throughput). Several CSPs (Amazon EC2; GoGrid; HP; OpSource) used uptime or downtime to define their SLA availability attribute. Since cloud computing is concerned with providing an environment for business users to access datacentre resources over the internet (Vaquero et al., 2008), besides uptime and downtime, the usability of the resources and the consistency with which the service is available (reliability and dependability), coupled with the speed at which the CSPs respond to requests from the customer are critical indicators of performance and service quality (Rappa, 2004).

Table 2 shows the maximum availability specified by CSPs in their cloud computing SLAs.

Table 2
The maximum availability specified by the CSPs in their cloud computing SLAs

% Availability	Cloud Service	CSP
99.90	Google cloud storage, prediction API, and BigQuery	Google
100.00	Windows azure storage, virtual machines, and virtual networks	Microsoft
99.95	Amazon elastic compute cloud (EC2)	Amazon
100.0	Hardware and network infrastructure services	GoGrid
99.95	Infrastructure services	HP
99.90	IBM SmartCloud - Infrastructure services	IBM
100.00	Hosting services	Joyent
99.90	Cloud block storage	Rackspace
99.95	Dedicated cloud	VMware vCloud
100.00	Cloud hosting services – except for Africa region which is 99.95% uptime	OpSource

Data Integrity

Tripathi and Jigeesh (2013) named the integrity of data as one of the many factors that influence the adoption of cloud computing. They suggested that data be encrypted to increase the integrity of the data. Tripathi and Jigeesh also suggested that secure logging of activities would also help to protect the integrity and confidentiality of data. Ahmad et al. (2012) also highlighted data integrity as one of the important factors to understand in their cloud computing SLA trust model between cloud providers and users.

Confidentiality

Another factor highlighted by Tripathi and Jigeesh (2013) that influences the adoption of cloud computing is confidentiality. Tripathi and Jigeesh also recommended that encryption of data be done before storage in the cloud in order to aid in maintaining confidentiality and privacy of the data. In addition, they argued that by not allowing the CSP staff to access the customers data, would help to maintain the integrity, privacy and confidentiality of the data. Classen and McCaw (2012) also listed confidentiality as one of the major risks facing cloud computing. They argued that there is a great need to developed confidentiality standards for cloud computing and to reduce the risks associated with confidentiality in the cloud.

Support Response Rate

Durkee (2010) argued that commercial enterprises require efficient support which is guaranteed by the cloud computing SLA. GoGrid included support response rate as one of its SLA attribute. According to GoGrid, support response is categorised into two main classes, emergency cases and non-emergency cases. Emergency support has a 30 minutes response rate and for other cases 120 minutes is the promised service level. GoGrid said they will respond to server down, pocket losses, and routing issues as emergency cases within 30 minutes and all other cases within 120 minutes. Opsource also included support response time in their cloud computing SLA and has the same specifications for emergency and non-emergency support response time.

Compensation for Breaches

Durkee (2010) and all of the SLA documents reviewed addressed compensation for breaches of terms in the cloud computing SLA. Most CSPs specify the level of compensation that would be given in the event that the service provider did not meet the SLA specified.

Definition

CSPs defined the key SLA terms that will be in the SLA document. These definitions could help in understanding what the SLA entails and reduce or eliminate uncertainties in some respects. Table 1 (shown above) highlight the CSPs that included this attribute in their SLA documents. According to Alhamad et al. (2010), clearly defining the SLA attributes will enhance the trust and improve the relationship between the CSP and CSU.

Exclusions/limitations

This helps to define the scope of the SLA. The SLA documents that have been reviewed as part of the content review included exclusions or limitations to define the boundaries of the SLA. For example, GoGrid indicated in its cloud computing SLA that network performance due to the users' connection to the internet has been excluded from the agreement. Exclusions or limitations seem to be included in most of the SLA documents reviewed.

Network performance

Generally, according to Ahmad et al. (2012), the cloud computing SLA helps to monitor the users' experience of the performance of the cloud. GoGrid also included network performance of the cloud as an attribute in their cloud computing SLA and promised high levels of availability for internal network performance. However, they added that the network performance of the users' local network as an exclusion of the cloud computing SLA.

Cloud storage

Several CSPs (GoGrid; HP; IBM; Rackspace) also provide what is called persistent, block or object storage services to CSUs. These services allow users to store various forms of contents in the cloud and access them on demand.

Maintenance/emergency

GoGrid stated that downtime due to schedule emergency maintenance will not be considered failure in their cloud computing SLA. They defined emergency maintenance as activities required to resolve hardware or software problems and other issues associated with attacks by viruses or worms. GoGrid also expressed that they will make every effort to inform customers of emergency maintenance, however, this notification is not a guarantee.

Physical security

The general security of cloud computing is a major concern (Dillon et al., 2010; Takabi et al., 2010). GoGrid has also included a physical security attribute in their cloud computing SLA. They claimed that they have 24 x 365 on-site physical security. This control could also be tested through frequent audits to help build the trust and confidence between the CSP and the CSU.

Physical location

The physical location of clouds has also been highlighted as a concern and is, therefore, being included for review and inclusion as an SLA attribute (Ahmad et al., 2012; Smith, 2009). The need, therefore, exists for this research to look at whether the physical location of clouds needs to be included in the SLA.

Engineering support

Engineering support refer to support offered by the CSP to monitor the cloud network resources and provide support to the CSUs (GoGrid). According to GoGrid 24x365 engineering support is provided and included in their cloud computing SLA.

Service Organisation Control Audits and Reports

According to Tripathi and Jigeesh (2013), open and transparent security practices in the cloud should be mandated. This can be assessed through frequent and periodic audits of the CSPs cloud computing infrastructure and services. Service Organisations Control (SOC) reports are becoming very applicable to providers of services such as cloud computing (Singleton, 2011). These audits should produce reports such as the Statement on Auditing Standards Number 70 (SAS 70) or the Statement on Standards for Attestation Engagements Number 16 (SSAE 16). These reports may then be shared with business users (or potential business users) through the cloud computing SLA. The introduction of internal controls that are of international standards, such as the SSAE 16, could build needed confidence of business users in cloud computing SLAs and ultimately cloud computing services. Tripathi and Jigeesh also believed that security certification such as ISO 27000 would be useful to help build the trust through improved integrity and confidentiality.

According to Singleton (2011), the SAS 70 and SSAE 16 are audit frameworks that provide assurance of controls in service organisations. Singleton indicated that the SAS 70 has been replaced by the newer SSAE 16 audits. The SSAE 16 requires that a description of the system and appropriateness of the design together with the effectiveness of the controls be presented in the report (Singleton). This includes a description of IT and IS systems. The management of the service organisations, under the SSAE 16, is expected to provide a written report of the fairness of the audit results which provides an attestation of the outcome of the audit and the report (Singleton). According to Singleton, these requirements were not included in the SAS 70.

Transaction Cost Theory

Williamson (1981) used the transaction cost approach to study the economics of the organization. He defined transaction cost economics as “an interdisciplinary undertaking that joins economics with aspects of organization theory and overlaps extensively with contract law”

(Williamson, 1979, p. 261). Ngwenyama and Bryson (1999) presented a simpler definition for transaction cost economics and stated that it is “an economic theory of the firm concerned with the modelling and analysis of buyer-supplier relationships” (p. 354). Aubert, Rivard, and Patry (1996) declared that organizations value the importance of transaction cost as they seek to manage the cost to coordinate the behaviour and secure the interest of transaction parties.

The main reasons for outsourcing business processes or functions are to minimize total cost and maximize the net worth of the firm (Ngwenyama & Bryson, 1999). Since the introduction of the transaction cost economics approach, several studies have been conducted focusing on outsourcing and inter-organizational behaviours (Ang & Straub, 1998; Aubert et al., 1996; Bahli & Rivard, 2003; Cannel & Nicholson, 2005; Grover, Cheon & Teng, 1996; Lacity & Willcocks, 1995; Ngwenyama & Bryson, 1999; Wang, 2002). Many of these research looked at transaction cost in terms of outsourcing decisions. Ang and Straub however, focused on production cost and transaction cost, as two primary determinants of entering into outsourcing agreements in banks and found that production cost played a greater role. The other studies found that transaction cost played a significant role in outsourcing decisions.

Lacity and Willcocks (1995) argued that transaction cost is similar to coordination cost and include the cost to control, monitor and manage transactions (p. 3). They argued that transaction cost for insourcing is less than that for outsourcing, because it is easier to manage opportunism internally than externally with vendors. They emphasized that transaction cost will increase as organizations manage and monitor contracts to eliminate vendor opportunism.

Bahli and Rivard (2003) applied the transaction cost economics and agency theory to outsourcing relationships. They concentrated on risks in outsourcing engagements and identified four risk scenarios: 1) lock-in; 2) costly contractual amendments; 3) unexpected transition and management costs; and 4) disputes and litigations. They presented asset specificity, uncertainty and measurement problems as the primary risk factors relating to these scenarios. This will help to strengthen the basis for the application of the transaction cost economics concept to cloud computing SLA, as these risk factors are present in SLAs for cloud computing.

Aubert et al. (1996) affirmed that uncertainty is the key challenge associated with transactions. They argued that uncertainty results in incomplete contracts, and in the context of this study, incomplete SLAs. Though complete or detailed contracts can be drawn, they argued that this gives rise to opportunism where acts of self-interest or exploits may be inevitable. They claimed that bounded rationality could also result due to the inability to think of everything possible to include in the contract. These they declared, make the development of contracts more difficult, costly to manage, and harder to evaluate and measure the performance of the parties involved in service agreements. They suggested that outsourcing engagements and strategic alliances become favourable when the levels of uncertainty and measurement problems are not high.

Williamson (1981) claimed that asset specificity is considered the most critical attribute in the discussion on transaction cost but believed that it has been neglected in earlier studies. Many later studies however have been highlighting the importance of asset specificity in the study of organizational economics and behaviour (Bahli & Rivard, 2003; Bunduchi, 2005; Cannel & Nicholson, 2005; Choudhury & Sampler, 1997; Grover et al., 1996; Lacity & Willcocks, 1995; Malone et al., 1987; Subramani, 2004; Wang, 2002; Welty & Becerra-Fernandez, 2001; Yates & Benjamin, 1987). Grover et al. suggested that decisions regarding outsourcing must include asset specificity. As cloud computing involves the procurement of services similar to that of outsourcing transactions, asset specificity is likewise of high importance to this study, particularly in the specification of SLA attributes.

Williamson (1981, 1985) defined three types of asset specificity: site specificity, relating to the location of parties who are transacting business; physical asset specificity, which defines the requirements for physical assets such as hardware requirements for a specific service; and human asset specificity, which specifies technical skills requirements. According to Williamson (1981), the cost of governance is less where assets are nonspecific. He argued that this gives the parties a better advantage and they may share the associated risks over the life of the transaction. However, he asserted that, as assets get more specific, the cost of governance may increase as service agreements become more necessary.

Choudhury and Sampler (1997) introduced information specificity and defined knowledge specificity and time specificity as its two primary dimensions. They explained that knowledge specificity falls into two categories namely use and acquisition. Accordingly, knowledge specificity in use refers to specific knowledge required to use information. Specific knowledge needed to acquire information relates to knowledge specificity in acquisition. They argued that in cases where specific knowledge is needed to capture the data, there is a high probability that specific knowledge may be required to use it. Choudhury and Sampler also outlined that time specificity represents the timeliness of information flow. Time specificity was originated and introduced earlier by Malone et al. (1987). They explained that “an asset is time specific if its value is highly dependent on its reaching the user within a specified, relatively limited period of time” (p. 486).

The literature showed that additional content relating to SLAs for cloud computing is needed for the cloud computing knowledge-base. This research is designed to provide this knowledge by identifying SLA attributes that could begin the standardization process for cloud computing SLAs.

Chapter 3

Methodology

Overview of Research Methodology

This research was executed over two phases. The first phase employed a qualitative study where specific attributes were identified and confirmed through literature reviews, content analysis and interviews with cloud computing providers. The cloud computing providers were considered experts in providing cloud computing services and helped to determine what they believed were the primary attributes for cloud computing SLAs. At the end of phase one a universal set of SLA attributes for cloud computing was established. The results of this phase provided the answers to research questions RQ1.1 and RQ1.2.

In phase two a quantitative study was conducted. This phase explored, through the use of a survey instrument, the perspectives of various businesses on the attributes established in the first phase of this research. The data collected in this phase was analysed to determine which SLA attributes are of high significance to business and commercial users of cloud computing services. The outputs from this phase provided answers to the main research question RQ1 and also for RQ1.3 to RQ1.6. The hypotheses were also addressed in this phase and the results presented in the results of the findings.

Specific Research Methods Employed

The specific research methods that were employed in this investigation are discussed in the design, data collection, and data analysis activities for this study. These included the following.

Research Design for the Proposed Study

A mixed methods sequential exploratory research design was used to conduct this proposed study. According to Creswell and Clark (2011):

> Mixed method research is a research design with philosophical assumptions as well as methods of inquiry. As a methodology, it involves philosophical assumptions that guide the direction of the collection and analysis of data and the mixture of qualitative and quantitative approaches in many phases in the research process. As a method, it focuses on collecting, analysing, and mixing both quantitative and qualitative data in a single study or series of studies. Its central premise is that the use of quantitative and qualitative approaches in combination provides a better understanding of research problems than either approach alone. (p. 5)

The mixed methods research design was chosen because qualitative or quantitative method alone would not be able to answer the research questions for this study. This is one of the reasons Creswell and Clark (2011) recommended the mixed methods research. The sequential exploratory design was applied in two phases as discussed in the following sections and illustrated in Figure 2.

Research Design for Phase one - Qualitative Study

The qualitative approach was used in this phase of this study. The first step involved content analysis and literature reviews. The content analysis included a research of CSPs who have details of their cloud computing SLAs available for public viewing. SLAs for 10 major multinational CSPs were reviewed and a list of attributes extracted. Additionally, literature review of discussions relating to cloud computing SLAs was also done and attributes deduced from these reviews. The list of attributes in Table 8 was the result of the content analysis and the literature review.

The second step in this study involved engaging cloud computing experts in an interview to obtain their perspectives on the list of attributes in Table 3. These interviews were conducted during December 2014 and February 2015. Ten (10) experts were interviewed during this period. Cloud computing experts were defined by this study as individuals who are working for CSPs who have been offering cloud computing services for at least four years. They included intermediaries, brokers and consultants who have been administering and selling cloud computing services or giving advice on cloud computing services for at least four years. The experts who were interviewed included Chief Executive Officers (CEOs), Vice Presidents, Engineers who are a part of sales teams selling and implementing cloud computing services, Heads of Business Units, and Executive Sales Officers. During the interviews cloud computing experts were asked about their perspective on the attributes to be included in the SLA. They were also asked if they would delete from the list of attributes and whether there were any other attributes that they thought should be included. The interviews lasted a maximum of one hour and involved cloud computing experts from multinational CSPs with offices based in Canada, the Caribbean, and the United States of America.

Table 3
List of Cloud Computing Attributes Extracted from CSPs and Literature Review

Attributes	Attributes
1. Availability	8. Network performance
2. Data integrity	9. Cloud storage
3. Confidentiality	10. Maintenance/emergency
4. Support response rate	11. Physical security
5. Compensation for breaches	12. Physical location
6. Definition of attributes	13. Engineering support

Attributes	Attributes
7. Exclusions/limitations	14. Service Organization Control Audits and Reports – SAS70/SSAE16/compliance/security certification such as ISO 27000

These attributes formed the basis for the semi-structured interviews with cloud computing experts in phase one of this study. The interviews in this phase were semi-structured. The experts were asked open-ended questions (shown in Appendix D). The output from this phase resulted in a set of attributes that experts believed should be included in this study. This set of attributes was established by taking the union of the recommendations from all the experts interviewed. These attributes went into phase two for the quantitative study.

Research Design for Phase two - Survey

This phase used the output from phase one to develop a survey instrument that was administered to businesses. Businesses were asked to rate their views on the 21 attributes in the context of the model depicted in Figure 1, and showed earlier. The instrument utilized closed ended Likert-style questions relating to the proposed attributes to capture quantitative data for analysis. The primary purpose of this survey was to collect quantitative data to determine which attributes should be included in cloud computing SLAs, thereby answering the main research question.

In the sequential exploratory design, the methods were implemented sequentially (Creswell & Clark, 2011). The qualitative study (QUAL) was done first, which corresponded to phase one of this study. This involved data collection and analysis. Once this phase was completed, the quantitative study (QUAN) was done, which is phase two of this study. Figure 2, explains this approach further. The QUAL and QUAN in the respective phases were of equal priority or weight. This is denoted by the QUAL → QUAN in Figure 2.

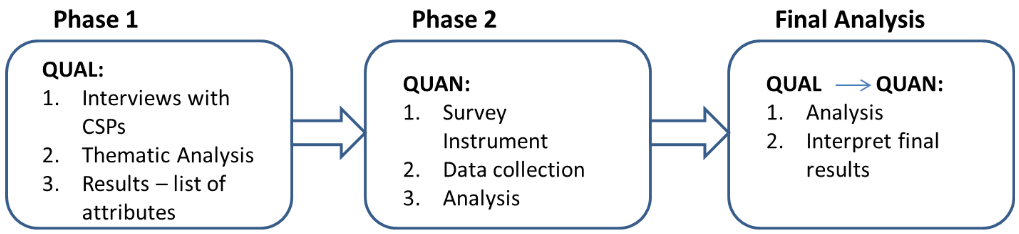

Figure 2. Mixed methods sequential exploratory research design (Creswell & Clark, 2011)

Bryman and Bell (2011) as well as Creswell and Clark (2011) endorsed the mixed methods research design and cited work done by Myers and Oetzel (2003) to explain how sequential exploratory research may be used in a mixed methods study. According to Creswell and Clark, Myers and Oetzel used a two-phased mixed methods sequential exploratory approach similar to what was done for this research. The first phase was a qualitative study and the second a quantitative study. Accordingly, 13 members of an organization were interviewed to collect qualitative data. A thematic analysis of the data generated six dimensions that were used to build a survey instrument to collect quantitative data. According to Bryman and Bell, 61 Likert-scale type questions were used in an instrument to collect the data. Additionally, according to Bryman and Bell, Myers and Oetzel established hypotheses to validate the constructs of their research. Similarly, this research also used hypotheses to validate the appropriateness of the model.

Data collection – Phase One

Phase one was primarily a qualitative study which produced a common set of cloud SLA attributes that have been verified by cloud computing experts. Literature and content reviews provided a preliminary list of attributes (Table 1 and Table 2 in the Literature Review) that formed the basis for the interviews that was conducted in this phase. The cloud computing SLAs for 10 major CSPs were used to collect qualitative data. The major CSPs were those providers who have established cloud computing infrastructures and have been selling cloud computing services to various types of customers. These major CSPs were also considered cloud computing experts. Thirteen (13) CSPs were interviewed in relation to the attributes that have been sifted from literature and other contents (and shown in Table 1 and Table 2 in the Literature Review). These CSPs were selected based on convenience. The goal of the interviews was to confirm with the CSPs which attributes they believed should be included in the cloud computing SLA. It was anticipated that the response rate in this phase of this study would be 76.9%. The data collected from the interviews with CSPs provided a finalised universal set of attributes that were used in phase two.

