MYKOLAS ROMERIS UNIVERSITY/UNIVERSIDADE FERNANDO PESSOA

FACULTY OF SOCIAL TECHNOLOGIES/FACULDADE DE CIENCIAS HUMANAS E SOCIAIS

DIGITAL TECHNOLOGIES INSTITUTE

KEISHA LARAINE INGRAM

Social Technologies Management Joint Degree Programme

CLOUD COMPUTING TECHNOLOGIES AND MANAGEMENT FOR IMPROVING EFFICIENCY IN SMALL AND MEDIUM-SIZED ENTERPRISES IN JAMAICA

Master Thesis

Master Thesis Supervisor:

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Consultant:

Assoc. Prof. Dr. Ana Salazar

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GLOSSARY OF TERMS AND ABBREVIATIONS

ASBA- American Small Business Administration

CERT- Computer Emergency Response Team

CIOs- Chief Information Officers

CRM- Customer Relationship Management

CSA- Cloud Security Alliance

CSP- Cloud Service Provider

CTOs- Chief Technology Officers

ERM- Enterprise Resource Management

ERP- Enterprise Resource Planning

E2C- Enterprise to Customer

GATS- General Agreement on Trade in Services

GDP- Gross Domestic Product

GNP- Gross National Product

IaaS- Infrastructure as a Service

IEEE- Institute of Electrical and Electronics Engineers

ICT- Information and Communications Technology

IT- Information Technology

IXPs- Internet Exchange Points

NIST- National Institute of Standards and Technology

MIF- Multilateral Investment Fund

OECD- Organization for Economic Co-operation and Development

PaaS- Platform as a Service

PC-GNI- Gross National Income Per Capita

PII- Personally Identifiable Information

QoS- Quality of Service

SaaS- Software as a Service

SLA- Service Level Agreements

SMEs- Small and Medium-sized Enterprises

SOHO-Small Office-Home Office

SSN- Social Security Number

TDFs- Trans-border Data Flows

TRN- Tax Registration Number

WTO- World Trade Organization

INTRODUCTION

Scope of the Work: - The increased awareness and use of ICT technologies in business enterprises have made competition reach the highest level (Alshamaila et al, 2012). The resulting consequence is that traditional processes for the creation of goods and services have become obsolete (Pauly, 2011). For Small and Medium-sized Enterprises (SMEs) especially for start-ups, the main problem is limited resources which results in less advantage to compete effectively. Although SMEs play a vital role in developing economies like Jamaica through the availability of more than 80% of jobs for that country, the survival of these of enterprises are dependent on new strategies and ideas that are at a faster pace to gain that competitive edge over other local and international rivals in the global market (Digicel Business, 2010). New strategies that enable Jamaican SMEs to integrate new technologies that reduce costs and develop innovation rapidly will aid in removing the barriers to global competition as well as promoting some degree of flexibility for them (Primus, 2012). Cloud computing technologies can play a key role towards addressing the inefficiencies often experienced by Jamaican SMEs (McNaughton et al, 2012; Muir, 2013). In addition to the inability to compete globally, some of the inefficiencies include lack of business agility, access to-ready-to-consume IT infrastructures, software platforms and business applications that are critical for business operations (Lozano and Marks, 2010). In addition, the traditional waiting period for a new server deployment is unacceptable in today's competitive global market, which most of these SMEs are dependent on (Primus, 2012). Therefore Cloud computing technologies have the potential to address these inefficiencies experienced by Jamaican SMEs and also play a major role in the economic growth and competitiveness for these organizations (Muir, 2013).

Research purpose: - In order to contribute to a growing body of research on Cloud computing for developing countries, a new study on the adoption and implementation of Cloud computing technologies by Jamaican SMEs is required. Issues such as security, privacy, trust and data loss concerns, awareness and understanding of cloud services, top management support and financial costs and technology readiness are the main factors that usually affect the decision of Jamaican SMEs to migrate towards cloud services. Previous research indicates that access to scalable technologies such as Cloud computing services enable enterprises like SMEs to potentially deliver products and services, in a similar manner

like large enterprises. Yet for SMEs in Jamaica, difficulties still exist on the best approach for implementing such services for improving the operational efficiencies of these enterprises. Therefore in order to assist SMEs towards adopting cloud computing technologies, the research aims to uncover the insights and other necessary requirements involved which can enhance the efficiency of business operations from the use of cloud computing technologies.