Data collection – Phase Two

Data collection for phase two used a survey instrument comprising closed-ended questions (shown in Appendix E) to capture the views of respondents about the attributes produced in phase one of this research. The survey instrument was administered to businesses (users and non-users of cloud computing services). The instrument was designed so that it could be self-administered or administered by an interviewer. A web form was developed and used by respondents as the primary means to complete the survey. The instrument was structured so that each business could indicate the levels of uncertainty and specificity that they believed are relevant to each attribute. The survey targeted approximately 320 businesses with an expected minimum response rate of approximately 30%. Data were, therefore, expected to be received for at least 96 respondents (see calculation of sample size below). The survey was administered to business representatives who have responsibility for or would input into the process for adoption of cloud computing services. The survey instrument was completed by Chief Information Officers (CIOs), IT Managers, Infrastructure Managers, Legal Officers or delegates who were part of the team reviewing the SLA for decisions relating to service adoption such as cloud computing.

Sample Size

A convenience sample of 13 CSPs with offices located in Canada, the Caribbean, and the United States of America (USA) were used for phase one of this study. For phase two of this study, the Cochran formula highlighted by Israel (1992) was used to compute the sample size for this research. This formula is shown below.

$$n_0 = Z^2\, pq/e^2$$

Where n_0 is the computed sample size; Z is the confidence level; p is the degree of variability in the sample; q is $p - 1$; and e is the level of precision. The 95% confidence level was used with a precision level or margin of error of 10%. The maximum variability in the population of business users of 0.5 was also assumed. Therefore, using the Cochran formula for calculating sample size, n_0 = 96.

According to Baruch and Holtom (2008), the average response rates for surveys administered to organizations in 2000 and 2005 were 36.2% and 35.2% respectively. They recommended a benchmark response rate for academic research of 35% to 40%. They argued that response rate may be lower for scholarly research that requires the collection of data at the organizational level, particularly surveys soliciting responses from business representatives or top executives. Hence, applying a response rate of 30% to this proposed study, adjustments to n_0 for nonresponses and other contingencies resulted in a sample size of 320. Therefore, the quantitative study in phase two of this research consisted of a sample size of 320 businesses with an expected response rate of 30%. This equates to 96 of the 320 businesses responding to the survey.

Pre-Analysis Data Screening - for Phase Two of this Study

Data screening was done to verify that data collected during the survey have been correctly entered, identify missing values and decide how to treat them, and identify multivariate outliers and find a way to resolve them.

The instrument, based on design, was expected to be fully completed by the respondent before it could be submitted for inclusion in the dataset. This was a requirement for the Web-instrument in SurveyMonkey before the Web form could be submitted. Therefore, it was not expected that there would be any missing values in the data. The SPSS software was used to provide the frequencies for each variable. The frequency tables produced by SPSS gave a summary of the responses for each variable.

Outliers could adversely impact the reliability of the results. According to Cousineau and Chartier (2010, p. 58), “outliers are observations or measures that are suspicious because they are much smaller or much larger than the vast majority of the observations”. Cousineau and Chartier claimed that outliers can be problematic to research and argued that suitable remedies must be applied to deal with them. They suggested the use of Mahalanobis Distance for handling outliers in multivariate cases. Joseph, Galeano, and Lillo (2013) also highlighted hypothesis testing and outlier detection among the many uses of Mahalanobis distance in multivariate analysis. For this study, multivariate outliers were examined by Mahalanobis Distance and extreme cases were evaluated for consideration of removal. SPSS was used to compute the probabilities of the Mahalanobis distance, using a chi-square statistics, which was then sorted and used to identify the outliers. In this regard, a point was an outlier if it has a p-value of less than 0.001. The outliers were removed before final analysis.

Data analysis – Phase One

Thematic, text and content analyses of the data collected from interviews with CSPs were used to identify attributes that were perceived as important for cloud services SLAs. The analysis of the data in this phase provided the answers to RQ1.1 and RQ1.2. At the end of the analysis for phase one, a set of cloud computing attributes was listed and sent to a panel of cloud computing experts to verify and validate the attributes. Once the verification and validation were done, the validated attributes were used as the input to phase two.

Data analysis – Phase Two

PLS was used in phase two to test the hypotheses and determine whether the model fits with the theoretical framework of this study. PLS quantitative analysis is a component-based SEM technique with similarities to regression (Chin, Marcolin, & Newsted, 2003). Though PLS has similarities to regression, it simultaneously models the theoretical relationships for the measurement and structural paths (Chin et al., 2003) for the concept model using variance-based SEM. The model presented in Figure 3 is the PLS model showing the measurement paths that were used to evaluate model-data fit for this study.

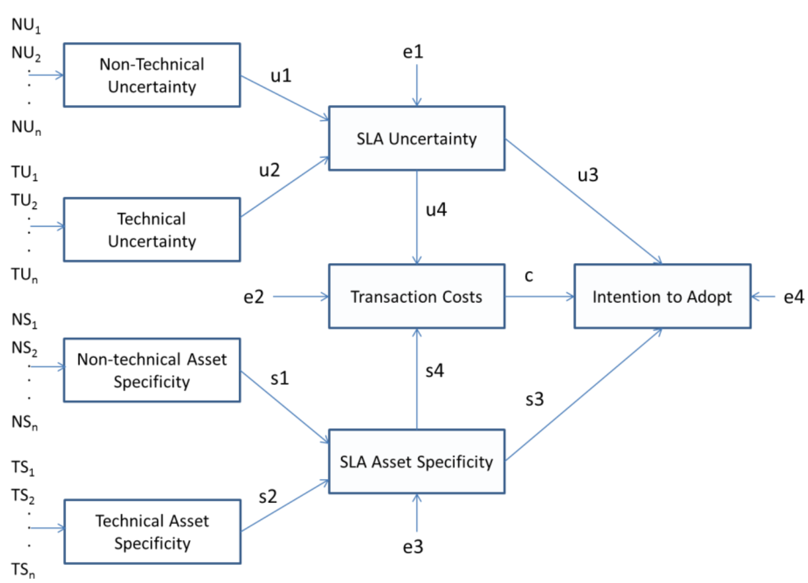

Figure 3. PLS model showing measurement paths – intention to adopt cloud computing

The model in Figure 3 consists of several observable variables and eight latent variables. The observable variables are denoted by NU_1 to NU_n, TU_1 to TU_n, NS_1 to NS_n, and TS_1 to TS_n. The NU_i and TU_i variables refer to non-technical and technical uncertainty while the NS_i and TS_i variables relate to non-technical and technical asset specificity (where i is any integer number from 1 to n). These variables were confirmed and fully defined from phase one of this study. The data for these observable variables were collected through responses to the survey instrument in phase two.

Lei and Wu (2007) referred to the observable variables as source variables or exogenous variables. They explained that exogenous variables are similar to independent variables. The latent variables are aggregates of the responses or observed variables. These are called result or endogenous variables by Lei and Wu. They explained that endogenous variables are similar to dependent variables. Lei and Wu also emphasized that when a variable serves as both source and result variables, it is called a mediator. SLA uncertainty, transaction cost, and SLA asset specificity are examples of mediators as they are result variables which become source variables for another variable (intention to adopt). NU_1 to NU_n, TU_1 to TU_n, NS_1 to NS_n, and TS_1 to TS_n are the independent (observable, exogenous, or source) variables. The eight dependent (latent, endogenous, or result) variables are Non-technical uncertainty, technical uncertainty, non-technical specificity, technical specificity, SLA uncertainty, SLA asset specificity, transaction cost, and intention to adopt.

The equations that were used in PLS to determine model-data fit included:

$SLAUncertianty = u_1 * NontechnicalUncertainty + u_2 * TechnicalUncertainty + e_1$

$SLASpecificity = s_1 * NontechnicalSpecificity + s_2 * TechnicalSpecificity + e_3$

$TransactionCost = u_4 * SLAUncertainty + s_4 * SLASpecificity + e_2$

$IntentionToAdopt = c_1*TransactionCost + u_3*SLAUncertainty + s_3*SLASpecificity + e_4$

The PLS model was executed using and version 3.2.0 of the SmartPLS software (Ringle, Wende, & Becker, 2015). Model-data fit and the validation of the theoretical framework led to the examination of the individual values returned for $\mathbf{u_1}$ to $\mathbf{u_4}$ and $\mathbf{s_1}$ to $\mathbf{s_4}$ for statistical significance. This was done based on t-values produced by SmartPLS. Using the 95% (or 0.05) confidence interval, t-values greater than 1.96 were considered statistically significant at the 0.05 level. The model was considered proper or a fit none of the variables has out of range estimates. The values of $\mathbf{e_1}$ to $\mathbf{e_4}$ represented the residual (error) at each of the latent variables which can be estimated during covariance SEM analysis.

Structural Path analysis is a special configuration of PLS. This was also examined for model fit and statistical significance of the individual variables in the model. The path analysis model is shown in Figure 4.

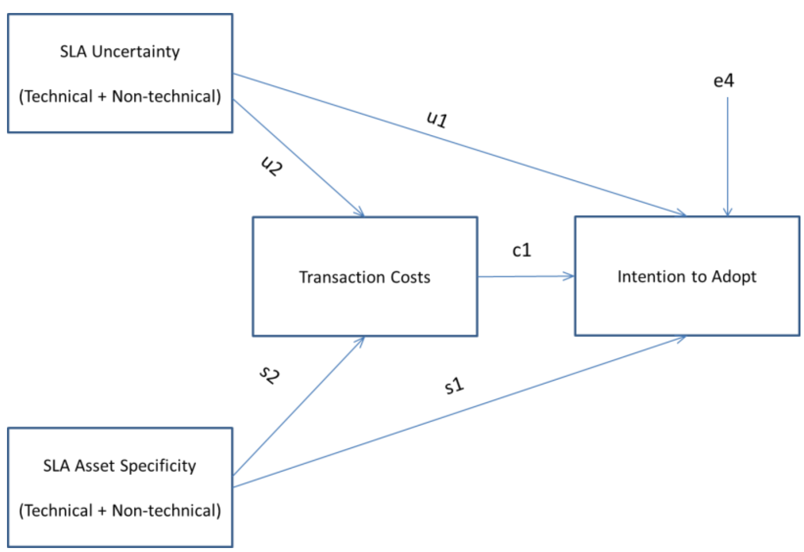

Figure 4. Path diagram (structural path) for intention to adopt cloud computing

The two PLS structures, shown in Figure 3 and Figure 4, were used to evaluate the validity of the model and present the estimates for the hypotheses (H1 to H5). Extensive use of SmartPLS statistical software together with SPSS provided the estimate of the variables in the model. SPSS was used to produce summary statistics about the data. The variables that were determined to produce statistical significance for the model helped to identify those attributes that should be included in SLAs for cloud computing and that could enable wider-scale adoption of related services. PLS or variance-based SEM was used due to its ability to analyse relatively small sample sizes for samples that do not necessarily exhibit normal distribution (Chin et al., 2003). According to Haenlein and Kaplan (2004), PLS may be used with sample size as low as 50, which is lower than the sample size of 96 (based on expected response rate) that has been calculated for the quantitative aspect of this study.

For the research sub-question, RQ1.3 to RQ1.6, the use of descriptive statistics, correlation, PLS path coefficients and statistical significance using the t-statistics from the PLS bootstrapping report were the main results used to assist in answering these questions. The t-values obtained from the PLS procedure was used to determine statistical significance of each variable relating to the latent constructs SLA uncertainty, SLA asset specificity, transaction costs, and intention to adopt cloud computing. This helped to determine which attributes should be included in the cloud SLA thereby answering the main research question (RQ1) and sub-questions RQ1.3 to RQ1.6.

Figures 5 and 6 summarise the approach that was used for both the qualitative and quantitative research components. Figure 5 focuses on the qualitative research for phase one while Figure 6 on the quantitative research for phase two.

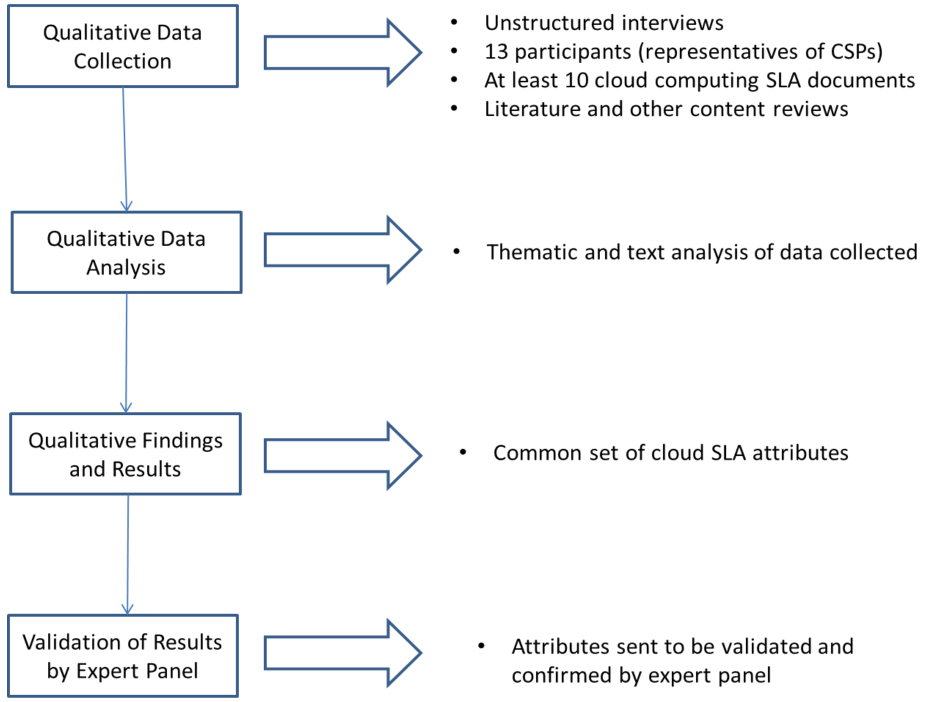

Figure 5. Phase I: Qualitative research

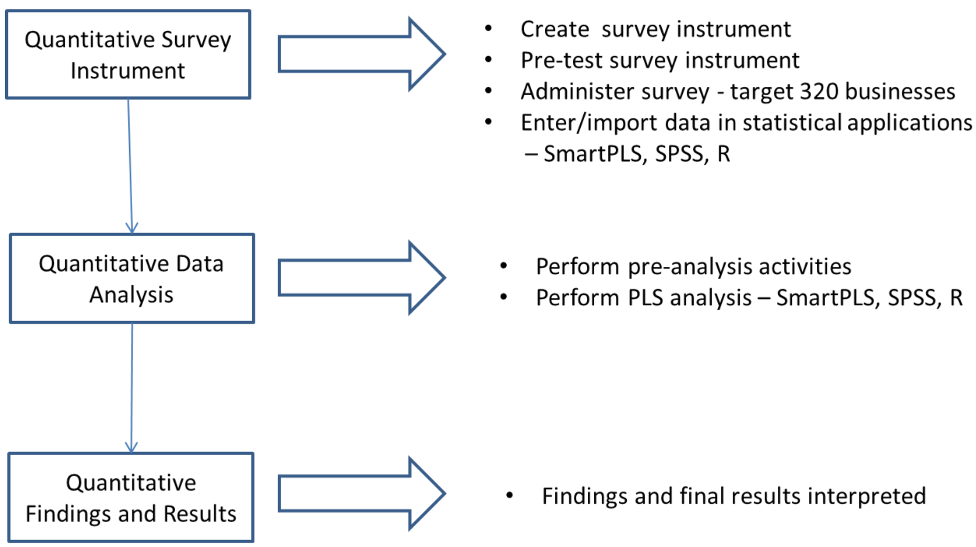

Figure 6. Phase II: Quantitative research

Instrument Development and Validation

Development of Instrument for Phase One of this Research

In phase one of this research, the questions in Appendix D were administered to experts or major CSPs. Data for this phase (Table 1 and Table 2) were collected through literature reviews, SLA documents and content reviews. Semi-structured interviews were held with the experts where the opened-ended questions in Appendix D were asked and used as the basis of the discussions with them about cloud computing SLAs.

Development of Survey Instrument for Phase Two of this Research

A 7-point Likert-Type scale instrument was used to collect data that represented how strongly each respondent felt about each attribute. Finstad (2010) claimed that 7-point scales produced more accurate responses than 5-point scales. He argued that 5-point scales are not granular enough to assess responses, particularly responses relating to usability. Finstad found that 7-point scales were more accurate when compared to 5-point scales. This study, therefore, used the 7-point scale in the survey instrument. Clear instructions were given for each section of the instrument. The survey instrument is shown in Appendix E. This instrument was developed based on the 21 attributes obtained from literature, the contents of cloud computing SLA documents of 10 CSPs, and the additions made in phase one of this study.

Instrument Validation

In order to ensure validity and reliability of the instrument that was used to conduct this study, particularly the survey instrument that was used in phase two, the following explains the steps that were taken. In addition to the ensuing, respondents were properly briefed to provide the right atmosphere for the interviews in both phases one and two of this study. The survey Instrument was prepared with sufficient details and instructions. This was done to provide the appropriate information to ensure consistency in responding to questions in the survey.

Pretest – The survey instrument was pretested before administered to allow for refinement of the questions and improvement in the reliability of the data that was collected. Approximately five businesses that meet the requirements for participating in this study were asked to engage in a pre-test exercise and provide feedback on the instrument. The feedback from the pretest was used to make the online instrument more presentable and user friendly.

Content validity – The survey instrument included a good representation of areas that were needed to provide sufficient coverage for each construct. The attributes that supported each construct were extensively reviewed and discussed with CSPs to ensure that the contents on which the questions were built are representative. This was a part of the validation exercise by the expert panel highlighted in Figure 5 earlier. The objective was to ensure that the attributes that were selected to be included in this survey were properly vetted and agreed by the expert panel. The expert panel was made up of CSPs with at least four years of experience providing cloud services and administering SLAs. The panel was comprised of five CSPs.

Construct validity – The use of PLS (variance-based SEM) in this research helped to validate the constructs illustrated by the conceptual model. PLS is a second generation technique which inherently includes validity assessment through its ability to analyse both structural and measurement models simultaneously and present the validity statistics as part of its output (Boudreau, Gefen, & Straub, 2001).

Reliability – The variables that were used to measure the constructs illustrated in the model for this research was properly selected to ensure that they are related and that the associated measurement errors are acceptably low. Cronbach's alpha (Cronbach, 1951) was used to assess the reliability of the questions in the survey instrument. Gefen (2003) stated that Cronbach's alpha is the most popular method used for measuring reliability and should be used as the first method for evaluating the quality of the survey instrument. By using the Cronbach's Alpha result reported by SmartPLS, an alpha coefficient of 0.7 or higher was used to suggest that the questions being assessed have a high internal reliability. The SmartPLS quality criteria results generated as an output from the calculation of the PLS algorithm also aided in the test for reliability. In addition to the Alpha values, the composite reliability values were used to assess the reliability of the constructs. These two criteria were expected to indicate construct reliability.

Formats for Presenting Results

The outputs of this research are presented in two parts, the qualitative and quantitative results. The qualitative results were primarily based on outputs from the first phase of this study, while the quantitative were based on phase two. The remainder of this section highlights the formats that have been used to present the results of this research.

Qualitative Results – From Phase One of the Study

The results from phase one was mainly qualitative and descriptive. Therefore, descriptive tables and texts were the primary formats used to present results in this phase. The 14 attributes identified in literature and SLA documents and described in the literature review were used as the input to the first phase of this research. These attributes were confirmed through interviews with cloud computing providers or experts in order to arrive at the universal set of attributes used as input to the second phase.

Table 4 and Table 5 list the universal set of cloud computing SLA attributes. These were the attributes that cloud computing providers or experts believed should be included in the cloud computing SLA and are the output from phase one of this research. The results are organised as technical and non-technical attributes.

Table 4
Technical cloud computing SLA attributes

Item Number	Technical Attributes
1	Availability
2	Data integrity
3	Confidentiality
4	Network performance
5	Cloud storage
6	Physical security
7	Orchestration
8	Portability
9	General security
10	Reliability

Table 5
Non-technical cloud computing SLA attributes

Item Number	Non-technical Attributes
1	Support response rate
2	Compensation for breaches
3	Definition of attributes
4	Exclusions/limitations
5	Maintenance/emergency
6	Physical location
7	Engineering support
8	SOC audits and reports
9	Features
10	Business continue and data recovery
11	Negotiation and customization

The attributes, listed in Table 4 and Table 5, were confirmed by the experts in phase one of this research.

Quantitative Results – From Phase Two of the Study

The results of the analysis have been presented mainly in a tabular form. Univariate analysis results such as frequency data on the Demographic and Cloud Computing Use component of this research are presented using tables. The results of the descriptive analysis of the research variables are presented in Chapter 4. Other analyses including reliability and validity tests results were produced by the PLS algorithm and presented in Chapter 4.

In addition, Table 6 illustrates the format used to present the results of the hypothesis testing.

Table 6
Format for results of hypotheses testing

Hypotheses	Results
H1: High SLA uncertainty will negatively impact transaction cost	supported/not supported
H2: High SLA asset specificity will negatively impact transaction cost	supported/not supported
H3: High SLA uncertainty will negatively impact the intention to adopt cloud computing	supported/not supported
H4: High SLA asset specificity will positively impact the intention to adopt cloud computing	supported/not supported
H5: High transaction cost will negatively impact the intention to adopt cloud computing	supported/not supported

The results from the quantitative analysis, in phase two, highlighted those attributes that businesses were uncertain about and those that they think should be fully specified in the cloud computing SLA. Table 7 and Table 8 illustrate the format of the results in this regard. The sample instrument in Appendix D shows the type of questions that were asked in the survey relating to the technical and non-technical attributes.

Table 7
SLA technical attributes contribution to uncertainty and specificity

	Results	
SLA Attributes	Contribute to uncertainty?	Contribute to Specificity?
1: Availability	Yes/No	Yes/No
2: Data integrity	Yes/No	Yes/No
3: Confidentiality	Yes/No	Yes/No
4: Network performance	Yes/No	Yes/No
5: Cloud storage	Yes/No	Yes/No
6: Physical security	Yes/No	Yes/No

Table 8
SLA non-technical attributes contribution to uncertainty and specificity

	Results	
SLA Attributes	Contribute to uncertainty?	Contribute to specificity?
1: Support response rate	Yes/No	Yes/No
2: Compensation for breaches	Yes/No	Yes/No
3: Definition of attributes	Yes/No	Yes/No
4: Exclusions/limitations	Yes/No	Yes/No
5: Maintenance/emergency	Yes/No	Yes/No
6: Physical location	Yes/No	Yes/No
7: Engineering support	Yes/No	Yes/No
8: SOC audits and reports	Yes/No	Yes/No

Tables 7 and 8 present results that have answered research questions RQ1.3 and RQ1.4.

Additionally, Square root of average variance extracted (AVE) for each variable, scores plots, and plot of the loadings, were presented to enhance the results of the PLS analysis that have been done and to aid in the test for discriminant validity.

Resource Requirements

The following resources were used to conduct the research:

1. Hardware – laptop, scanner, and printer
2. Software – SPSS, Microsoft suite (Word, Excel, PowerPoint, Visio, Project), SmartPLS, and Adobe Professional
3. People – business executives, business customers of cloud services, CSPs, CSUs
4. SLA documents, SLAs, and other related literature

Summary

A robust approach to this study was necessary for successful completion of this research. The mixed methods research design was used because this methodology was believed to be the most suitable to answer the research questions and test the statistical significance of the hypotheses. The approach also employed the PLS analysis in the QUAN aspect of the study to validate the concept model.

The two phases used in this study were implemented sequentially with both the QUAN and QUAL carrying equal importance. The samples for both phases were carefully selected to ensure that biases were eliminated and that there was a sound framework for analysis. The Instrument was validated to ensure reliable results. The use of statistical software tools such as SmartPLS and SPSS assisted with the quantitative and qualitative analyses of the findings.

Chapter 4

Results

Overview

Two phases were used during the execution of this study. The first phase was a qualitative study and the second phase a quantitative study. The results of both phases of this research are presented in this chapter with details of the qualitative study presented first and then focus on the findings from the quantitative study.

Phase One – The Qualitative Study

The primary objectives of phase one were to: 1) confirm the cloud computing SLA attributes that cloud computing experts believed should be included in the SLA and that should form the premise for phase two of this study; and 2) to determine the cloud computing SLA attributes that cloud computing experts perceived to be of highest importance and that are common in cloud service offerings, thus answering RQ1.1 and RQ1.2. Data was captured as audio notes and then transcribed during the analysis. Thematic and text analyses were used to study the data collected and provided intelligent codes of the main themes discussed in the interviews. For this phase of the study, 13 cloud computing experts were invited to participate. Only 10 cloud computing experts responded positively and participated in the interviews. This resulted in a response rate of approximately 77% which met expectations based on the design of this research.

Analysis of Interviews with Cloud Computing Experts

Thematic analysis was done to extract from the interviews themes that were relevant to cloud computing SLAs. In addition, the original set of attributes that was used in the interviews was coded and ranked using three categories, high (H), medium (M), and low (Low). High means that the expert highly recommended that the attribute be specified in the cloud computing SLA. Medium means that the expert recommended that the attribute be included in the cloud computing SLA, but this recommendation is below the high and above the low category. Medium is the median category between high and low. The low category means that the expert believed the attribute could be included in the SLA, but it is not as important as H and M. Low also means that though the expert believed that the attribute could be included, omitting it should not result in any substantial issues with the cloud computing SLA. Table 9 summarizes the ranks for each attribute based on the analysis of data from the interviews.

Table 9
Distribution of the ranking (H, M, L) of the original cloud computing attributes by experts

Attributes	High (H) %	Medium (M) %	Low (L) %
1. Availability	100	0	0
2. Data integrity	90	10	0
3. Confidentiality	80	20	0
4. Support response rate	40	40	20
5. Compensation for breaches	30	60	10
6. Definition of attributes	30	50	20
7. Exclusion / limitations	20	60	20
8. Network performance	90	0	10
9. Cloud storage	0	50	50
10. Maintenance / emergency	50	40	10
11. Physical security	80	10	10
12. Physical location	50	30	20
13. Engineering support	40	50	10
14. Service Organization Control Audits and Reports – SAS70/SSAE16/compliance/security certification such as ISO 27000	60	30	10

Experts were asked whether there were any other SLA attributes than those in Table 9 that they would suggest for inclusion in the cloud computing SLA. The attributes in Table 10 are those that experts during the interviews said they would include in this study.

Table 10
Attributes that cloud computing experts suggested for inclusion in the SLA

Attributes	Notes
1. Orchestration	Application systems used to manage cloud resources and interactions.
2. Features	Identify the features of the incentives that are given with the cloud service being acquired.
3. Negotiation and Customization	Provisions for the negotiation and customization of specific attributes in the SLA.
4. Business Continuity and Disaster Recovery	SLA attributes relating to the establishment of plans to detail how events such as "acts-of-God", natural or environmental disasters will be treated and dealt with in the best interest of the CSUs.
5. Portability	Attributes that define how Data, infrastructure, and applications can be moved across different cloud brands.
6. Security	This represents general data and network security of the cloud.
7. reliability	This refers to optimum access and use of the cloud service by the customer when the service is available.

Summary of the Findings from the Interviews with Cloud Computing Experts

The main findings from this phase included the following:

1. The cloud computing experts agreed that the study should include the 21 attributes listed in Table 9 and Table 10;
2. Experts want to see SLA attributes that are specific to portability of services across various cloud providers and cloud brands;

3. Experts want to see cloud computing SLA attributes for cloud orchestration where business users will be able to control and manage cloud resources as the business requirements become more elastic.

All the experts gave availability an H. Availability seemed to be the most important attribute for CSPs. This provided the answer to RQ1.1 as availability was the most common attribute among the CSPs. Data integrity, confidentiality, network performance, and physical security were next in line with 80% to 90% of experts giving an H rating for these cloud computing SLA attributes. Also, all the experts rated availability, data integrity, and confidentiality between H and M. This highlights the strong views of the experts that these attributes should be included in the cloud computing SLA.

The data also revealed that 80% to 100% of the experts gave either an H or an M rating for each of the SLA attribute except for cloud storage. 50% of experts gave cloud storage an L. Experts reasoned that while cloud storage is important it may only be relevant for cloud computing services that require storage as part of the service offering. Some also reasoned that cloud storage could be included in the formal contract but not in the SLA document and, if it is included in the SLA it should be a part of the features defined in Table 10.

Cloud Computing Orchestration

Orchestration allows the CSU to dynamically manage the scalability of the cloud infrastructure (Ciovica, Cristescu, & Fratila, 2014). This involves the management of the activities among cloud infrastructures and the business processes that are using them. The orchestrator is a software tool. The Cloud computing orchestration according to experts is relatively new and there is still much work to be done in this area. Cloud computing experts however, believed that providers should develop SLA attributes for orchestration in the cloud.

Using the control panel of a cloud orchestrator, the business user will be able to add or remove resources as its demand for particular service or infrastructure become more elastic. Experts expressed that measurable SLA attributes that will guarantee quality services through user interaction with cloud computing resources should be considered for inclusion in the SLA.

Features

Cloud computing experts are recommending that features associated with cloud offerings be defined in the cloud computing SLA. Features include the incentives of the services that are associated with the primary cloud computing services being acquired. This could include in some instances storage, memory, processor and similar cloud-based resources.

Negotiation and Customization

Some providers believed that SLAs for cloud computing services are fixed for the more popular attributes such as availability and compensation for breaches. Though SLAs are developed by CSPs and it appears that CSUs are asked to take it or leave it, most of the cloud computing experts interviewed believed that there should be some room for negotiation or to customize the SLA. Some CSPs are able to accommodate negotiations that could result in customization of the SLA while others may not. This is dependent on the service offerings. The CSPs also believed that customization could result in the CSU paying a premium for the customized SLA, but they agreed that by facilitating negotiation, increased adoption of the cloud computing services could be achieved.

Business Continuity and Disaster Recovery

Business continuity planning to protect against disruptions in operations is one of the responsibility of the vendor and the business customer procuring cloud computing services (Jarvelainen, 2013). The CSU is depending on the CSP to keep its technology infrastructure operational and available so that its services are reliable. Though Business Continuity and Disaster Recovery Plans may be included in the Audit Report produced by a third party auditing firm, this is not usually made available to CSUs. Experts recommended that SLA attributes for Business Continuity and Disaster Recovery be included in the cloud computing SLA.

Attributes could include the mean time to recover from downtime caused by disasters, commitment to carrying out business continuity and contingency tests and possibly stating the number of times this will be done over a specific period. Experts believed that including contingency planning with the correct intentions could improve the trust between CSP and CSU and ultimately provide the premise on which CSUs may consider rolling out more of their critical applications into the cloud.

Portability

Business enterprises may not necessarily find a single CSP to host all their hardware and software needs. Even if they do, they may want to diversify their cloud computing service options and employ a variety of cloud platforms and CSP offerings. Selecting a cloud provider should not be based on just who the provider is but more on the systems that the enterprise wants to move to the cloud and its overall business requirements. For example, an enterprise may want to use Amazon's Web Services (AWS) for its platform as a service (PaaS) to launch a database application but chose to use Microsoft for its Office 365 running in the cloud. The same business may also choose to use Salesforce.com for its customer relationship management (CRM) function. These are all different cloud offerings and CSP products which are employed by the same enterprise. This prompts the need for interoperability and portability of services between CSPs which has been a concern for cloud computing and its future forecasts (Gupta, Seetharaman, & Raj, 2013). The ability to be able to move business data and applications from one provider to the next in the event that there is catastrophic failure of a provider has been a requirement for business users (Gupta et al., 2013).

Cloud computing experts believed that SLA attributes should be developed for this type of portability across cloud service brands and offerings. This could also improve the adoption of cloud computing, particularly for larger businesses that have critical enterprise systems as a major part of their operations.

Reliability

Cloud providers suggested that cloud computing SLA attributes be developed for reliability. This they believed is important because though a CSP may achieve the level of availability specified in the SLA, the service may not necessarily be reliable. Reliability in this case means that the service is available and the cloud computing user (CSU) is able to access it to perform regular business activities without any bottlenecks. If the service is available but performance is poor or for unforeseen reasons, on the part of the provider, it is inaccessible then it is unreliable. Business users have highlighted reliability as one of the attributes that could hinder adoption of cloud computing and it is especially important for large commercial enterprises (Gupta et al., 2013).

Security

General cloud security seems to be one of the main issues still impacting cloud computing adoption. Cloud computing experts highlighted this as one of the hot topics for business users. The experts believed that other than the attributes for availability, physical security, confidentiality and privacy attributes, a comprehensive set of attributes for data and network security should be developed and included in the cloud computing SLA. Experts outlined that discussions with users and potential users still revealed that one of the major concerns for not wanting to go all the way with cloud computing is discomfort with the level of security in the cloud. They believed that including a comprehensive set of general security attributes in the SLA could increase trust and develop confidence in business users and those who are still thinking about adopting the cloud. This is in line with findings of research focusing on the adoption of cloud computing services by businesses that found security and privacy to be high on the list of factors influencing adoption (Gupta et al. 2013).

Answer to RQ1.1 and RQ1.2

The findings from this research provided the answer to RQ1.1 and RQ1.2 of this study. The list of attributes in Tables 9 and 10 suggest that CSPs and experts believed that these are attributes that are necessary for cloud computing SLAs and could impact the adoption of cloud computing services. All the experts interviewed rated availability of the cloud service as an H. The availability attribute, therefore, seems to be an H on the list for all CSPs. Therefore, in answering RQ1.1, availability seemed to be the attribute that is most common to all CSPs. A total of 21 attributes have resulted from phase one of this study and represent the answer to RQ1.2. Experts believed that these 21 attributes are comprehensive, have a place in the cloud computing SLAs, and could impact how business customers respond to cloud computing services.

Phase Two – The Quantitative Study

Sample Size

According to Marcoulides and Saunders (2006), specifically relating to information systems research, an appropriate sample size when doing PLS path analysis is very important. Accordingly, with a statistical power of 80%, minimum R-squared values of 0.25, a maximum of 3 arrows pointing to a latent variable, and significance level of 5%, a sample size of 59 is believed to be appropriate (Wong, 2013). In addition to the foregoing specifications and including factor loadings of 0.5, the recommended sample size is 78 (Marcoulides & Saunders, 2006). Therefore, the sample size of 96 for this study seemed appropriate based on suggestions from Wong (2013) as well as Marcoulides and Saunders (2006).

Pre-Analysis Data Screening

The pre-analysis data screening activities focused on identifying missing data and checking for multivariate outliers. There were no missing data since SurveyMonkey which was used to collect the responses was designed to screen responses that had missing data. None of the pages in SurveyMonkey was allowed to be saved unless all the questions and related rows had an answer. Also, if all the pages in the survey were not completed, SurveyMonkey labelled the response as ‘INCOMPLETE’. SurveyMonkey showed the responses with missing pages as ‘INCOMPLETE’ and these were not included in the final dataset. Only responses marked ‘COMPLETE’ in SurveyMonkey were included in the final dataset used in the analysis.

Mahalanobis Distance - Multivariate outliers were handled using Mahalanobis Distance. SPSS was used to compute the Mahalanobis distance and determine if there were outliers in the data. Once the distances were computed, the Chi-Square statistic was calculated for each distance and the p-value used to identify the outliers. The outliers were determined by p–value < 0.001. There were no values with p-value < 0.001, therefore, it was determined that there were no outliers in the data.

Analysis of Demographic Data and Cloud Computing Use

The frequency table in Table 11 shows a summary of the demographic and cloud computing use for the responses.

Table 11
Relevant demographic and cloud computing use data from respondents (N = 97)

Demographics		Frequency	Percentage (%)
Industry	Information Technology	25	25.5
	Telecommunications	1	1.0
	Education	11	11.3
	Government	29	29.9
	Services – Logistics and Dist.	3	3.1
	Finance	7	7.2
	Manufacturing	4	4.1
	Transportation	1	1.0
	Other	16	16.5
Company size	1-99	36	37.1
	100-299	16	16.5
	300-499	9	9.3
	500-699	10	10.3
	700+	26	26.8
Cloud services used	SaaS	51	52.6
	PaaS	47	48.5
	IaaS	36	37.1
	None	12	12.4
Reason for use	Agility	50	51.5
	Competitive advantage	29	29.9
	Cost savings	58	59.8
	Data/information sharing	50	51.5
	Performance over in-house	33	34.0
	None of the above	3	3.1
	Other	15	15.5

The frequency table shows that the majority (55.4%) of the responses were received from information technology companies (25.5%) and government organizations (29.9%). This was followed by other (16.5%), education (11.3%) and the finance industry (7.2%). The other industries that responded were comprised of those shown in Table 12 below.

Table 12
Other Industries from which data were received

Industry	Frequency	Percent (%)
Consulting	1	1.0
Energy	1	1.0
Healthcare	2	2.1
Hospitality	2	2.1
Housing industry	1	1.0
Law/Legal Services	3	3.1
Media and Entertainment	1	1.0
Real Estate	2	2.1
Retail	1	1.0
Security	1	1.0
Social Enterprise	1	1.0
Total	16	16.4

Most of the data received came from companies that were of size 1 to 99 (37.1%) and 700 and over (26.8%). 56.2% of the respondents said they either are using, have used or intend to use SaaS. 48.5% said they are using, have used or intend to use PaaS while 37.1% said they have the same experience or intent with IaaS. Only 12.4% said they are not using, never used or have no intention to use any of the cloud computing services. Respondents were allowed to select multiple options in this case since they could be using any combination of the cloud computing services.

When asked about the reason for using or intent to use cloud computing services, most of the respondents said cost savings (59.8%), agility (51.5%), or data/information sharing (51.5%) were the main reasons for using or wanting to use cloud computing. 34.0% of the respondents said they use, have used, or intent to use cloud computing services because of expected performance over in-house systems. Another 29.9% used, have used or intend to use these services for competitive advantage. There were also another 15.5% who said they used, have used, or intend to use cloud computing services for other reasons listed in Table 13 below. Accordingly, some respondents highlighted their intended reason for using cloud computing services as availability and security (5.2%), convenience (3.1%) and for mixed reasons shown in Table 13.

Table 13
Other reasons for using cloud computing services

Reason for using cloud services	Frequency	Percent (%)
Business Continuity Planning	1	1.0
Convenience	3	3.1
Data Backup/Recovery	2	2.1
Data Availability, Security and Redundancy	5	5.2
Ease of administration	1	1.0
Flexibility and scalability	2	2.1
Risk Migration	1	1.0
Total	15	15.5

The demographic and cloud use data also revealed that 50.5% of the respondents said they were using some form of cloud computing in their company or organization and that they were certain that they will continue to use the service. Another 22.7% of respondents said that they were not currently using any form of cloud computing services but they intend to do so in the future. 10.3% said they were using cloud computing services now but they were not sure they will continue to use them in the future. In addition, another 12.4% said that they have used cloud computing services in the past, but they were not currently using any such services, while there were another 4.1% who were currently not using cloud computing and believed that they will not use it in the future.