Research novelty: - *Practical***:** The research gives a new look on the approach for recommending and implementing Cloud computing services for Jamaican SMEs and the risks and benefits involved for this implementation. The scientific community, managers and information and communication technologies (ICT) providers, stand to benefit. Previous, studies already indicate that advanced and complex technologically savvy SMEs of developed and developing countries have already realized the cost-benefit advantages and flexibility of Cloud computing services. They are also aware of the risks involved. Although Cloud computing service is already theorized as an efficient model for successful business processes, the traditional IT environment will require specialist staff to manage complex software, hardware and networking equipment for smooth business operations. In addition, SMEs will achieve from the added IT services maintenance benefits and still remain competitive in the continuous demanding business environment.

Theoretical: Many scholars have pointed out through previous and extant research that Cloud computing architecture provides access to potential applications and software as well for enterprises, despite the size or equity of that enterprise. Consequently, the novelty is validating the main presumption that Jamaican SMEs that access the scalable technologies of Cloud computing, have the potential to improve business efficiency in the delivery of products and services similar to that of large enterprises in the competitive business industry.

Research Problem Statements: - Previous research on cloud computing has been mainly concentrated on the business agility of this service (Berman et al. 2012). For developing countries such as Jamaica, concerns such as the availability of good internet connection, the quality of the level of data security and privacy within the cloud, and the most suitable cloud service model that promotes business efficiency at a minimal cost are key considerations. Therefore all factors including the political, economic, social factors can affect the implementation level of cloud computing adoption.

Jamaican SMEs business owners and managers are highly interested in cloud computing services due to the cost reductions, flexibility and the prospects for increased

business agility. Therefore a *"well-fitting environment"* for cloud computing adoption is also desired by these SMEs. Cloud computing technologies can indeed improve the efficiencies of SMEs however it is important to understand if this *"environment"* truly impacts the level of efficiency cloud computing can potentially provide to Jamaican SMEs and if business owners and managers of Jamaican SMEs are aware of those potentialities. Furthermore, as with any other technology cloud computing has many potential advantages and disadvantages, and although these advantages clearly prevail over its negative aspects (Briscoe and Marinos, 2009), the main problem is managers and business owners of Jamaican SMEs are not aware of the type of cloud computing technologies, if any, that are currently utilized by their SMEs.

Studies already confirm that more companies including SME are gradually adopting Cloud computing Services as a strategic pillar for business operations (Sultan, 2011). The growing unavailability of Information and Communication Technologies (ICT) in Jamaica has made this impossible. With this in mind the research aims to answer what will be the main requirements Jamaican SMEs should consider before fully adopting cloud computing technologies.

Aims and tasks of the work: - In recommending and aiding the adoption of cloud computing technologies by Jamaican SMEs, the main aim is: "To research how cloud computing technologies are perceived efficient by Jamaican SMEs business owners and managers." and addressing the problem statements raised in the previous section. In order to achieve this, the following tasks will be completed:

1) To determine the legal and external factors within the political, economic, social and technological (PEST) analysis that Jamaican SMEs must consider before cloud computing adoption.
2) To determine the underlying dynamics behind the decision for opting towards cloud computing adoption.
3) Determining the relevant business processes of Jamaican SMEs that requires cloud computing technologies and the extent to which cloud adoption improves those processes.
4) To identify the primary forces that supports and drives the cloud strategy.

Research objects: - The research objects for this work are **first**, the assumptions that an implemented cloud computing technology improves SMEs' efficiency, and **second**, the

assumptions that cloud computing technologies are perceived according to the use of its technology by SMEs users.

Design/methodology/approach: - *Theoretical* (including systematic analysis and review of archived scientific literature (journals) and case studies; comparative analysis of United Nations Development Programme ICT development country report documents and United Nations Conference on Trade and Development conference reports) for the primary data analysis. This approach is taken in order to evaluate and analyse the important scientific literature and concepts that underlies cloud computing technologies, ICT tools and infrastructure that are necessary for adopting technology by business enterprises. Taking into consideration that cloud computing is still in its early stages, the thesis will attempt to capture the insights that Jamaican SMEs business owners have towards Cloud Computing, understand its potential and what are SMEs main concerns toward the adoption of such technology for improving business efficiency. The qualitative exploratory approach will be used to assess further to evaluate the data from semi-structured interviews with ICT managers and specialists. These interviews are necessary since a majority of owned SMEs in Jamaica do not have in-house Chief Information Officers/Chief Technology Officers (CIOs/CTOs) rather IT and IT related services are normally outsourced. This should complement the explicit interpretive quantitative investigation approach which will involve the distribution such as structured questionnaire surveys to the research sample. Jamaica is selected as the region for the study, as the research is garnered on the main possibility that cloud services adoption improves efficiency of SMEs' business operations. SMEs are chosen for this research as they are perceived as the entities that contribute to creation of "decent" jobs in Jamaica, and are usually the business cubicle for the development of the larger firms in Jamaica. More importantly, SMEs are predominantly involved in the development of appropriate innovative technologies and for Jamaica, most private sector companies are SMEs.