The Partial Least Squares Model

The latent variables used to define the model in SmartPLS are shown in Table 14 below.

Table 14
List of constructs and latent (unobserved) variables

Constructs	Variable Name
SLA uncertainty	SU
Non-technical uncertainty	NU
Technical uncertainty	TU
SLA asset specificity	SS
Non-technical asset specificity	NS
Technical asset specificity	TS
Transaction cost	TC
Intention to adopt	IA

The cloud computing SLA questions in the survey instrument were grouped into seven sections namely: 1 – SLA Uncertainty; 2 – SLA Specificity; 3 – SLA Uncertainty and Transaction Cost; 4 – SLA Specificity and Transaction Cost; 5 – SLA Uncertainty and Adoption; 6 – SLA Specificity and Adoption; and 7) questions for the four main constructs. All of the variables in Table 15 below were tested in each of these sections. Therefore, the nomenclature of variable names has a two-letter suffix to represent variables for corresponding sections. For example, t_ava_su represents availability which is a technical SLA attribute for SLA uncertainty while t_ava_ss represent the availability attribute but a response to the question asking whether availability should be specified in the SLA in relation to SLA specificity. Details of these variables are shown in Appendix F.

Table 15
Nomenclature of indicator variables used during analysis

	Attributes or Variables	Variable Name
1	Availability	t_ava
2	Integrity	t_int
3	Confidentiality	t_conf
4	Support response	n_sup
5	Compensation for breaches	n_comp
6	Definition of attributes	n_def
7	Exclusions/limitations	n_exc
8	Network performance	t_perf
9	Cloud storage	t_sto
10	Maintenance/emergency	n_mtn
11	Physical security	t_psec
12	Physical location	n_loc
13	Engineering support	n_eng
14	Information security audits	n_soc
15	Orchestration	t_orch
16	Features	n_fea
17	Negotiation and customization	n_neg
18	Business continuity and DR	n_bc
19	Portability	t_port
20	General security	t_gsec
21	Reliability	t_rel

The model depicted in Figure 7 shows the conceptual framework constructed in the SmartPls application.

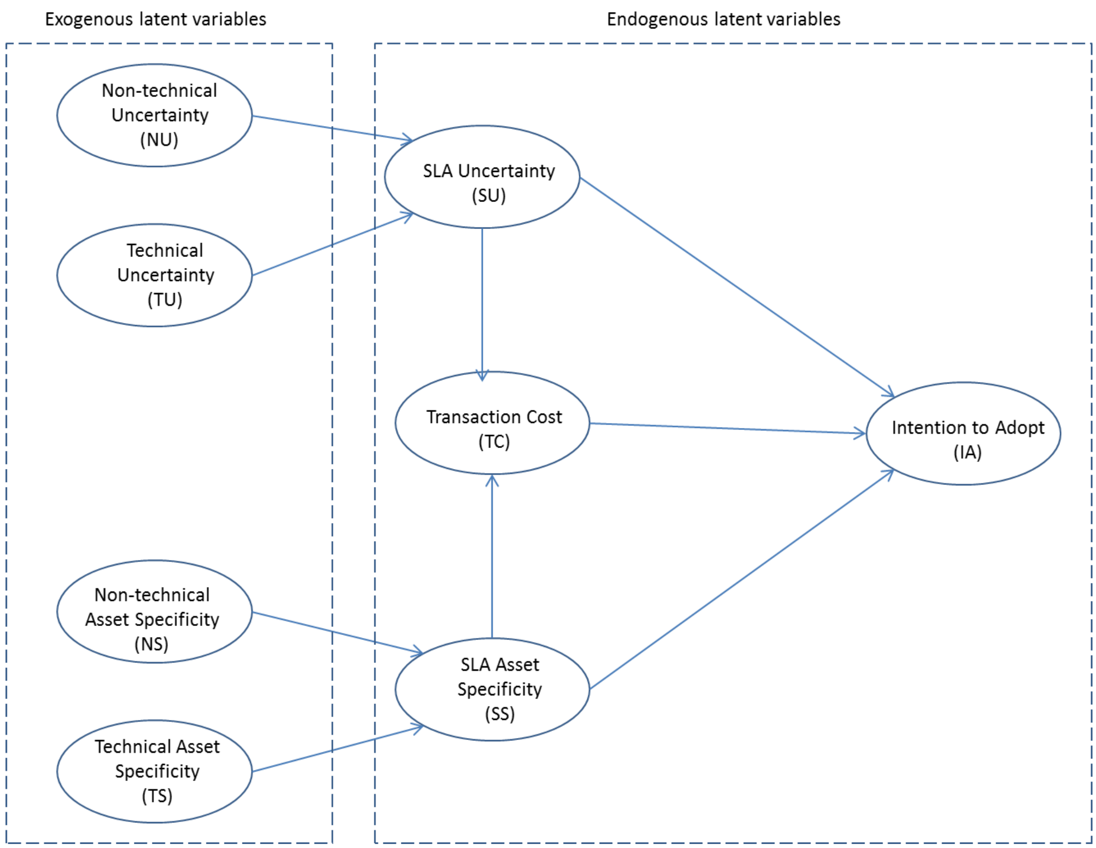

Figure 7. Inner structural model of the conceptual framework

There are eight latent variables representing the constructs in Figure 7. The model shows the exogenous latent variables as non-technical uncertainty (NU), technical uncertainty (TU), non-technical asset specificity (NS), and technical asset specificity (TS). The indicators for uncertainty and asset specificity latent variables are those with “su” and “ss” suffixes in Appendix F. The endogenous latent variables are SLA uncertainty (SU), transaction cost (TC), SLA asset specificity (SS), and intention to adopt (IA). Indicators for these endogenous latent variables are those with “cu”, “cs”, “au”, and “as” suffixes and “u”, “s”, “c” and “a” shown in Appendix F.

Partial Least Squares Structural Equation Modelling (PLS-SEM) Output

The final model from SmartPLS is shown in Figure 8 below. This shows the structural path model for the intention to adopt cloud computing.

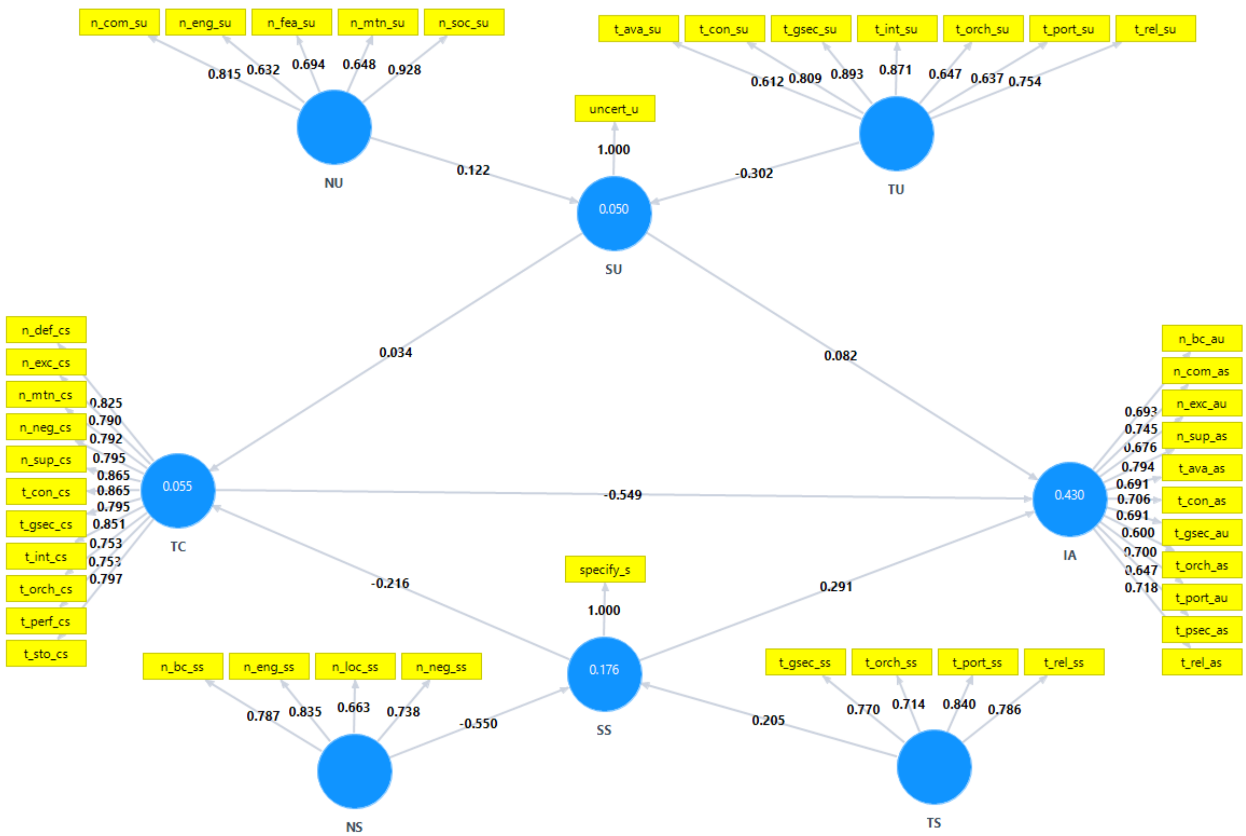

Figure 8. Final Model from SmartPLS

Figure 8 shows the indicator variables that made it into the model and that contributed to the constructs. This model also provided the answers to the research questions RQ1.3 and RQ1.4. Tables 16 and 17 list the attributes that contribute to SLA uncertainty and SLA asset specificity for cloud computing.

Table 16
The attributes that contribute to SLA uncertainty for cloud computing

SLA Attribute	Indicator	Attribute Class
Compensation for breaches	n_com_su	Non-technical
Engineering support	n_eng_su	Non-technical
Features	n_fea_su	Non-technical
Maintenance/emergency	n_mtn_su	Non-technical
Information systems audits	n_soc_su	Non-technical
Availability	t_ava_su	Technical
Confidentiality	t_con_su	Technical
General security	t_gsec_su	Technical
Data integrity	t_int_su	Technical
Orchestration	t_orch_su	Technical
Portability	t_port_su	Technical
Reliability	t_rel_su	Technical

Table 17
The attributes that contribute to SLA asset specificity for cloud computing

SLA Attribute	Indicator	Attribute Class
Business continuity planning	n_bc_ss	Non-technical
Engineering Support	n_eng_ss	Non-technical
Physical location	n_loc_ss	Non-technical
Negotiation/customization	n_neg_ss	Non-technical
General security	t_gsec_ss	Technical
Orchestration	t_orch_ss	Technical
Portability	t_port_ss	Technical
Reliability	t_rel_ss	Technical

The answer to RQ1.5 and RQ1.6 can be deduced from Table 19 showing the correlation values between the latent variables below in the discriminant validity section. The extent of any challenge or difficulty in understanding or using the cloud computing SLA was used as a proxy for transaction cost in this study. The correlation coefficient between SU and TC is 0.146 (or 14.6%) which reflects a very weak relationship between the two variables. This suggests that there is very little impact of SLA uncertainty on transaction cost (RQ1.5). The path coefficient for SU → TC (0.034) also supports this result. Similarly, the correlation coefficient between SS and TC is -0.233 (or 23.3%) which suggests that there is a weak relationship between the two latent variables. Therefore, SLA asset specificity has an impact on transaction cost (RQ1.6) however, this impact is not strong. The path coefficient for SS → TC (-0.216) also supports this answer which implies that specificity has a negative impact on transaction cost. Figure 9, gives a summary of the model showing path coefficients and R^2 values for the inner model latent variables.

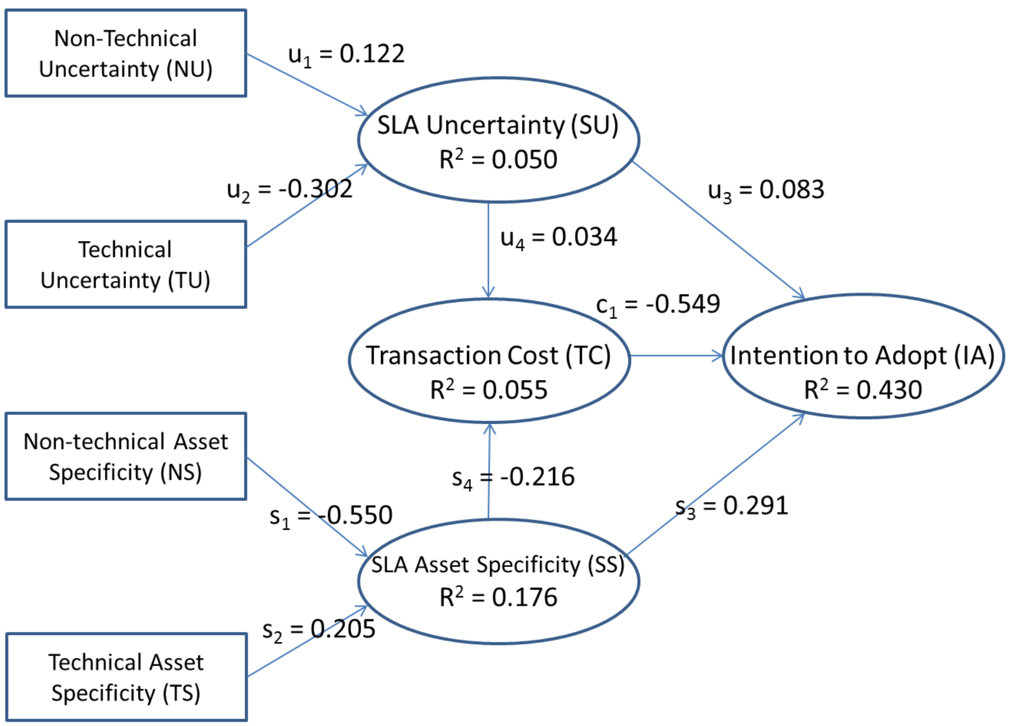

Figure 9. Path coefficients and R^2 values for inner model latent variables

Target Endogenous Variable Variance

By examining the final model depicted in Figure 8, it can be seen that the coefficient of determination, R^2, is 0.430 for the IA endogenous latent variable. This means that the three latent variables (SU, SS, and TC) moderately explained 43.0% of the variance in IA. SU and SS together explained 5.5% of the variance in TC. By observing the model it can also be seen that only 5.0% of the variance in SU is explained by NU and TU, while a low of 17.6% of the variance in SS is explained by NS and TS combined.

Inner model Path coefficient Sizes and Significance

The inner model suggests that TC has the strongest effect on IA (-0.549) followed by SS (0.291) and SU (0.082). The direction of the effect of TC on IA showing – 0.549 is an inverse effect which implies that higher TC could result in lower rate of IA. This, therefore, suggests that the hypothesized path relationship between TC and IA (H5) is statistically significant. The hypothesized path relationship between SS and IA (H4) is also statistically significant with the standardized path coefficient of SS (0.291) greater than 0.2 (Wong, 2013). This implies that the path relationship between SU and IA (H3) is not statistically significant. It also indicates that SS has a stronger effect on TC (-0.216), than SU (0.034) on TC. Based on the magnitude of the path coefficient for the SS and TC link (-0.216), this path (H2) is also statistically significant. However, the path linking SU and TC (0.034) (H1) is not statistically significant (path coefficient 0.034 < 0.2). The model further suggests that TU (-0.302) has a stronger effect on SU than NU (0.122) and NS (-0.550) has a stronger effect on SS than TS (0.205).

Outer Model Loadings and Significance (outer model loadings)

The outer model loadings are shown in Table 18. All the loadings are equal to or greater than 0.600 and are statistically significant in the model. A stable estimation was reached as the PLS Algorithm converged at 6 iterations before reaching the maximum number of iterations of 300 set in SmartPLS. This suggests that the model estimation is good (Wong, 2013).

Reliability and Validity

In examining the structural model the reliability and validity of the latent variables were also determined. Indicator reliability and internal consistency reliability were examined to check the reliability of the latent variables. Convergent validity and discriminant validity were evaluated to determine validity of the latent variables. The SmartPLS software provided the details needed to determine reliability and validity in all aspects of the model. Table 18 gives a summary of the descriptive measures of the outer model.

Indicator Reliability

Indicator reliability is the square of the loadings for each indicator. As shown in Table 18), all the individual indicator reliability values (when rounded up to one decimal place) are greater than or equal to the minimum 0.4 (Wong, 2013). Therefore, the data met the requirement for indicator reliability.

Table 18
Descriptive Measures of the Outer Model (Outer Model Loadings)

Latent Variable	Indicators	Loadings	Indicator Reliability (Loadings^2)	Composite Reliability	Cronbach's Alpha	AVE
	n_com_su	0.815	0.664			
	n_eng_su	0.632	0.399			
NU	n_fea_su	0.694	0.482	0.864	0.851	0.565
	n_mtn_su	0.648	0.420			
	n_soc_su	0.928	0.861			
	t_ava_su	0.612	0.375			
	t_con_su	0.809	0.654			
	t_gsec_su	0.893	0.797			
TU	t_int_su	0.871	0.759	0.900	0.890	0.568
	t_orch_su	0.647	0.419			
	t_port_su	0.637	0.406			
	t_rel_su	0.754	0.569			
	n_bc_ss	0.787	0.619			
NS	n_eng_ss	0.835	0.697	0.843	0.756	0.575
	n_loc_ss	0.663	0.440			
	n_neg_ss	0.738	0.545			
	n_gsec_ss	0.770	0.593			
TS	n_orch_ss	0.714	0.510	0.860	0.804	0.607
	n_port_ss	0.840	0.706			
	n_rel_ss	0.786	0.618			
SU	uncert_u	1.000	1.000	1.00	-	1.00
SS	specify_s	1.000	1.000	1.00	-	1.00
	n_def_cs	0.825	0.681			
	n_exc_cs	0.790	0.624			
	n_mtn_cs	0.792	0.627			
	n_neg_cs	0.795	0.632			
TC	n_sup_cs	0.865	0.748	0.954	0.947	0.653

Latent Variable	Indicators	Loadings	Indicator Reliability (Loadings^2)	Composite Reliability	Cronbach's Alpha	AVE
	t_con_cs	0.865	0.748			
	t_gsec_cs	0.795	0.632			
	t_int_cs	0.851	0.724			
	t_orch_cs	0.753	0.567			
	t_perf_cs	0.753	0.567			
	t_sto_cs	0.797	0.635			
	n_bc_au	0.693	0.480			
	n_com_as	0.745	0.555			
	n_exc_au	0.676	0.457			
	n_sup_as	0.794	0.630			
	t_ava_as	0.691	0.477			
IA	t_con_as	0.706	0.498	0.912	0.984	0.487
	t_gsec_au	0.691	0.477			
	t_orch_as	0.600	0.360			
	t_port_au	0.700	0.490			
	t_psec_as	0.647	0.419			
	t_rel_as	0.718	0.516			

Internal Consistency Reliability

Cronbach's Alpha and composite reliability values from SmartPLS were used to measure the internal consistency reliability of the structural model. As shown in Table 18, both the alpha values and composite reliability values exceeded the 0.7 minimum. Therefore, high levels of internal consistency reliability have been confirmed among all the latent variables.