Organization of the work: - The work will be organized into **four sections**. The **first section** gives an overview of cloud computing technologies, description of the cloud adoption models as well as the main concepts of those models will be introduced; this includes cloud computing architectures, cloud deployment strategies, cloud security and types of platforms. This section also gives an overview of Small and Medium-sized Enterprises (SMEs), the relevance of these enterprises in a country's economy, and the impact that the political, environmental, social and technological influencers has on the decision towards cloud

computing adoption for SMEs. The **second section** of the work discusses the current situation of cloud computing in developed and developing economies. The **third section** comprises of the research methodology and findings and explains the methodological approach for the work. Interviews with experts within the IT and business profession will be done in addition to an online structured questionnaire and the review of scientific literature and case studies discussed. The analysis from the literature review will provide additional insights into main influencers for cloud computing adoption. The critical and comparative approach strategy will be used for the analysis. The last part will present the findings (results) obtained from the applied methodology described. The **fourth section** provides the conclusions derived, and recommendations for future research.

Research Limitations/Implications: - The research focus was centered mainly on Jamaican small and medium-sized enterprises which may limit the applicability and generalization of the findings. In addition, as the majority of the findings were from SMEs based in services industry of Jamaica this may also limit usability as well.

Practical Implications: - The findings posed to offer Jamaican SMEs owners better insights and perspectives on how cloud computing technologies can be instrumental increasing key business efficiencies such as productivity, innovation, competitiveness and profitability.

ENUNCIATION

1. OVERVIEW OF THE MAIN CONCEPTS OF CLOUD COMPUTING, SMALL AND MEDIUM-SIZED ENTERPRISES (SMEs)

1.1 Cloud Computing Technologies

1.1.1 The Concept of the Cloud Computing

According to Gartner (Gartner, 2008) cloud computing is listed as one of the ten most disruptive technologies that would be responsible for shaping the information technology (IT) landscape. The concept of the cloud is not relatively new, as during the 1990s attempts by organizations to reduce the reliance of IT hardware first began with the concept of networking then towards grid computing systems in the 2000s (Chen and Low, 2010). Cloud development is as a result of the convergence of networking and grid computing with the increasing trend towards external outsourcing of IT resources (Chen and Low, 2010; Dimitrios and Dimitrios, 2012). This convergence was not a disruptive but rather a development of slow migration towards cloud. The cloud concept is primarily based on virtualization where the host on running the *"hypervisor"* application, develops virtual machines on the system which results in the processing of various OS and applications by the machine simultaneously (Chen and Low, 2010). In commissioning and operating these machines, the main task of hypervisors was ensuring that all individual copies of virtual machines are running independently without any overlap of the resource utilization (PCI Security Standards Council, 2011); at that time, the most popular types of machines in operation were Cirtix Xenworks and the Linux kernel based virtual machine, (Chen and Low, 2010).

The most significant event occurring in the history of cloud computing was introduction of delivering applications via a simple web site by Salesforce.com in 1999; following this Amazon launched its enterprise-to-customer cloud service, enterprise to customer (E2C), in 2006 and after the development of Web2.0 in 2009, the growth of cloud computing was established. Nowadays, organizations are continually bombarded with conflicting and extravagant claims of how cloud computing can instantly transform their businesses (Sahandi et al, 2013). As a result there are a lot of marketing hype from cloud vendors and IT analysts on capabilities of this technology. In addition to this, incumbent issues and risks surrounding cloud computing are also raised.