Convergent Validity

Using Table 18, it can be seen that the Average Variance Extracted (AVE) for each latent variable has been found to be equal to or greater than the minimum acceptable value of 0.5 (Wong, 2013). This suggests that convergent validity of the latent variables is confirmed.

Discriminant Validity

The Fornell and Larcker (1981) criterion for examining determinant validity was used by SmartPLS. The square root of the AVE values for each latent variable was taken and presented in Table 20 below. According to Wong (2013) in application of the Fornell-Larcker principle, if the computed value is greater than the other correlation values among the latent variables, then discriminant validity would have been demonstrated. The correlation among the latent variables were reported by SmartPLS and shown in Table 19 below.

Table 19
Correlation Values among the Latent Variables

	IA	NS	NU	SS	SU	TC	TS	TU
IA	**1.000**							
NS	-0.453	**1.000**						
NU	-0.036	-0.060	**1.000**					
SS	0.377	-0.396	0.085	**1.000**				
SU	0.149	0.274	-0.109	-0.519	**1.000**			
TC	-0.605	0.297	0.145	-0.233	0.146	**1.000**		
TS	-0.422	0.748	-0.050	-0.206	0.186	-0.359	**1.000**	
TU	0.063	-0.049	0.764	0.137	-0.209	0.029	-0.054	**1.000**

The discriminant validity report from SmartPLS shows the square root of the AVEs and has been represented in Tables 20 below.

Table 20
Square Root of AVE and the Correlation Values among the Latent Variables

	IA	NS	NU	SS	SU	TC	TS	TU
IA	**0.698**							
NS	-0.453	**0.759**						
NU	-0.036	-0.060	**0.752**					
SS	0.377	-0.396	0.085	**1.000**				
SU	0.149	0.274	-0.109	-0.519	**1.000**			
TC	-0.605	0.297	0.145	-0.233	0.146	**0.808**		
TS	-0.422	0.748	-0.050	-0.206	0.186	-0.359	**0.779**	
TU	0.063	-0.049	0.764	0.137	-0.209	0.029	-0.054	**0.754**

By examining Table 20, the square root of the AVE values recorded for IA (0.698), NS (0.759), SS (1.000), SU (1.000), TC (0.808), TS (0.779), and TU (0.754), it can be seen that these values are larger than or equal to the other values in their corresponding rows and columns (when rounded up to one place of decimal). It can, therefore, be inferred that discriminant validity is demonstrated by the latent variables.

Structural Path Significance in Bootstrapping

The Bootstrapping algorithm in SmartPLS was used to compute t-statistics for significance testing of the inner and outer model of the structural paths. According to Wong (2013), the bootstrapping procedure in SmartPLS estimates the normality of the data during execution. The two-tailed t-test with a significance level of 5% was used to compute the t-statistics for the structural paths. For significance level of 5%, the path coefficient will be statistically significant if the t-statistic is larger than 1.96. If the significance level is 10%, then the path coefficient will be significant for t-statistics greater than 1.65. Table 21 shows the t-statistics for the structural paths in the model.

Table 21
T-Statistics of Path Coefficients (Inner Model)

Path	T-Statistics
NU → SU	1.115
TU → SU	*2.418***
NS → SS	*3.244****
TS → SS	*1.902**
SU → TC	0.455
SS → TC	*1.679**
SU → IA	1.295
SS → IA	*3.226****
TC → IA	*7.944*****

*p –value < 0.1; **p-value < 0.05; ***p-value < 0.01; ****p-value < 0.001

The results in Table 21 shows that the TU → SU (2.418), NS → SS (3.244), TS → SS (1.902), SS → TC (1.679), SS → IA (3.226), and TC → IA (7.944) paths are statistically significant. This suggests that the hypothesized paths SS → IA (3.226) (H4) and TC → IA (7.944) (H5) are statistically significant at least at the 0.05 significance level, while SS → TC (1.679) (H2) is significant at the 0.1 level. The hypothesized paths SU → TC (0.455) (H1) and

SU → IA (1.295) (H3) are not statistically significant neither at the 90% confidence level (t-value > 1.645 and p-value < 0.1) nor 95% confidence level (t-value > 1.96 and p-value < 0.05).

Table 22
T-Statistics of Outer Model Loadings

	NU	TU	NS	TS	SU	SS	TC	IA
n_com_su	3.631							
n_eng_su	2.737							
n_fea_su	3.110							
n_mtn_su	2.893							
n_soc_su	3.808							
t_ava_su		3.183						
t_con_su		4.336						
t_gsec_su		4.706						
t_int_su		4.631						
t_orch_su		3.332						
t_port_su		3.605						
t_rel_su		3.760						
n_bc_ss			7.645					
n_eng_ss			12.180					
n_loc_ss			5.773					
n_neg_ss			6.133					
n_gsec_ss				3.873				
n_orch_ss				3.874				
n_port_ss				5.297				
n_rel_ss				3.960				
uncert_u					-			
specify_s						-		
n_def_cs							12.966	
n_exc_cs							10.781	
n_mtn_cs							10.807	
n_neg_cs							22.241	
n_sup_cs							38.250	
t_con_cs							38.511	
t_gsec_cs							12.440	
t_int_cs							23.368	
t_orch_cs							10.128	
t_perf_cs							9.005	
t_sto_cs							16.645	
n_bc_au								10.169
n_com_as								13.113
n_exc_au								9.723
n_sup_as								13.100
t_ava_as								8.839
t_con_as								8.871

	NU	TU	NS	TS	SU	SS	TC	IA
t_gsec_au								10.449
t_orch_as								5.129
t_port_au								10.843
t_psec_as								8.068
t_rel_as								12.383

The t-statistics presented in Table 22 shows that all the t-values are greater than 1.96. This suggests that the outer model loadings are highly statistically significant at the 0.05 significance level.

Collinearity among Indicators

According to Wong (2013), multicollinearity evaluation helps to determine whether exogenous latent variables have issues with collinearity. They highlighted that by assessing the collinearity of the latent variables, a determination of whether variables should be eliminated, combined into one, or to develop higher order latent variables can be done. Ringle, Wende, and Becker (2015). SmartPLS 3.2.0 provides the variance inflation factor (VIF) or collinearity statistic to assist in the assessment of multicollinearity. The collinearity values from the report produced by SmartPLS are shown in Table 23.

Table 23
Collinearity of Latent Variables

	IA	NS	NU	SS	SU	TC	TS	TU
IA								
NS				2.270				
NU					2.403			
SS	1.418					1.368		
SU	1.369					1.368		
TC	1.059							
TS				2.270				
TU					2.403			

According to Wong (2013), collinearity problems exist in the latent variables if the VIF value is larger than 5 or less than 0.2. As shown in Table 23 above, all the values are less than 5 and greater than 0.2. Therefore, there were no collinearity problems with the latent variables in the model.

Discussion of the Findings

The findings from this study provided the answer to the research questions and helped to determine whether to support or not support the hypotheses. The final results for the hypotheses are shown in Table 24 below.

Table 24
Results of hypothesis testing

Hypotheses	Results
H1: High SLA uncertainty will negatively impact transaction cost	Not Supported
H2: High SLA asset specificity will negatively impact transaction cost	Supported
H3: High SLA uncertainty will negatively impact the intention to adopt cloud computing	Not Supported
H4: High SLA asset specificity will positively impact the intention to adopt cloud computing	Supported
H5: High transaction cost will negatively impact the intention to adopt cloud computing	Supported

The findings suggest that SLA uncertainty has very little impact or has only little effect on transaction cost neither does it present any serious threats to the intention to adopt cloud computing (H1 & H3). This may be due to the fact that some companies just simply accept the SLA as presented to them when they are about to acquire the service. The data shows that there is little or no concern by business users about the non-technical SLA uncertainties (NU → SU has low path coefficient = 0.122 and t-value = 1.115). However, this is not the case for the technical SLA uncertainties. The data suggest that there is concern about the technical SLA uncertainties as TU → SU has path coefficient of -0.302 and t-value of 2.418 reflecting statistical significance at the 95% confidence level (t-value > 1.96 and p-value < 0.05). SLA asset specificity, however, seems to have some impact on transaction cost (H2) and will influence the intention to adopt cloud computing services (H4). Transaction cost will also have an impact on the intention to adopt cloud computing (H5).

While there is no known research using transaction cost economics and PLS to conduct a similar study focusing on cloud computing, this research confirmed some of the principles surrounding transaction cost economics. Williamson (1981, 1985) defined site specificity, physical asset specificity, and human asset specificity as the three types of asset specificity for transaction cost economics. Relative to cloud computing, this study demonstrated that SLA asset specificity has a significant impact on transaction cost. Williamson (1981) argued that transaction cost is less where there exists less asset specificity, suggesting that there is a relationship between transaction cost and asset specificity. Williamson (1981) also theorized that as assets become more specific the transaction cost increases as service agreements become more necessary. H2 of this study supports this argument.

Aubert et al. (1996) found that uncertainty could give rise to increase difficulty and cost to manage contracts associated with bounded rationality. While this study found some relationship between SLA uncertainty and transaction cost (H1), the effect was small (t-value = 0.455 for SU → TC) or the correlation was very weak for the path SU → TC (0.146 or 14.6%).

This study also provided an answer to RQ1.0. Table 25 shows the list of attributes produced by SmartPLS that provided the solution to this question. There were 11 discrete attributes that seemed to influence the adoption of cloud computing services (see Table 25 below). These attributes may also be identified on the IA latent variable in Figure 8, shown earlier in this chapter.

Table 25
Attributes of cloud computing SLAs that influence business adoption of cloud computing

SLA Attribute	Attribute Class
Business continuity planning	Non-technical
Compensation for breaches	Non-technical
Exclusion/limitation	Non-technical
Support response rate	Non-technical
Availability	Technical
Confidentiality	Technical
General security	Technical
Orchestration	Technical
Portability	Technical
Physical security	Technical
Reliability	Technical

According to the model in Figure 8, though SLA uncertainty on a whole shows only little effect on intention to adopt (SU → IA has path coefficient = 0.083 t-value = 1.295), uncertainty in business continuity and disaster recovery, exclusion, general security, and portability will influence the intention to adopt cloud computing services. Attention should, therefore, be placed on these areas of uncertainty as they could have some effect on intention to adopt cloud computing. The data also suggest that the specification of compensation for breaches, support response rate, availability, confidentiality, orchestration, physical security, and reliability will also influence how business customers adopt to cloud computing services. Overall, of the 11 attributes that have been determined by the model to have significant impact on the intention to adopt cloud computing, only 4 of them were from SLA uncertainty and 7 were from SLA specificity (see Table 25 & Figure 8). Also, 4 were non-technical and 7 were technical attributes (see Table 25 & Figure 8).

Model Fit and Goodness of the Model

Tenenhaus, Vinzi, Chatelin, and Lauro (2005) suggested the use of communality, redundancy and goodness of fit (GoF) as global fit measures to validate the quality of a PLS structural model. Wetssels, Odekerken-Schröder, and Van-Oppen (2009) also recommended the use of communality and GoF. The model fit for the structure described in this study will be discussed using Cohen (1988) effect size index and Tenenhaus et al. (2005) communality and GoF measure for PLS path modelling. Both approaches will be using the AVE and R^2 to determine effect size and model-data fit.

Cohen (1988) classified effect size as small, medium and large. He highlighted that the proportion of total variance accounted for by group membership (or R^2) may be used as one of the methods to determine the effect size. Cohen used the variable 'f' to represent the effect size. According to Cohen, a small effect size occur at a minimum of $f = 0.10$; a medium effect size at $f = 0.25$; a large effect size at $f = 0.40$. Relative to these f indices, Wetssels et al. (2009) emphasized Cohen's effect size f as being equivalent to R^2 of 0.02 for small effect, 0.13 for medium effect, and 0.26 for large effect. Based on these recommendations to assess the effect size of the constructs, SLA uncertainty (SU) has small effect on the model ($R^2 = 0.050$; $0.02 < R^2 < 0.13$), SLA asset specificity (SS) has a medium effect on the model ($R^2 = 0.176$; $0.13 < R^2 < 0.26$), transaction cost (TC) has a small effect on the model ($R^2 = 0.050$; $0.02 < R^2 < 0.13$), and all of these contribute to intention to adopt (IA) with a large effect on the model ($R^2 = 0.430$; $R^2 > 0.26$). Therefore, based on the effect size determined by the R^2 values, there is a large model-data fit for the overall structural model presented by this research.

Tenenhaus et al. (2005) as well as Wetssels et al. (2009) used the communality and GoF to determine global fit for the PLS model. According to Wetssels et al. communality is equivalent to the AVE in PLS and is assumed an average of 0.5 (Fornell and Larcker, 1981) for good fit. The structural model shown in Figure 8 exhibits an AVE of at least 0.5 for all the endogenous latent variables SU, SS, TC, and IA. Using communality and AVE, the overall structural model presented in this research demonstrated model-data fit.

In addition, Tenenhaus et al. (2005) as well as Wetssels et al. (2009) theorised that GoF is equivalent to the square root of the product of the average AVE of 0.5 proposed by Fornell and Larcker (1981) and the average R^2 for the model. This results in a GoF for the model of 0.626. According to Wetssels et al. the effect of the GoF can be classified as small (GoF = 0.1), medium (GoF = 0.25), and large (GoF = 0.36). The GoF measure (GoF = 0.626; GoF > 0.36) for the structure presented by this research demonstrates that the PLS model is validated globally with a very large effect for the goodness of model-data fit.

The communality (AVE), R^2 fit, and the GoF value confirmed that the model performs very well in relation to the benchmarked effect size and measures proposed by Cohen (1988), Tenenhaus et al. (2005) as well as Wetssels et al. (2009). There is goodness of fit for the overall structural model presented by this research.

Summary

This chapter reports the results and findings of the analysis of the data collected in the qualitative and quantitative studies of this research. It also provided answers to the primary research question (RQ1.0), the six sub-questions (RQ1.1 to RQ1.6), and decisions about the five hypotheses (H1 to H5). All the research questions and hypotheses were addressed within this chapter and the results may be referenced in the preceding sections.

In the qualitative analysis, the answers to RQ1.1 and RQ1.2 were provided. The analysis of the qualitative data revealed that the availability attribute was highly rated by 100% of the experts interviewed. This suggests that this attribute is the one that is most common to CSPs. This confirms what is currently seen in literature and working cloud computing SLA documents where availability is seen as the basis for many cloud computing service agreements and contracts. The qualitative study also provided the final set of attributes that were used as the basis for the quantitative phase two of this study.

The main tools used to perform the quantitative analysis were SPSS and SmartPLS. SPSS was used to compute the Mahalanobis Distance to determine outliers during pre-analysis and to perform the analysis on the demographic and cloud use component of this study. SmartPLS was used to execute the analysis relating to the model fit.

The analysis presented the answers to the research questions and provided the decision on whether the hypotheses are to be supported. Two of the hypotheses (H1 & H3) were not supported based on the results from the t-statistics produced by SmartPLS. The other three hypotheses (H2, H4, & H5) were supported based on the t-values from the SmartPLS report. H2 was statistically significant, p-value < 0.1, and H4 and H5 statistically significant at the 95% confidence interval (p-value < 0.05). The PLS results showed that there were 12 attributes that contributed to SLA uncertainty (RQ1.3), 8 attributes that contributed to SLA asset specificity (RQ1.4), and 11 attributes that have been determined to influence the intention to adopt cloud computing (RQ1.0). Table 16 and Table 17 give a list of the attributes that answered both RQ1.3 and RQ1.4.

This chapter also determined that SLA uncertainty has very little impact on transaction cost (RQ1.5 & H1) as the path between SU and TC in the model is not significant (t-value = 0.455, path coefficient = 0.034). However, SLA asset specificity will impact transaction cost (RQ1.6 & H2), as the path between SS and TC (t-value = 1.679, path coefficient = -0.216, p-value < 0.1) is statistically significant at the 90% confidence level.

Chapter 5

Conclusions, Implications, Recommendations, and Summary

Conclusions

The primary goal of this study was to apply the theoretical concept of transaction cost economics to determine the SLA attributes that are influencing the adoption of cloud computing. These attributes were not intended to be actual KPIs or metrics for the cloud computing SLAs, but were instead high level categories for which relevant KPIs can be identified. To meet the objectives defined by this study and to answer the research questions associated with this research, a two-phased approach was employed. The first phase used a qualitative study to identify and confirm cloud computing SLA attributes and to determine how CSPs feel about the attributes that will be examined in this research. The output from the qualitative study provided the input to the quantitative study in phase two. There were 21 attributes that came out of the first phase that were used to develop an online survey instrument to obtain the perspective from the business community about their inclusion in the cloud computing SLA. Respondents from businesses and organizations were asked to rate their views on a 7-point Likert-type scale regarding uncertainties and difficulties surrounding the specification and adoption of the attributes in the cloud computing SLA.

The main research question RQ1.0 asked: What are the attributes of cloud computing SLAs that influence business adoption of cloud computing? The answer to this question was presented in the previous chapter. The 11 attributes that seemed to be influencing business adoption of cloud computing include business continuity and disaster recovery, exclusion and limitations, general security, portability, compensation for breaches, support response rate, availability, confidentiality, orchestration, physical security, and reliability. The data revealed that in some instances the influence is based on uncertainties about the attributes in the SLA which means that respondents are not clear or have doubts about some of the attributes. On the other hand, some of the attributes relating to the answer to this question have to do with their specificity in the SLA. From an uncertainty perspective respondents thought that business continuity and disaster recovery, exclusion, general security, and portability are not clear or there are doubts about them and hence this could influence the intention to adopt cloud computing services. From a specificity perspective, the data suggest that the specification of compensation for breaches, support response rate, availability, confidentiality, orchestration, physical security, and reliability will also influence how business customers adopt to cloud computing services. Examining the answer to this research question also revealed that businesses are still concerned about the general security of the cloud and this is clearly one of the attributes that could further influence the adoption of cloud computing.

The hypothetical paths defined in the model were also evaluated to determine whether they were statistically significant and to decide whether to support or not support the hypotheses (H1 to H5). It was determined by this study that there is a relationship between SLA asset specificity and transaction cost which led to the conclusion that SLA asset specificity has an impact on transaction cost (RQ1.6). However, there is only a small relationship between SLA uncertainty and transaction cost (RQ1.5 & H1). The relationship between SLA uncertainty and intention to adopt cloud computing (H3) was also not significant and hence H3 was not supported. SLAs are mostly developed by the providers and presented to the users for their acceptance. The findings seem to suggest that business users are willing to accept cloud computing without too much concern about the uncertainties in the SLAs. By extension, users are also ready to use the cloud computing services even if they do not understand fully some of the attributes that are specified in the SLA.

It was also revealed that H2, H4, and H5 were supported by the model. This suggests that business users want more specificity for the cloud computing SLA. It seems that these users are also willing to accept the transaction cost involved with more specificity in the SLA. The data also showed that business users are more willing to adopt cloud computing when the attributes are clearly specified in the SLA.

The final analysis of this study showed that intention to adopt cloud computing is highly correlated with transaction cost and asset specificity. However, transaction cost has a higher impact on intention to adopt cloud computing services. It was also revealed that the model fits well with variables used (R^2 = 0.430, GoF = 0.626, communality or AVE = 0.5). This suggests that at least 43.0% of the variance in intention to adopt cloud computing services can be explained by SLA uncertainty, SLA asset specificity, and transaction cost. It may, therefore, be inferred that the conceptual framework using transaction cost economics is a good model to study the intention to adopt cloud computing.