1.1.2 Cloud Computing

Grossman et al., states that no common standard or definition for cloud computing exists (Grossman, 2009; Voas and Zhang, 2009). Nevertheless, a definition that describes cloud computing as clusters of distributed computers that provide on-demand resources and services over a networked medium, usually an internet connection, is proposed by Grossman et al. Another definition developed by the U.S. National Institute of Standards and Technology (NIST) defines cloud computing as, *"a model for enabling 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 (NIST. Low *et al.* (Low et al, 2011) however, states that cloud computing is *"a kind of computing application service that is like e-mail, office software, and enterprise resource planning (ERP) and uses ubiquitous resources that can be shared by the business employee or trading partners".* Another definition used by Dahiru *et al*. (2014) states that cloud computing is defined as *"a parallel and distributed computing system consisting of a collection of inter-connected and virtualized computers that are dynamically provisioned and presented as one or more unified computing resources based on service-level agreements (SLA) established through negotiation between the service provider and consumers"* (Voorsluys et al.., 2011, p. i-xxv). Low et al. in their definition however agrees with Hayes (Hayes 2008) that a user on the internet can communicate with many servers at the same time, and these servers exchange information among themselves (Hayes, 2008). While the author agrees as all definitions provide a holistic explanation of the attributes and processes of cloud computing, the definition from NIST describes cloud computing as a *"model"* while Grossman et al. describes cloud computing as "*clusters of distributed computing"*; Low et al. in their definition has summarize the definition in one statement and has successfully defined cloud computing in both practical and theoretical contexts which represents the analogy and processes involved. Though the definitions describes the elements of the cloud, Dahiru *et al*. further argues, that cloud computing enables users to have access to highly scalable and reliable computing services, where service providers make available software and technology as services (computing and storage) over the internet. Yet, Armbrust et al, (2010) and Buyya et al (2009) states that the concept of cloud computing involves several computing paradigms

that has the potential for delivering a utility computing vision. These utility computing normally include cluster computing, grid computing, and more recently, cloud computing (Armbrust et al, 2010; and Buyya et al, 2009). Gartner (2009) likewise defines cloud computing as a style of computing in which massively scalable IT-related capabilities are provided as a service to external customers using internet technologies. With cloud technology, it is presumed that the end-user does not require the knowledge of the physical location and configuration of the system that delivers cloud services (Dahiru *et al.* 2014). Ambrust et al. (Ambrust *et. al*, 2010) have further summarized the key characteristics of cloud computing as: *"1) the illusion of infinite computing resources available on-demand; 2) the elimination of an up-front commitment by cloud users whereby resource allocation can be adjusted; and 3) the ability to pay for the use of computing resources when needed".*

As mentioned earlier, no standard definition exists for cloud computing however, UNCTAD states that cloud services can be collectively defined as: "*as services that are provided and used by clients on demand at any time, through any access network, using any connected devices that use cloud computing technologies"* (UNCTAD, 2013; ITU, 2012a). The key distinction between cloud services, cloud computing and cloud-based services is that cloud services can be accessed via a web browser; cloud computing is a way of delivering applications, services or content remotely to end users, rather than requiring them to hold data, software or applications on their own devices- through a process known as *"virtualization";* and cloud-based services are services that require software installation in order to make use of cloud resources (UNCTAD, 2013). However in order to avoid ambiguity and maintain simplicity of this study, cloud services and cloud computing will be used on an interchangeable basis.

1.1.3 Cloud Computing Architecture

Cloud computing architecture mainly relies on virtualization systems (Sahandi et al, 2013). These systems create multiple virtual IT environments, which controls the efficiency and the flexibility of cloud computing services. Sahandi et al (2013) states that the architecture plays a vital role for cloud computing operations- through virtualization, the capabilities for isolating physical server failures or slow server responses from user services is ensured.

As illustrated in Figure 1.3.1, the cloud computing structure contains five essential characteristics, four deployment models and three service models (Sahandi et al, 2013). More

importantly, the four deployment models in the cloud architecture are represented as layers in the cloud technology stack: cloud infrastructure (Infrastructure as a Service- IaaS); cloud application platform (Platform as a Service- PaaS); and cloud application (Software as a Service- SaaS) (Sahandi et al, 2013; Lozano and Marks, 2010). Several deployment models are offered in the cloud structure and the type chosen by organizations are usually dependent on management decisions, associated costs, and security. Previous studies indicate that due to the clouds' elastic and usage-based pricing model, public clouds are opted predominantly, as the most attractive solutions for SMEs. The main reason is because this model often allows start-ups and SMEs to benefit from enterprise level services and products as well as security, at a reduced cost than other deployment models (Wilson, 2002). Furthermore, common services like e-mail and other office-based application suites used by small companies equally can be obtained from major cloud vendors (Sahandi et al, 2013).