Implications of this Study

As cloud computing continues to develop, the issues surrounding its use could influence business adoption. Besides the highly exposed concerns about information security in the cloud, the challenges with cloud computing SLAs continue to be a major discussion among the business environment. Meaningful and relevant SLAs for cloud computing services could help foster trust and improve relationship with business consumers and providers. This could move the cloud to the next level where more businesses are confident in migrating core and critical applications to the cloud.

This study focused on SLA attributes that could help streamline and standardize the contents of cloud computing SLAs. As the effort to arrive at a methodology to standardize cloud computing SLAs continues, the results of this study could contribute to the initiatives that will be executed. This research, therefore, has substantial implications to the project currently being executed by the National Institute of Standards and Technology (NIST) to propose metrics for cloud computing services.

Pertaining to the knowledge base for cloud computing SLAs, this study provided a new perspective for studying the influence of cloud computing SLAs on the intention to adopt cloud computing services. The application of transaction cost economics now allows researchers to view the intention to adopt cloud computing by looking at the uncertainties that exists within the SLA, how much is specified in the SLA and overall costs surrounding the execution and use of the SLA during the life cycle of the agreement. Though uncertainties seem to have little effect on intention to adopt cloud computing in this study, there are still at least 12 attributes that business customers seem to need clarity or have doubts about. Therefore, in the context of this study the data is showing that it is important to address this area of concern.

Overall, this study should add to the knowledge base for cloud computing and SLAs. It should aid in the development of standards for cloud computing SLAs and provide the basis for which metrics and KPIs can be developed to help monitor service agreements for cloud computing services. It is also expected that the results of this study will help to develop more meaningful cloud computing SLAs to foster greater adoption of cloud computing, in particular businesses moving more of their critical applications to the cloud.

Recommendations for Future Research

There is much latitude for future research in this area. In this study, the conceptual model was validated qualitatively using an expert panel and then quantitatively using a survey methodology. Future studies could apply the model to study cloud computing adoption in different contexts or seek to extend the initial model. In addition, further research could look at applying the covariance SEM technique in the analysis to assess whether a similar fit would result. Further studies could also focus on developing KPIs and metrics for the attributes that have been identified in this study and obtain the perspectives of business users on these metrics in a quantitative study similar to this research. This should help with the generalizability of the model and assist in taking cloud computing closer to SLA standardization.

Summary

This research is a preliminary step to determine cloud computing SLA attributes that could help build trust and commence work towards standardizing SLAs for cloud computing. It is further anticipated that the results of this research will help both the provider and the business consumer to better understand each other and reduce the uncertainties that exist in cloud computing SLAs. It should also provide a guide to businesses thinking about using cloud computing services of attributes that could be specified in SLAs when negotiating with CSPs. Furthermore, this study provides results that should help to foster greater adoption and use of cloud computing services through more meaningful cloud computing SLAs.

This study used a conceptual model to build on transaction cost economics to examine constructs that could influence business use of cloud computing. It introduced SLA uncertainty and SLA asset specificity as two of the main constructs in the initial model presented. These two constructs together with transaction cost provided the basis for intention to adopt cloud computing. There is a reasonably good model fit based on the PLS results provided in SmartPLS. This study has implications for business users who will use the results to guide them in their decision about cloud computing SLAs and how they transition their in-house systems to the cloud platform. It also has implications for agencies such as the NIST that is currently working in the development of SLA metrics for cloud computing in an attempt to design a template and commence the process of standardizing SLAs relating to cloud computing.

Appendices

Appendix A

IRB Approvals

NOVA SOUTHEASTERN UNIVERSITY

MEMORANDUM

To: Howard Hamilton, B.Sc., M.Sc.
Graduate School of Computer and Information Sciences

From: David Thomas, M.D., J.D.
Chair, Institutional Review Board

WHS for Dr. Thomas

Date: November 12, 2014

Re: *An Examination of Service Level Agreement Attributes that Influence Cloud Computing Adoption* – NSU IRB No. 10021401Exp.

I have reviewed the revisions to the above-referenced research protocol by an expedited procedure. On behalf of the Institutional Review Board of Nova Southeastern University, *An Examination of Service Level Agreement Attributes that Influence Cloud Computing Adoption* is approved in keeping with expedited review category #6. Your study is approved on **November 10, 2014** and is approved until **November 9, 2015. Your request for waiver of the Informed Consent process and documentation for the anonymous survey for Survey Monkey, quantitative component only, is granted in keeping with 45CFR46.117(c) (2).** You are required to submit for continuing review by **October 9, 2015.** As principal investigator, you must adhere to the following requirements:

1) CONSENT: You must use the stamped (dated consent forms) attached when consenting subjects. The consent forms must indicate the approval and its date. The forms must be administered in such a manner that they are clearly understood by the subjects. The subjects must be given a copy of the signed consent document, and a copy must be placed with the subjects' confidential chart/file.

2) ADVERSE EVENTS/UNANTICIPATED PROBLEMS: The principal investigator is required to notify the IRB chair of any adverse reactions that may develop as a result of this study. Approval may be withdrawn if the problem is serious.

3) AMENDMENTS: Any changes in the study (e.g., procedures, consent forms, investigators, etc.) must be approved by the IRB prior to implementation.

4) CONTINUING REVIEWS: A continuing review (progress report) must be submitted by the continuing review date noted above. Please see the IRB web site for continuing review information.

5) FINAL REPORT: You are required to notify the IRB Office within 30 days of the conclusion of the research that the study has ended via the IRB Closing Report form.

The NSU IRB is in compliance with the requirements for the protection of human subjects prescribed in Part 46 of Title 45 of the Code of Federal Regulations (45 CFR 46) revised June 18, 1991.

Cc: Dr. James Parrish
Mr. William Smith
Dr. Ling Wang

Institutional Review Board
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NOVA SOUTHEASTERN UNIVERSITY
Graduate School of Computer and Information Sciences

NSU

NOVA
Institutional Review Board
Approval Date: NOV 14 2014
Continuing Review Date: NOV 09 2015

Consent Form for Participation in the Research Study Entitled
An Examination of Service Level Agreement Attributes that Influence Cloud Computing Adoption

Funding Source: None.

IRB protocol #: 10021401Exp

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For questions/concerns about your research rights, contact:
Human Research Oversight Board (Institutional Review Board or IRB)
Nova Southeastern University
(954) 262-5369/Toll Free: 866-499-0790
IRB@nsu.nova.edu

Site Information
Room 4153, 4th Floor Carl DeSantis Building
Nova Southeastern University
Graduate School of Computing and Information Sciences
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What is the study about?
You are invited to participate in the first phase of a research study. The primary purpose of this first phase of the study is to determine which cloud computing SLA attributes cloud computing experts believe should be included in the second phase of the study. A list of pre-extracted attributes from SLA documents and literature will be used as the input to this phase. The output from this phase will be the input to the second phase which will be used to conclude the study.

Why are you asking me?
We are inviting you to participate because you were identified by the researchers as

a cloud computing expert. A cloud computing expert in this study is defined as a provider of cloud computing services who has a minimum of four years' experience providing these services. There will be 13 participants in this phase of the research study.

What will I be doing if I agree to be in the study?
You will be interviewed by the researcher, Howard Hamilton. Mr. Hamilton will ask you questions about the cloud computing SLA attributes that have been selected for inclusion in the second phase of the study. You will not be asked any personal questions. There is an interview guide with five questions that will be used to guide the interview. Only your opinion and/or perspective about the inclusion or exclusion of the SLA attributes will be sought. There will be no survey for you to complete. The interview is expected to last no more than 30 minutes. If during the interview the researcher learns that you are no longer willing to continue voluntary participation, Mr. Hamilton will end the interview. Before this phase of the study comes to an end, you may be ask to be a member of a panel to validate the final list of attributes that have been selected to be part of phase two. This validation exercise will only require a few minutes of your time and an email indicating that you are satisfied with the list of attributes selected for the next phase.

Is there any audio or video recording?
This research project will include audio recording of the interview. This audio recording will be available to be heard by the researcher, Mr. Howard Hamilton, personnel from the IRB, and the dissertation chair, Dr. Parrish. The recording will be transcribed by Mr. Howard Hamilton. Mr. Hamilton will use earphones while transcribing the interviews to guard your privacy. The recording will be kept securely in Mr. Hamilton's office in a locked cabinet. The recording will be kept for 36 months from the end of the study. The recording will be destroyed after that time by deleting the audio files from the media on which the audio is being stored. Because your voice will be potentially identifiable by anyone who hears the recording, your confidentiality for things you say on the recording cannot be guaranteed although the researcher will try to limit access to the storage media as described in this paragraph.

What are the dangers to me?
Risks to you are minimal, meaning they are not thought to be greater than other risks you experience every day. Being recorded means that confidentiality cannot be promised. If you have questions about the research, your research rights, or if you experience an injury because of the research please contact Mr. Hamilton at (876) 342-6855. You may also contact the IRB at the numbers indicated above with questions about your research rights.

Are there any benefits for taking part in this research study?
The completion of this research study will benefit the participants. The results of the study will benefit cloud computing vendors, cloud computing customers and potential users of cloud computing services as they will provide them with useful information about cloud computing SLAs and how they impact the adoption of cloud services. The generalization of the results of this research will help cloud computing vendors when developing cloud computing SLAs. They will be more informed of what customers are interested in seeing in the SLA. This research will also help the cloud

computing users to better negotiate with the vendor on what should be in the cloud computing SLA. The results from this research could help to inform more meaningful cloud computing SLAs.

Will I get paid for being in the study? Will it cost me anything?
There are no costs to you or payments made for participating in this study.

How will you keep my information private?
The questions that will be asked in the interview will not require any information that could be linked to you. The transcripts of the audio recordings will not have any information that could be linked to you. As mentioned, the audio recordings will be deleted or destroyed 36 months after the study ends. All information obtained in this study is strictly confidential unless disclosure is required by law. The IRB, regulatory agencies, or Dr. Parrish may review research records.

What if I do not want to participate or I want to leave the study?
Participation is voluntary. You have the right to leave this study at any time or refuse to participate. If you do decide to leave or you decide not to participate, you will not experience any penalty or loss of services you have a right to receive. If you choose to withdraw, any information collected about you **before** the date you leave the study will be kept in the research records for 36 months from the conclusion of the study but you may request that it not be used.

Other Considerations:
If significant new information relating to the study becomes available, which may relate to your willingness to continue to participate, this information will be provided to you by Mr. Hamilton.

Voluntary Consent by Participant:
By signing below, you indicate that

- this study has been explained to you
- you have read this document or it has been read to you
- your questions about this research study have been answered
- you have been told that you may ask the researchers any study related questions in the future or contact them in the event of a research-related injury
- you have been told that you may ask Institutional Review Board (IRB) personnel questions about your study rights
- you are entitled to a copy of this form after you have read and signed it
- you voluntarily agree to participate in the study entitled *An Examination of Service Level Agreement Attributes that Influence Cloud Computing Adoption*

Participant's Signature: ____________________________ Date: ________________

Participant's Name: ______________ ___________ Date: ________________

Signature of Person Obtaining Consent: ______________________________

Date: ______________________________

Initials: ________ **Date:** ________

NOVA
Institutional Review Board
Approval Date: NOV 10 2014
Continuing Review Date: NOV 09 2015

NOVA SOUTHEASTERN UNIVERSITY
Graduate School of Computer and Information Sciences

NSU

NOVA
Institutional Review Board
Approval Date: NOV 10 2014
Continuing Review Date: NOV 09 2015

An Examination of Service Level Agreement Attributes that Influence Cloud Computing Adoption

IRB protocol #: 10021401Exp

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Nova Southeastern University
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Nova Southeastern University
Graduate School of Computing and Information Sciences
3301 College Avenue
Fort Lauderdale, FL 33314

Description of Study
Howard G. Hamilton is a doctoral student at Nova Southeastern University engaged in research for the purpose of satisfying a requirement for a Doctor of Philosophy degree. You are invited to participate in the second phase of a research study. The primary purpose of this phase of the study is to explore, through the use of a survey instrument, the perspectives of various businesses on a set of cloud computing SLA attributes which were obtained from SLA documents and literature. These cloud computing SLA attributes were endorsed by cloud computing experts in the first phase of this study.

If you agree to participate, you will be asked to complete the online survey instrument in SurveyMonkey. This instrument will help the researcher use quantitative analysis to identify the cloud computing attributes that influence the adoption of cloud computing services. The survey instrument will take approximately thirty minutes to complete.

Risks/Benefits to the Participants
There may be minimal risk involved in participating in this study. The results of the study will benefit cloud computing vendors, cloud computing customers and potential users as they will provide them with useful information about cloud computing SLAs and how they impact the adoption of cloud services. If you have any concerns about the risks/benefits of participating in this study, you can contact the investigators and/or the university's human research oversight board (the Institutional Review Board or IRB) at the numbers listed above.

Cost and Payments to the Participant
There is no cost for participation in this study. Participation is completely voluntary and no payment will be provided.

Confidentiality
Information obtained in this study is strictly confidential unless disclosure is required by law. All data will be collected in a secured environment. Your name, business or other data elements that could be used to identify you will not be collected in the survey instrument.

Participant's Right to Withdraw from the Study
You have the right to refuse to participate in this study and the right to withdraw from the study at any time without penalty.

I have read this letter and I fully understand the contents of this document and voluntarily consent to participate. All of my questions concerning this research have been answered. If I have any questions in the future about this study they will be answered by the investigator listed above or his/her staff.

I understand that the completion of this questionnaire implies my consent to participate in this study.

NOVA
Institutional Review Board
Approval Date: NOV 10 2014
Continuing Review Date NOV 09 2015

Appendix B

Expert Panel Review of the Attributes in Phase One

An Examination of Service Level Agreement Attributes that Influence Cloud Computing Adoption

Expert Panel Review of the List of Attributes from Phase 1

Purpose of this Document

The primary purpose of this document is to present the cloud computing attributes from phase one of this study to a panel of cloud computing experts for confirmation before the implementation of phase two.

Original List of Cloud Computing Attributes

Table 1 lists the original set of cloud computing attributes used in the interview with cloud computing experts.

Table 1

List of cloud computing attributes extracted from CSPs and literature review

Attributes	Attributes
1. Availability	8. Network performance
2. Data integrity	9. Cloud storage
3. Confidentiality	10. Maintenance/emergency
4. Support response rate	11. Physical security
5. Compensation for breaches	12. Physical location
6. Definition of attributes	13. Engineering support
7. Exclusions/limitations	14. Service Organization Control Audits and Reports – SAS70/SSAE16/compliance/security certification such as ISO 27000

Attributes Suggested for Inclusion by Cloud Computing Experts

The attributes in Table 2 include the suggestions for addition to the list in Table 1. These attributes are an aggregate of those that cloud computing experts recommended for inclusion in the list of SLA attributes. They are tabled here in Table 2 and will be included in the quantitative study in phase 2.

Table 2

Other attributes that cloud computing experts believed should be in the SLA

Attributes	Notes
1. Orchestration and Control Panel	Application systems used to manage cloud resources and interactions.
2. Features	Identify the features that come with the particular cloud service. These features should be measurable or verifiable.
3. Negotiation and Customization	Provision in the SLA to negotiate or customize specific attributes.
4. Business Continuity and Disaster Recovery	SLA attributes relating to how disasters such as "acts-of-God", natural or environmental events are treated. May be included in Attribute 14 in Table 1.
5. Portability	Attributes that define how cloud resources will move, integrate or interact across cloud brands.
6. Security	This represents general data and network security other than those already highlighted as attributes.
7. reliability	This speaks to smooth and continuous access to the service when it is available.

Response from Expert Panel

Please fill in the table below after reviewing the list of cloud computing SLA attributes in Table 1 and 2.

Table 3

Expert response from review of cloud computing SLA attributes

Item	Description	Expert Response [yes/no]	Notes
1	I am endorsing Table 1 as the original set of attributes to be included in phase two of the study.		
2	I am endorsing Table 2 as the additional set of attributes to be included in phase two of the study.		
3	I am satisfied with the 21 SLA attributes that will be used in the quantitative study in phase two.		
4	Date Completed:		

Appendix C

Outer Model Loadings

Table 26
Outer Model Loadings

	NU	TU	NS	TS	SU	SS	TC	IA
n_com_su	0.815							
n_eng_su	0.632							
n_fea_su	0.694							
n_mtn_su	0.648							
n_soc_su	0.928							
t_ava_su		0.612						
t_con_su		0.809						
t_gsec_su		0.893						
t_int_su		0.871						
t_orch_su		0.647						
t_port_su		0.637						
t_rel_su		0.754						
n_bc_ss			0.787					
n_eng_ss			0.835					
n_loc_ss			0.663					
n_neg_ss			0.738					
n_gsec_ss				0.770				
n_orch_ss				0.714				
n_port_ss				0.840				
n_rel_ss				0.786				
uncert_u					1.000			
specify_s						1.000		
n_def_cs							0.825	
n_exc_cs							0.790	
n_mtn_cs							0.792	
n_neg_cs							0.795	
n_sup_cs							0.865	
t_con_cs							0.865	
t_gsec_cs							0.795	
t_int_cs							0.851	
t_orch_cs							0.753	
t_perf_cs							0.753	
t_sto_cs							0.797	
n_bc_au								0.693
n_com_as								0.745
n_exc_au								0.676
n_sup_as								0.794
t_ava_as								0.691
t_con_as								0.706
t_gsec_au								0.691
t_orch_as								0.600
t_port_au								0.700
t_psec_as								0.647

	NU	TU	NS	TS	SU	SS	TC	IA
t_rel_as								0.718

Appendix D

Semi-structured Interview Questions – Phase 1

An Examination of Service Level Agreement Attributes that Influence Cloud Computing Adoption
Semi-structured Interview Questions – Phase 1

General Instructions: The following questions will be used in the interview with cloud computing experts for the first phase of this study. These questions are open ended and will form the basis of the discussions with the experts about cloud computing SLAs and their attributes. At the end of the interview it should be clear which attributes the experts believe should be included in the cloud computing SLA. The expert will be provided with the list of attributes garnered from literature and content reviews.

1. How many years have you been providing cloud computing services?

2. The following cloud computing SLA attributes were obtained from literature and existing SLAs that cloud computing providers have been using. What are your views about these being in cloud computing SLAs? (Expert will look at the list of attributes and give opinion).

3. If you would delete any of the attribute(s) from this list, which one(s) would you delete? Why?

4. If you would add attribute(s) to the list, what would you include? Why?

5. Which SLA attribute(s) do you perceive is (are) the most important to the advancement and greater acceptance of cloud computing (1 being the highest level of perceived importance)? Why?

Appendix E

Survey Instrument – Phase 2

An Examination of Service Level Agreement Attributes that Influence Cloud Computing Adoption
Survey Instrument – Phase 2

General Instructions

Completing the survey indicates your voluntary participation in the study.

Use the answer keys provided to select the best response to each of the questions in this instrument. There are two sections to the instrument. Section A asks questions about cloud computing and related service level agreements (SLAs), while Section B asks questions relating to the demographic characteristics of the respondents. Only ONE of the numbers (1-7) must be selected for each question in Section A. Please read each question carefully before answering. ALL questions MUST be answered.

SECTION A – Cloud Computing SLAs

What is your perception about each of the following as they are represented in the cloud computing SLA?