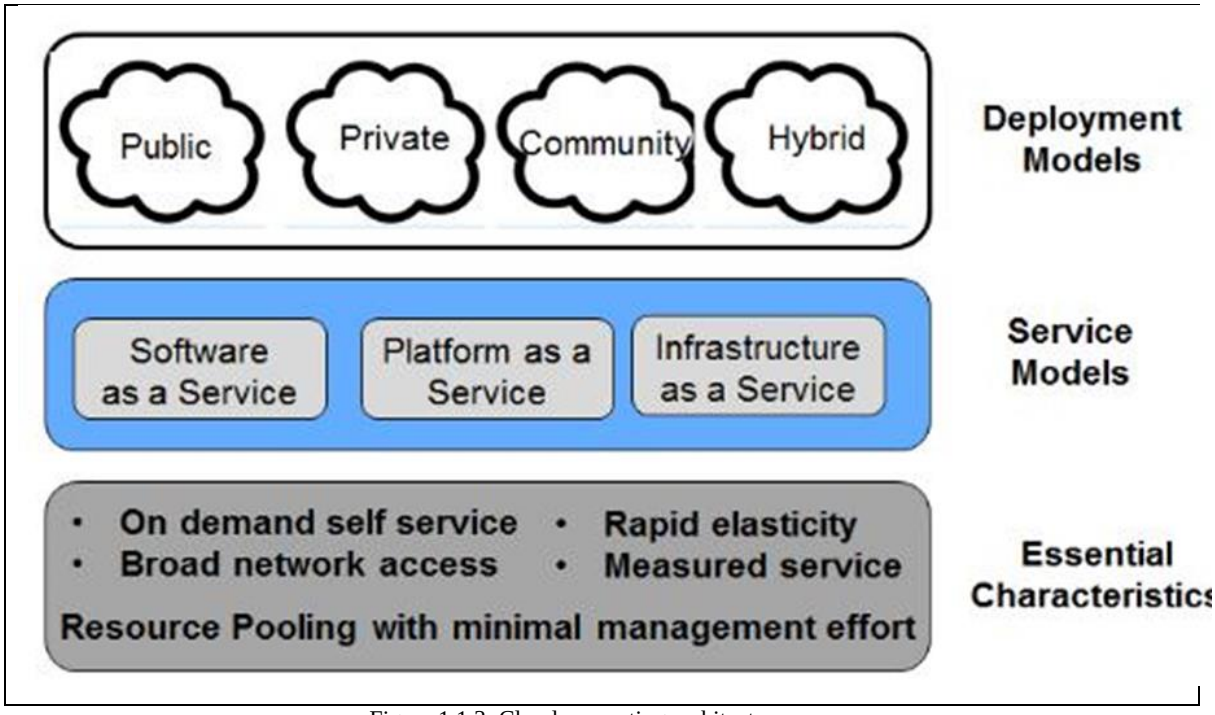

Figure 1.1.3: Cloud computing architecture
Source: NIST, 2010

1.1.4 Cloud Computing Deployment Models

The deployment of cloud services to organizations is usually dependent on the capacity of the cloud service provider. Currently, there are various existing combinations for deploying the cloud platform to users. The four common cloud models are private, public, hybrid and community cloud deployment models. Private cloud deployment model is

characterized as a cloud infrastructure that is operated exclusively for a single organization (Aleem and Sprout, 2013). Usually, it is managed by the same organization or a third party that exists on or off premises. Private clouds are attractive to organizations that require strict data control, while additional IT infrastructure investment is not an issue. On the other hand, a public cloud infrastructure is owned by the cloud service provider (CSP); for this cloud the CSP is responsible for the overall security and operations of cloud services. There is low degree of control by the consumer that uses this cloud infrastructure; however enhanced data efficiency and cost effectiveness are available (Aleem and Sprout, 2013).