Key: 1 – Strongly disagree 2 – Disagree 3 – Somewhat disagree 4 – Neither agree or disagree 5 – Somewhat agree 6 – Agree 7 – Strongly agree

Items	1	2	3	4	5	6	7
1. I am not sure that the amount of availability specified in the cloud computing SLA can be achieved by the provider or I have doubts surrounding the availability of cloud computing	O	O	O	O	O	O	O
2. I am not certain that the integrity of the data stored in the cloud is maintained by the provider and I am not sure that the SLA appropriately addresses data integrity	O	O	O	O	O	O	O
3. I do not believe or I am doubtful that cloud computing SLAs address concerns about confidentiality of information and data in the cloud.	O	O	O	O	O	O	O
4. I am not sure what the support response rate is for cloud computing services being offered by cloud service providers	O	O	O	O	O	O	O
5. It is not clear how compensation for breaches is computed and I am unsure about what to expect	O	O	O	O	O	O	O
6. The attributes of the cloud computing SLAs are not well defined and therefore result in lack of understanding or doubts about them	O	O	O	O	O	O	O
7. I am very certain about what the limitations of the cloud computing services are and what are excluded from the services being provided	O	O	O	O	O	O	O
8. There is no guarantees about the expected performance of the cloud service providers' network and I am therefore uncertain about what to expect in this regard	O	O	O	O	O	O	O
9. I am uncertain about the amount of storage to receive from cloud service providers	O	O	O	O	O	O	O
10. I am uncertain about how the cloud service providers deal with emergency maintenance and similar activities which could impact	O	O	O	O	O	O	O

the availability of the service							
11. I am unsure about the physical security of the facilities used by providers to offer cloud computing services	O	O	O	O	O	O	O
12. There is no information given by the cloud service provider that highlights the physical location from which the cloud service is being provided thereby causing some uncertainties about the guarantees of the service	O	O	O	O	O	O	O
13. I am not sure whether there is engineering support to users of cloud services and how much time is allotted for engineering support	O	O	O	O	O	O	O
14. I am not sure that the cloud service provider is conducting frequent information security audits of the cloud infrastructure and making reports such as the SAS70/SSAE16 available as part of the cloud computing SLA	O	O	O	O	O	O	O
15. I am uncertain that I can control and manage my cloud resources when this becomes necessary	O	O	O	O	O	O	O
16. I am not sure that the cloud service provider outlines the features of any incentives given in addition to the cloud service I am purchasing	O	O	O	O	O	O	O
17. I am uncertain that the cloud service provider will have discussions with me regarding the contents of the SLA or will be inclined to drafting a cloud computing SLA specifically related to my needs before finalizing the agreement	O	O	O	O	O	O	O
18. I am uncertain about the plans my cloud service provider has to minimize interruptions during unforeseen events and to recover from such events in the shortest possible time	O	O	O	O	O	O	O
19. I am not certain that there is portability of data, infrastructure and applications running in the cloud from one cloud provider to another	O	O	O	O	O	O	O
20. I am uncertain about the measures my provider is taking to ensure my applications and data are secured	O	O	O	O	O	O	O
21. I am uncertain of the reliability of the cloud service offerings even though the service may be available	O	O	O	O	O	O	O

How important do you think these are as they relate to specifying them in the cloud computing SLA?

Key: 1 – Extremely important 2 – Very important 3 – Moderately important 4 – Neither important nor unimportant (does not matter seriously) 5 – Slightly important 6 – Low importance 7 – Not at all important

Items	1	2	3	4	5	6	7
22. Availability of the cloud computing services	O	O	O	O	O	O	O
23. Data Integrity of business data and information stored in the cloud	O	O	O	O	O	O	O
24. Confidentiality and privacy of data stored in the cloud	O	O	O	O	O	O	O

25. Support response rate relating to concerns with the cloud services or queries from customers about the cloud services being offered	O	O	O	O	O	O	O
26. Compensation for breaches of agreed SLA	O	O	O	O	O	O	O
27. Definition of attributes specified in the cloud computing SLA	O	O	O	O	O	O	O
28. Exclusions/limitations to the cloud computing services being offered	O	O	O	O	O	O	O
29. Expected network performance of the cloud services that are being offered	O	O	O	O	O	O	O
30. The expected storage capacity that is provided through the cloud computing service	O	O	O	O	O	O	O
31. Maintenance or emergency activities that are executed during the periods in which the cloud service is being offered	O	O	O	O	O	O	O
32. The physical security of the cloud computing facilities from which cloud computing services are being offered	O	O	O	O	O	O	O
33. The physical location of the cloud computing facilities where the cloud computing services are being offered	O	O	O	O	O	O	O
34. Engineering support outlining the amount of time that the cloud service provider will have this type of support available to its customers	O	O	O	O	O	O	O
35. Outcomes of information security audits and the availability or access to audit reports such as SAS70 or SSAE16 showing that periodic security audits are done on the cloud computing operations of the cloud service provider	O	O	O	O	O	O	O
36. How to control and manage resources in the cloud as your requirements change and this becomes necessary	O	O	O	O	O	O	O
37. The features of any incentives given as a result of acquiring the cloud service	O	O	O	O	O	O	O
38. Flexible means by which I can discuss the contents of the SLA with the provider and if necessary provide a SLA specifically designed to meet my needs	O	O	O	O	O	O	O
39. Plans to keep the business in operation and to recover from unforeseen disasters	O	O	O	O	O	O	O
40. Ability to move applications, data, and infrastructure to other cloud providers platform	O	O	O	O	O	O	O
41. General data and network security of the cloud	O	O	O	O	O	O	O
42. The reliability of the cloud services being provided	O	O	O	O	O	O	O

What is your perception of the level of effort required to understand how cloud service providers are providing the following in the cloud computing SLA? Use the effort scale below to indicate the level of effort required.

Key: 1 – Extremely high level of effort 2 – Very high level of effort 3 – Moderate level of effort 4 – Neither extremes of the effort scale (or Neutral) 5 – Low level of effort 6 – very Low level of effort 7 – Extremely low or no effort at all

Items	1	2	3	4	5	6	7
43. To understand the availability of the cloud computing services being provided	O	O	O	O	O	O	O
44. To understand how the cloud service provider is providing for data integrity in the cloud	O	O	O	O	O	O	O
45. To understand how confidentiality and privacy of the data in the cloud are protected	O	O	O	O	O	O	O
46. To understand the support response rate that the provider is guaranteeing in the cloud computing SLA.	O	O	O	O	O	O	O
47. To understand how compensation for breaches is computed and how the cloud service provider rewards the user for lost service	O	O	O	O	O	O	O
48. To understand the terms/attributes that are defined in the cloud computing SLA.	O	O	O	O	O	O	O
49. To understand what the exclusions and limitations of the cloud computing SLA are	O	O	O	O	O	O	O
50. To understand the network performance to be expected from the cloud service provider as part of the SLA	O	O	O	O	O	O	O
51. To understand the amount of storage space provided by the cloud service provider as it relates to the cloud computing SLA	O	O	O	O	O	O	O
52. To understand what maintenance and emergency activities are and how these activities will impact the service being provided	O	O	O	O	O	O	O
53. To understand whether the cloud service provider implements reasonable measures to protect the physical security of the cloud computing facilities	O	O	O	O	O	O	O
54. To understand where the physical location of cloud service is being provided from	O	O	O	O	O	O	O
55. To understand the level of engineering support that is being provided by the cloud service provider	O	O	O	O	O	O	O
56. To understand the frequency of information security audits and whether the cloud service provider makes reports of such audits (eg. SAS70/SSAE16) available as part of the cloud computing SLA	O	O	O	O	O	O	O
57. To understand how to control and manage resources in the cloud	O	O	O	O	O	O	O
58. To understand the features of any incentives given with the cloud service offerings	O	O	O	O	O	O	O
59. To understand the provision to discuss the contents of the SLA and to get the provider to configure the SLA to your specific needs	O	O	O	O	O	O	O
60. To understand the plans to prevent loss of operation due to unforeseen events such as natural disasters and to recover from	O	O	O	O	O	O	O

these events in the shortest time possible							
61. To understand how data, applications, and infrastructure can be moved from one cloud service provider to another	O	O	O	O	O	O	O
62. To understand the general data and network security arrangements for the cloud service being provided	O	O	O	O	O	O	O
63. To understand how the cloud service provider makes the cloud service reliable when the service is available	O	O	O	O	O	O	O

What is your perception of the level of challenge or difficulty introduced into the cloud computing SLA as a result of specifying, or NOT specifying, the following in the SLA?

Key: 1 – Extremely difficult 2 – Very difficult 3 – Difficult 4 – Neither difficult nor easy 5 – Easy 6 – Very easy 7 – Extremely easy

Items	1	2	3	4	5	6	7
64. Specifying the availability of the service to be expected in the cloud computing SLA	O	O	O	O	O	O	O
65. Not specifying how data integrity will be safeguarded in the cloud computing SLA	O	O	O	O	O	O	O
66. Not specifying how confidentiality and privacy are protected in the cloud computing SLA	O	O	O	O	O	O	O
67. Not specifying the support response rate to be expected from the provider in the cloud computing SLA	O	O	O	O	O	O	O
68. Specifying what compensation for breaches is and how compensation for breaches is administered in the SLA	O	O	O	O	O	O	O
69. Not defining the primary terms or clauses of the cloud computing SLA	O	O	O	O	O	O	O
70. Not specifying what are excluded from the cloud computing SLA or the limitations of the SLA	O	O	O	O	O	O	O
71. Not specifying the network performance to be expected by the provider in the cloud computing SLA	O	O	O	O	O	O	O
72. Not specifying the amount of storage to be expected in the cloud computing SLA	O	O	O	O	O	O	O
73. Not specifying how maintenance and/or emergency activities will be dealt with by the provider in the cloud computing SLA	O	O	O	O	O	O	O
74. Including details of how the physical security of the cloud computing facility is safeguarded by the provider in the cloud computing SLA	O	O	O	O	O	O	O
75. Not specifying the physical location of the cloud computing facility from which the service is being provided	O	O	O	O	O	O	O
76. Specifying the level of engineering support to be expected from the cloud service provider over the life of the agreement	O	O	O	O	O	O	O
77. Commitment to conducting routine audits and making the reports (such as SAS70/SSAE16) available to users of the cloud	O	O	O	O	O	O	O

Items	1	2	3	4	5	6	7
computing service							
78. Not specifying how I can control and manage resources in the cloud	O	O	O	O	O	O	O
79. Specifying the features of any incentives given for the cloud service being acquired	O	O	O	O	O	O	O
80. Not specifying that I can have discussions with the provider about the contents of the SLA	O	O	O	O	O	O	O
81. Specifying plans for continued operations during unforeseen events such as natural disasters and to recover from these events in the shortest possible time	O	O	O	O	O	O	O
82. Specifying how data, infrastructure and applications may move from one cloud to another if this becomes necessary	O	O	O	O	O	O	O
83. Not specifying how general data and network security of the service will be provided	O	O	O	O	O	O	O
84. Specifying how the reliability of the service will be guaranteed by the provider	O	O	O	O	O	O	O

In your opinion, which of the following are you not clear about in the cloud computing SLA and as a result makes it difficult for you to work with the SLA or use cloud computing services?

Key: 1 – Strongly disagree 2 – Disagree 3 – Somewhat disagree 4 – Neither agree or disagree 5 – Somewhat agree 6 – Agree 7 – Strongly agree

Items	1	2	3	4	5	6	7
85. I find the SLA more difficult to work with when I am not clear about the availability of the service	O	O	O	O	O	O	O
86. I find the SLA more difficult to work with when I am not sure how the provider maintains the integrity of the data stored in the cloud	O	O	O	O	O	O	O
87. I do not have a problem working with the SLA whether or not I am clear about aspects of how the cloud service provider safeguards the confidentiality and privacy of business information and data stored in the cloud	O	O	O	O	O	O	O
88. I find the SLA more difficult to work with when I am unclear about the support response rate that will be received from the cloud service provider	O	O	O	O	O	O	O
89. SLAs are more difficult to work with when I am not sure about what I am getting for compensation for breaches	O	O	O	O	O	O	O
90. I find the SLAs more difficult to work with even when the terms within the SLA are clearly defined	O	O	O	O	O	O	O
91. I find the SLA easier to work with when it clearly outlines what are excluded and the scope of the SLA	O	O	O	O	O	O	O
92. I do not necessarily find the SLA problematic if the cloud service provider did not clearly outline what level of network performance I am getting	O	O	O	O	O	O	O

Items	1	2	3	4	5	6	7
93. I do not find it difficult to work with the SLA and use cloud computing services when I have doubts about the amount of storage guaranteed in the cloud by the SLA	O	O	O	O	O	O	O
94. I do not find the SLA difficult to work with when I am not clear about how maintenance or emergency activities are scheduled or dealt with in the cloud computing SLA	O	O	O	O	O	O	O
95. I find the SLA easier to work with when I am not clear how the physical security of the cloud is managed by the cloud service provider	O	O	O	O	O	O	O
96. I find the SLA easier to work with when I am not clear where the cloud computing facility is physically located	O	O	O	O	O	O	O
97. Doubts about access to and availability of engineering support do not create any difficulty for me to work with the SLA and use the cloud computing services	O	O	O	O	O	O	O
98. I do not find the SLA easier to work with when the cloud service provider does not conduct independent routine information security audits of the cloud computing facilities and make the reports (eg. SAS70 and SSAE16) of the findings available as part of the cloud computing SLA	O	O	O	O	O	O	O
99. I find the SLA more difficult to work with when I am not clear that I can control and manage the resources in the cloud	O	O	O	O	O	O	O
100. I find the SLA more difficult to work with if the features of the incentives given with the cloud service are not clearly defined	O	O	O	O	O	O	O
101. I find the SLA more difficult to work with if it is unclear that I can have discussions regarding the contents of the SLA with the provider before signing the agreement	O	O	O	O	O	O	O
102. I find the cloud computing SLA more challenging to work with if there are no clear plans to continue operations and recover from unforeseen events such as natural disasters in the shortest possible time	O	O	O	O	O	O	O
103. I find the SLA more difficult to work with if I am not clear that the cloud services can be moved seamlessly to another cloud provider's infrastructure if this becomes necessary	O	O	O	O	O	O	O
104. I find the SLA more difficult to work with if I am unclear about the general data and network security of the cloud infrastructure	O	O	O	O	O	O	O
105. I do not find the SLA easier to work with if I am clear about the level of reliability of the cloud computing service	O	O	O	O	O	O	O

What is your perspective of how the specification or inclusion of the following in the cloud computing SLA impacts your decision to work with the SLA or use cloud computing services?

Key: 1 – Strongly disagree 2 – Disagree 3 – Somewhat disagree 4 – Neither agree or disagree
5 – Somewhat agree 6 – Agree 7 – Strongly agree

Items	1	2	3	4	5	6	7

Items	1	2	3	4	5	6	7
106. I find that I am more encouraged to work with the SLA and use cloud computing services when the SLA includes details of the availability of the service	O	O	O	O	O	O	O
107. I find that I am more encouraged to work with the SLA and use cloud computing services when the SLA does not include details of how the cloud service provider will maintain the data integrity of business data and information stored in the cloud	O	O	O	O	O	O	O
108. I find that I am more encouraged to work with the SLA and use cloud computing services when the SLA clearly specifies the details of how the confidentiality and privacy of business data and information will be safeguarded	O	O	O	O	O	O	O
109. I find that I am more encouraged to work with the SLA and use cloud computing services when the SLA clearly specifies the support response rate to expect from the cloud service provider	O	O	O	O	O	O	O
110. I find that I am more comfortable with the SLA and more encouraged to use cloud computing services when the SLA specifies what I will receive for compensation for breaches and how this will be administered	O	O	O	O	O	O	O
111. I find that I am not more encouraged to work with the SLA and use cloud computing services when the SLA defines the terms that make up the cloud computing SLA	O	O	O	O	O	O	O
112. I find that I am not more encouraged to work with the SLA or use the cloud computing services when the SLA specifies the details of what is excluded from the agreement and the scope which the agreement covers	O	O	O	O	O	O	O
113. I find that I am more willing to work with the SLA and use cloud computing services when the SLA clearly specifies the minimum network performance I am to expect	O	O	O	O	O	O	O
114. I find that I am not more encouraged to use the cloud computing services or work with the SLA when the amount of storage to be received is specified in the cloud computing SLA	O	O	O	O	O	O	O
115. I find that I am not more willing to work with the SLA or use cloud computing services when the cloud service provider specifies how it will schedule and execute maintenance and emergency activities	O	O	O	O	O	O	O
116. I find that I am more willing to work with the SLA and use cloud computing services when details of how the cloud service provider will deal with the physical security for the cloud computing facilities are specified in the SLA	O	O	O	O	O	O	O
117. I find that I am more encouraged to work with the SLA and use cloud computing services when the cloud service provider specifies where the cloud computing facilities are located	O	O	O	O	O	O	O
118. I find that I am not more willing to work with the SLA or use cloud computing services when the cloud service provider specifies the level of engineering support to expect in the SLA	O	O	O	O	O	O	O

Items	1	2	3	4	5	6	7
119. I find that I am not more encouraged to work with the SLA when the SLA specifies that information security audits will be conducted by the service provider and reports from the findings will be made available to users	O	O	O	O	O	O	O
120. I find that I am more encouraged to work with the SLA or use cloud computing services when the SLA specifies how I can control and manage my resources in the cloud	O	O	O	O	O	O	O
121. I am not more willing to work with the SLA or use cloud computing services if the provider details the features of any incentives given with the service I am acquiring	O	O	O	O	O	O	O
122. I find that I am more interested in working with the SLA or using cloud computing services when it is specified that I can discuss the contents of the SLA with the provider before entering the agreement	O	O	O	O	O	O	O
123. I find that I am not more encouraged to work with the SLA or use cloud services when details of plans to continue operations and recover from unforeseen events are specified in the SLA	O	O	O	O	O	O	O
124. I find that I am not more interested in working with the SLA or using cloud services when it is specified that my data, infrastructure and applications can be moved to another cloud provider if this becomes necessary	O	O	O	O	O	O	O
125. I find that I am not more encouraged to work with the SLA or use cloud computing services when the SLA specifies how general data and network security of the services will be ensured	O	O	O	O	O	O	O
126. I find that I am more encouraged to work with or use cloud computing services when the level of reliability to expect of services in the cloud is clearly specified	O	O	O	O	O	O	O

Based on your knowledge and/or experience, how do you feel about using or continuing to use cloud computing services?

Key: 1 – Strongly disagree 2 – Disagree 3 – Somewhat disagree 4 – Neither agree or disagree 5 – Somewhat agree 6 – Agree 7 – Strongly agree

Items	1	2	3	4	5	6	7
127. I am encouraged to use or continue to use cloud computing services even when I am not clear about certain aspects of the SLA	O	O	O	O	O	O	O
128. I am not encouraged to use or continue to use cloud computing services because the cloud computing SLA is too difficult to understand and work with	O	O	O	O	O	O	O
129. I will not use or continue to use cloud computing services when the SLA does not include certain aspects I consider important	O	O	O	O	O	O	O
130. I am willing to use or continue to use cloud computing services for business related purposes regardless of how I feel about the SLA	O	O	O	O	O	O	O

SECTION B – Demographic and Cloud Computing Use

131.	**Which of these categories best describes your company/industry? Select only one of the following.**	Codes
O	Information Technology	1
O	Telecommunications	2
O	Education (Private or Public)	3
O	Government	4
O	Services – Logistics and Distribution	5
O	Finance (Banking, Insurance, etc.)	6
O	Manufacturing	7
O	Transportation	8
O	Other : ____	99

132.	**What is the size of the business/organization? Select the option that best describes the range in which the size of the company belongs.**	Codes
O	1 to 99	1
O	100 to 299	2
O	300 to 499	3
O	500 to 699	4
O	700 +	5

133.	**Which of the following best describes your company's experience with cloud computing? Select only ONE of the following.**	Codes
O	I am currently using cloud computing service(s) but I am uncertain that I will continue to use it (them) in the future	1
O	I have used cloud computing service(s) in the past but I am not using it (them) now	2
O	I am currently using cloud computing service(s) and I am certain that I will continue to use it (them) in the future	3
O	I am not using cloud computing service(s) and I do not intend to use it (them) in the future	4
O	I am not using cloud computing service(s) now but I intend to use it (them) in the future	5

134.	**Which of the cloud computing services have you used or are using or intent to use? Select all that apply.**	Codes
☐	Software as a service – SaaS	1
☐	Platform as a service – PaaS	2
☐	Infrastructure as a service – IaaS	3
☐	None of these services	4

135.	**If you are using or have used or if you were to use cloud computing services, which of the following best describes your reason for using or if you were to use cloud computing services? Select all that apply.**	Codes

☐	Agility	1
☐	Competitive advantage	2
☐	Cost savings	3
☐	Data/information sharing	4
☐	Performance over in-house	5
☐	None of the above	6
☐	Other: ____	99

***** END OF SURVEY INSTREUMENT *****

Appendix F

Variables Used

An Examination of Service Level Agreement Attributes that Influence Cloud Computing Adoption
Survey Instrument – Phase 2

Indicator Variables Used

SECTION A – Cloud Computing SLAs

SLA Uncertainty

What is your perception about each of the following as they are represented in the cloud computing SLA?

Items	Variables
136. I am not sure that the amount of availability specified in the cloud computing SLA can be achieved by the provider or I have doubts surrounding the availability of cloud computing	t_ava_su
137. I am not certain that the integrity of the data stored in the cloud is maintained by the provider and I am not sure that the SLA appropriately addresses data integrity	t_int_su
138. I do not believe or I am doubtful that cloud computing SLAs address concerns about confidentiality of information and data in the cloud.	t_con_su
139. I am not sure what the support response rate is for cloud computing services being offered by cloud service providers	n_sup_su
140. It is not clear how compensation for breaches is computed and I am unsure about what to expect	n_com_su
141. The attributes of the cloud computing SLAs are not well defined and therefore result in lack of understanding or doubts about them	n_def_su
142. I am very certain about what the limitations of the cloud computing services are and what are excluded from the services being provided	n_exc_su
143. There is no guarantees about the expected performance of the cloud service providers' network and I am therefore uncertain about what to expect in this regard	t_perf_su
144. I am uncertain about the amount of storage to receive from cloud service providers	t_sto_su
145. I am uncertain about how the cloud service providers deal with emergency maintenance and similar activities which could impact the availability of the service	n_mtn_su
146. I am unsure about the physical security of the facilities used by providers to offer cloud computing services	t_psec_su
147. There is no information given by the cloud service provider that highlights the physical location from which the cloud service is being provided thereby causing some uncertainties about the	n_loc_su

guarantees of the service	
148. I am not sure whether there is engineering support to users of cloud services and how much time is allotted for engineering support	n_eng_su
149. I am not sure that the cloud service provider is conducting frequent information security audits of the cloud infrastructure and making reports such as the SAS70/SSAE16 available as part of the cloud computing SLA	n_soc_su
150. I am uncertain that I can control and manage my cloud resources when this becomes necessary	t_orch_su
151. I am not sure that the cloud service provider outlines the features of any incentives given in addition to the cloud service I am purchasing	n_fea_su
152. I am uncertain that the cloud service provider will have discussions with me regarding the contents of the SLA or will be inclined to drafting a cloud computing SLA specifically related to my needs before finalizing the agreement	n_neg_su
153. I am uncertain about the plans my cloud service provider has to minimize interruptions during unforeseen events and to recover from such events in the shortest possible time	n_bc_su
154. I am not certain that there is portability of data, infrastructure and applications running in the cloud from one cloud provider to another	t_port_su
155. I am uncertain about the measures my provider is taking to ensure my applications and data are secured	t_gsec_su
156. I am uncertain of the reliability of the cloud service offerings even though the service may be available	t_rel_su

SLA Asset Specificity

How important do you think these are as they relate to specifying them in the cloud computing SLA?

Items	Variables
157. Availability of the cloud computing services	t_ava_ss
158. Data Integrity of business data and information stored in the cloud	t_int_ss
159. Confidentiality and privacy of data stored in the cloud	t_con_ss
160. Support response rate relating to concerns with the cloud services or queries from customers about the cloud services being offered	n_sup_ss
161. Compensation for breaches of agreed SLA	n_com_ss
162. Definition of attributes specified in the cloud computing SLA	n_def_ss
163. Exclusions/limitations to the cloud computing services being offered	n_exc_ss

164. Expected network performance of the cloud services that are being offered	t_perf_ss
165. The expected storage capacity that is provided through the cloud computing service	t_sto_ss
166. Maintenance or emergency activities that are executed during the periods in which the cloud service is being offered	n_mtn_ss
167. The physical security of the cloud computing facilities from which cloud computing services are being offered	t_psec_ss
168. The physical location of the cloud computing facilities where the cloud computing services are being offered	n_loc_ss
169. Engineering support outlining the amount of time that the cloud service provider will have this type of support available to its customers	n_eng_ss
170. Outcomes of information security audits and the availability or access to audit reports such as SAS70 or SSAE16 showing that periodic security audits are done on the cloud computing operations of the cloud service provider	n_soc_ss
171. How to control and manage resources in the cloud as your requirements change and this becomes necessary	t_orch_ss
172. The features of any incentives given as a result of acquiring the cloud service	n_fea_ss
173. Flexible means by which I can discuss the contents of the SLA with the provider and if necessary provide a SLA specifically designed to meet my needs	n_neg_ss
174. Plans to keep the business in operation and to recover from unforeseen disasters	n_bc_ss
175. Ability to move applications, data, and infrastructure to other cloud providers platform	t_port_ss
176. General data and network security of the cloud	t_gsec_ss
177. The reliability of the cloud services being provided	t_rel_ss

Transaction Cost (with uncertainty)

What is your perception of the level of effort required to understand how cloud service providers are providing the following in the cloud computing SLA? Use the effort scale below to indicate the level of effort required.

Items	Variables	V
178. To understand the availability of the cloud computing services being provided	t_ava_cu	
179. To understand how the cloud service provider is providing for data integrity in the cloud	t_int_cu	
180. To understand how confidentiality and privacy of the data in the cloud are protected	t_con_cu	

181. To understand the support response rate that the provider is guaranteeing in the cloud computing SLA.	n_sup_cu
182. To understand how compensation for breaches is computed and how the cloud service provider rewards the user for lost service	n_com_cu
183. To understand the terms/attributes that are defined in the cloud computing SLA.	n_def_cu
184. To understand what the exclusions and limitations of the cloud computing SLA are	n_exc_cu
185. To understand the network performance to be expected from the cloud service provider as part of the SLA	t_perf_cu
186. To understand the amount of storage space provided by the cloud service provider as it relates to the cloud computing SLA	t_sto_cu
187. To understand what maintenance and emergency activities are and how these activities will impact the service being provided	n_mtn_cu
188. To understand whether the cloud service provider implements reasonable measures to protect the physical security of the cloud computing facilities	t_psec_cu
189. To understand where the physical location of cloud service is being provided from	n_loc_cu
190. To understand the level of engineering support that is being provided by the cloud service provider	n_eng_cu
191. To understand the frequency of information security audits and whether the cloud service provider makes reports of such audits (eg. SAS70/SSAE16) available as part of the cloud computing SLA	n_soc_cu
192. To understand how to control and manage resources in the cloud	t_orch_cu
193. To understand the features of any incentives given with the cloud service offerings	n_fea_cu
194. To understand the provision to discuss the contents of the SLA and to get the provider to configure the SLA to your specific needs	n_neg_cu
195. To understand the plans to prevent loss of operation due to unforeseen events such as natural disasters and to recover from these events in the shortest time possible	n_bc_cu
196. To understand how data, applications, and infrastructure can be moved from one cloud service provider to another	t_port_cu
197. To understand the general data and network security arrangements for the cloud service being provided	t_gsec_cu
198. To understand how the cloud service provider makes the cloud service reliable when the service is available	t_rel_cu

Transaction cost (with specificity)

What is your perception of the level of challenge or difficulty introduced into the cloud computing SLA as a result of specifying, or NOT specifying, the following in the SLA?

Items	Variables
199. Specifying the availability of the service to be expected in the cloud computing SLA	t_ava_cs
200. Not specifying how data integrity will be safeguarded in the cloud computing SLA	t_int_cs
201. Not specifying how confidentiality and privacy are protected in the cloud computing SLA	t_con_cs
202. Not specifying the support response rate to be expected from the provider in the cloud computing SLA	n_sup_cs
203. Specifying what compensation for breaches is and how compensation for breaches is administered in the SLA	n_com_cs
204. Not defining the primary terms or clauses of the cloud computing SLA	n_def_cs
205. Not specifying what are excluded from the cloud computing SLA or the limitations of the SLA	n_exc_cs
206. Not specifying the network performance to be expected by the provider in the cloud computing SLA	t_perf_cs
207. Not specifying the amount of storage to be expected in the cloud computing SLA	t_sto_cs
208. Not specifying how maintenance and/or emergency activities will be dealt with by the provider in the cloud computing SLA	n_mtn_cs
209. Including details of how the physical security of the cloud computing facility is safeguarded by the provider in the cloud computing SLA	t_psec_cs
210. Not specifying the physical location of the cloud computing facility from which the service is being provided	n_loc_cs
211. Specifying the level of engineering support to be expected from the cloud service provider over the life of the agreement	n_eng_cs
212. Commitment to conducting routine audits and making the reports (such as SAS70/SSAE16) available to users of the cloud computing service	n_soc_cs
213. Not specifying how I can control and manage resources in the cloud	t_orch_cs
214. Specifying the features of any incentives given for the cloud service being acquired	n_fea_cs
215. Not specifying that I can have discussions with the provider about the contents of the SLA	n_neg_cs
216. Specifying plans for continued operations during unforeseen	n_bc_cs

Items	Variables
events such as natural disasters and to recover from these events in the shortest possible time	
217. Specifying how data, infrastructure and applications may move from one cloud to another if this becomes necessary	t_port_cs
218. Not specifying how general data and network security of the service will be provided	t_gsec_cs
219. Specifying how the reliability of the service will be guaranteed by the provider	t_rel_cs

Intention to Adopt (with uncertainty)

In your opinion, which of the following are you not clear about in the cloud computing SLA and as a result makes it difficult for you to work with the SLA or use cloud computing services?

Items	Variables
220. I find the SLA more difficult to work with when I am not clear about the availability of the service	t_ava_au
221. I find the SLA more difficult to work with when I am not sure how the provider maintains the integrity of the data stored in the cloud	t_int_au
222. I do not have a problem working with the SLA whether or not I am clear about aspects of how the cloud service provider safeguards the confidentiality and privacy of business information and data stored in the cloud	t_con_au
223. I find the SLA more difficult to work with when I am unclear about the support response rate that will be received from the cloud service provider	n_sup_au
224. SLAs are more difficult to work with when I am not sure about what I am getting for compensation for breaches	n_com_au
225. I find the SLAs more difficult to work with even when the terms within the SLA are clearly defined	n_def_au
226. I find the SLA easier to work with when it clearly outlines what are excluded and the scope of the SLA	n_exc_au
227. I do not necessarily find the SLA problematic if the cloud service provider did not clearly outline what level of network performance I am getting	t_perf_au
228. I do not find it difficult to work with the SLA and use cloud computing services when I have doubts about the amount of storage guaranteed in the cloud by the SLA	t_sto_au
229. I do not find the SLA difficult to work with when I am not clear about how maintenance or emergency activities are scheduled or dealt with in the cloud computing SLA	n_mtn_au
230. I find the SLA easier to work with when I am not clear how the	t_psec_au

Items	Variables
physical security of the cloud is managed by the cloud service provider	
231. I find the SLA easier to work with when I am not clear where the cloud computing facility is physically located	n_loc_au
232. Doubts about access to and availability of engineering support do not create any difficulty for me to work with the SLA and use the cloud computing services	n_eng_au
233. I do not find the SLA easier to work with when the cloud service provider does not conduct independent routine information security audits of the cloud computing facilities and make the reports (eg. SAS70 and SSAE16) of the findings available as part of the cloud computing SLA	n_soc_au
234. I find the SLA more difficult to work with when I am not clear that I can control and manage the resources in the cloud	t_orch_au
235. I find the SLA more difficult to work with if the features of the incentives given with the cloud service are not clearly defined	n_fea_au
236. I find the SLA more difficult to work with if it is unclear that I can have discussions regarding the contents of the SLA with the provider before signing the agreement	n_neg_au
237. I find the cloud computing SLA more challenging to work with if there are no clear plans to continue operations and recover from unforeseen events such as natural disasters in the shortest possible time	n_bc_au
238. I find the SLA more difficult to work with if I am not clear that the cloud services can be moved seamlessly to another cloud provider's infrastructure if this becomes necessary	t_port_au
239. I find the SLA more difficult to work with if I am unclear about the general data and network security of the cloud infrastructure	t_gsec_au
240. I do not find the SLA easier to work with if I am clear about the level of reliability of the cloud computing service	t_rel_au

Intention to Adopt (with specificity)

What is your perspective of how the specification or inclusion of the following in the cloud computing SLA impacts your decision to work with the SLA or use cloud computing services?

Items	Variables
241. I find that I am more encouraged to work with the SLA and use cloud computing services when the SLA includes details of the availability of the service	t_ava_as
242. I find that I am more encouraged to work with the SLA and use cloud computing services when the SLA does not include details of how the cloud service provider will maintain the data integrity of business data and information stored in the cloud	t_int_as

Items	Variables
243. I find that I am more encouraged to work with the SLA and use cloud computing services when the SLA clearly specifies the details of how the confidentiality and privacy of business data and information will be safeguarded	t_con_as
244. I find that I am more encouraged to work with the SLA and use cloud computing services when the SLA clearly specifies the support response rate to expect from the cloud service provider	n_sup_as
245. I find that I am more comfortable with the SLA and more encouraged to use cloud computing services when the SLA specifies what I will receive for compensation for breaches and how this will be administered	n_com_as
246. I find that I am not more encouraged to work with the SLA and use cloud computing services when the SLA defines the terms that make up the cloud computing SLA	n_def_as
247. I find that I am not more encouraged to work with the SLA or use the cloud computing services when the SLA specifies the details of what is excluded from the agreement and the scope which the agreement covers	n_exc_as
248. I find that I am more willing to work with the SLA and use cloud computing services when the SLA clearly specifies the minimum network performance I am to expect	t_perf_as
249. I find that I am not more encouraged to use the cloud computing services or work with the SLA when the amount of storage to be received is specified in the cloud computing SLA	t_sto_as
250. I find that I am not more willing to work with the SLA or use cloud computing services when the cloud service provider specifies how it will schedule and execute maintenance and emergency activities	n_mtn_as
251. I find that I am more willing to work with the SLA and use cloud computing services when details of how the cloud service provider will deal with the physical security for the cloud computing facilities are specified in the SLA	t_psec_as
252. I find that I am more encouraged to work with the SLA and use cloud computing services when the cloud service provider specifies where the cloud computing facilities are located	n_loc_as
253. I find that I am not more willing to work with the SLA or use cloud computing services when the cloud service provider specifies the level of engineering support to expect in the SLA	n_eng_as
254. I find that I am not more encouraged to work with the SLA when the SLA specifies that information security audits will be conducted by the service provider and reports from the findings will be made available to users	n_soc_as
255. I find that I am more encouraged to work with the SLA or use cloud computing services when the SLA specifies how I can control and manage my resources in the cloud	t_orch_as

Items	Variables
256. I am not more willing to work with the SLA or use cloud computing services if the provider details the features of any incentives given with the service I am acquiring	n_fea_as
257. I find that I am more interested in working with the SLA or using cloud computing services when it is specified that I can discuss the contents of the SLA with the provider before entering the agreement	n_neg_as
258. I find that I am not more encouraged to work with the SLA or use cloud services when details of plans to continue operations and recover from unforeseen events are specified in the SLA	n_bc_as
259. I find that I am not more interested in working with the SLA or using cloud services when it is specified that my data, infrastructure and applications can be moved to another cloud provider if this becomes necessary	t_port_as
260. I find that I am not more encouraged to work with the SLA or use cloud computing services when the SLA specifies how general data and network security of the services will be ensured	t_gsec_as
261. I find that I am more encouraged to work with or use cloud computing services when the level of reliability to expect of services in the cloud is clearly specified	t_rel_as

Uncertainty, specificity, transaction cost, and adoption

Based on your knowledge and/or experience, how do you feel about using or continuing to use cloud computing services?

Items	Variables
262. I am encouraged to use or continue to use cloud computing services even when I am not clear about certain aspects of the SLA	uncert_u
263. I am not encouraged to use or continue to use cloud computing services because the cloud computing SLA is too difficult to understand and work with	cost_c
264. I will not use or continue to use cloud computing services when the SLA does not include certain aspects I consider important	specify_s
265. I am willing to use or continue to use cloud computing services for business related purposes regardless of how I feel about the SLA	adopt_a

SECTION B – Demographic and Cloud Computing Use

		Codes	Variable
266.	**Which of these categories best describes your company/industry? Select only one of the following.**	Codes	Variable
O	Information Technology	1	Industry
O	Telecommunications	2	
O	Education (Private or Public)	3	
O	Government	4	
O	Services – Logistics and Distribution	5	
O	Finance (Banking, Insurance, etc.)	6	
O	Manufacturing	7	
O	Transportation	8	
O	Other : ____________________	99	IndOther
267.	**What is the size of the business/organization? Select the option that best describes the range in which the size of the company belongs.**	Codes	Variable
O	1 to 99	1	OrgSize
O	100 to 299	2	
O	300 to 499	3	
O	500 to 699	4	
O	700 +	5	
268.	**Which of the following best describes your company's experience with cloud computing? Select only ONE of the following.**	Codes	Variable
O	I am currently using cloud computing service(s) but I am uncertain that I will continue to use it (them) in the future	1	CloudExp
O	I have used cloud computing service(s) in the past but I am not using it (them) now	2	
O	I am currently using cloud computing service(s) and I am certain that I will continue to use it (them) in the future	3	
O	I am not using cloud computing service(s) and I do not intend to use it (them) in the future	4	
O	I am not using cloud computing service(s) now but I intend to use it (them) in the future	5	
269.	**Which of the cloud computing services have you used or are using or intent to use? Select all that apply.**	Codes	Variables
☐	Software as a service – SaaS	1	SaaS
☐	Platform as a service – PaaS	2	PaaS
☐	Infrastructure as a service – IaaS	3	IaaS
☐	None of these services	4	ServiceNone

		Codes	Variables
270.	**If you are using or have used or if you were to use cloud computing services, which of the following best describes your reason for using or if you were to use cloud computing services? Select all that apply.**		
☐	Agility	1	Agility
☐	Competitive advantage	2	CompAdv
☐	Cost savings	3	Saving
☐	Data/information sharing	4	Sharing
☐	Performance over in-house	5	Perform
☐	None of the above	6	ReasonNone
☐	Other: ____________________	99	ReasonOther/ ReasonSpec

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