Hybrid clouds are a composition of two or more clouds (private, community or public) developed to serve a particular purpose. In this setup, organizations may consider running non-critical applications in a public cloud while keeping critical business services in their private cloud. The main drawback for hybrid clouds is that it lacks standardization due to the integration and interoperability of different deployment models (Marks and Lozano, 2010). For a community cloud deployment model, the infrastructure is shared by several independent organizations with similar requirements (Aleem and Sprout, 2013). Usually these models have remarkable possibilities for organizations with the same business needs, compliance or legal limitations. Figure 1.1.4 illustrates the characteristics of each cloud deployment models

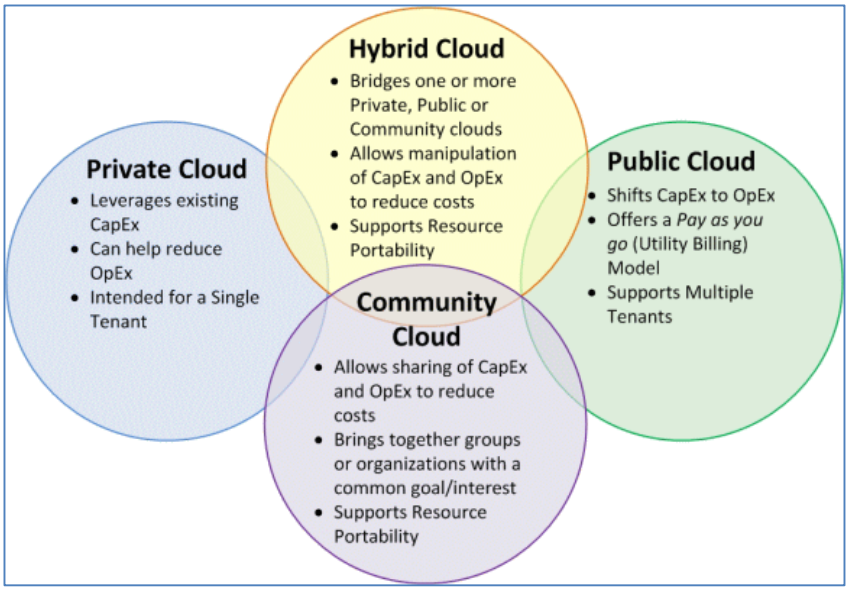

Figure 1.1.4: Cloud computing models
Source: IBM, 2011

1.1.5 Cloud Computing Service Models

Cloud computing services can be deployed through three main services models: Infrastructure as a Service (IaaS), Platform as a Service (PaaS) and Software as a Service

(SaaS) (Miller and Veiga, 2009; Salesforce.com; Sultan, 2010). Figure 1.1.5 illustrates the cloud service models:

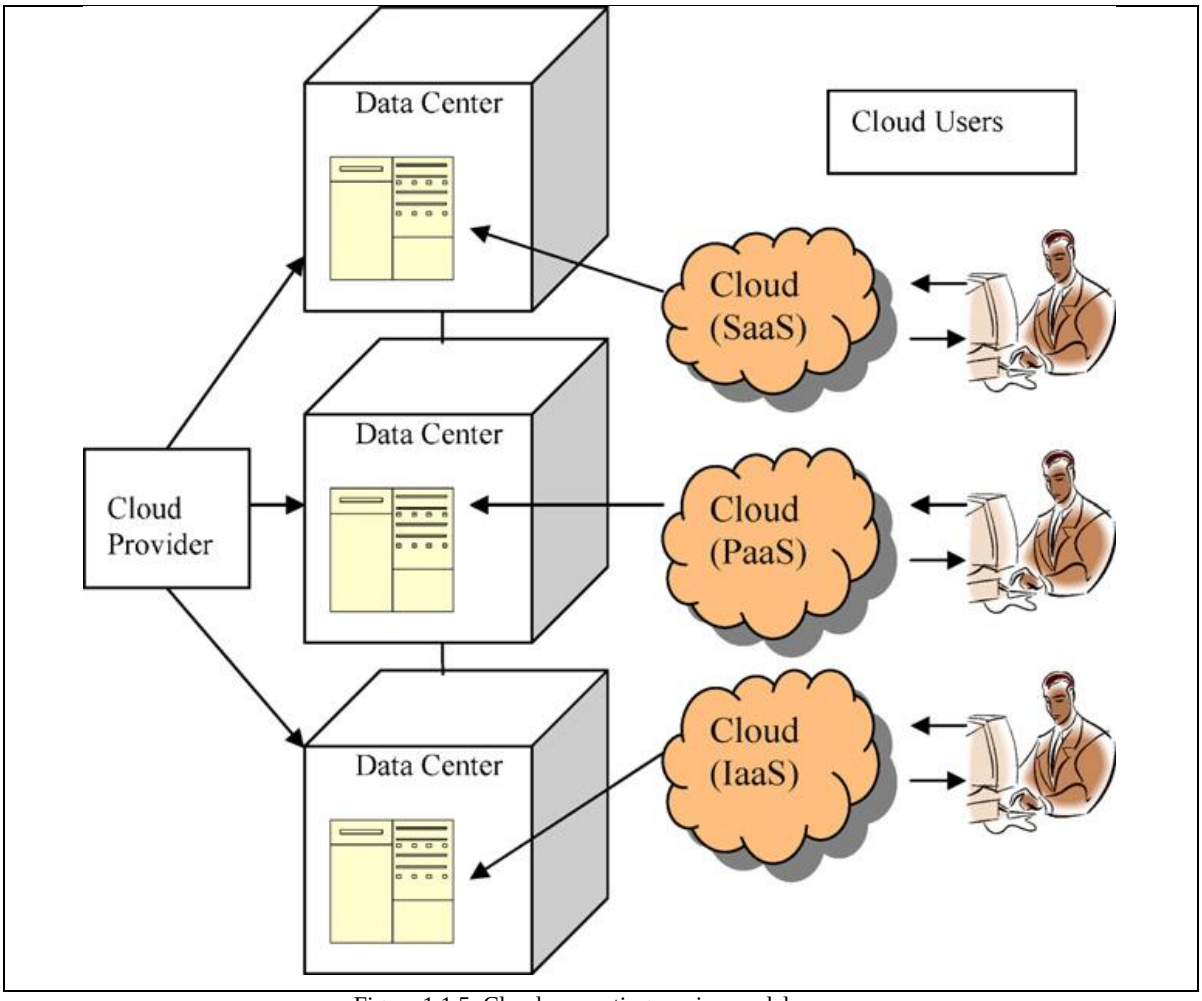

Figure 1.1.5: Cloud computing service models
Source: IBM, 2011

Infrastructure as a Service (IaaS) model delivers computer infrastructure as a service. With this model, organizations are able to outsource the equipment used to support operations, including storage, hardware, servers, and networking components. Products offered via this mode include the remote delivery (through the Internet) of a full computer infrastructure (e.g., virtual computers, servers, storage devices, etc.). This model is attractive for organizations, as it allows them the flexibility to manage their service demand, and help them access to the latest network technology at a much smaller cost (Mather et al., 2009). Amazon's EC2, GoGrid's Cloud Servers, and Joyent are well-known cloud service models.

The services provided by the traditional computing model which involved teams of network, database, and system management experts to keep everything up and running (e.g.,

operating systems, databases, middleware, Web servers and other software) are now provided remotely by cloud providers under this layer. Platform as a Service (PaaS) represents clouds that access a range of computer, database, and storage functions within a virtualized platform provided over the internet; the services from this cloud are released by Salesforce.com, Microsoft Azure, and Google App Engine. For this service, the service provider owns the equipment and is responsible for housing, running, and maintaining it (Hurwitz et al., 2010).

Software as a Service (SaaS) delivers software applications through the Internet as a service. For this service model, organization do not require to install and maintain software, rather it is access through the Internet; complex software and hardware management are not managed by the organization as well. Complete application functionality is offered which ranges from productivity applications (e.g., word processing, spreadsheets, etc.) to programs such as those for Customer Relationship Management (CRM) or Enterprise-Resource Management (ERM).

1.1.6 Challenges in the Deployment of Cloud Computing Service Models

The main challenge for vendors in the deployment of cloud computing services is making the service more interoperable with other cloud computing products and service partners (Sutherland and Chetty, 2014). Sutherland and Chetty (Sutherland and Chetty, 2014), further states that by making cloud service more interoperable, users have access to a wide selection services across multiple service providers. While this is a clear advantage for users/clients/applications, Kuyoro (Kuyoro *et al*, 2011) however contends that the availability of differentiated services from cloud service providers can lead to the underdevelopment of cloud ecosystems and cause vendor lock-in. This further prohibits users/clients/applications to choose from alternative vendors simultaneously in order to optimize resources at different levels within an organization (Kuyoro *et al*, 2011). While vendor lock-in, and data security are the main concerns for private users (Aleem and Sprout, 2013) business enterprises are faced with challenge especially when it comes to integrating the organization's existing systems with cloud services (Kuyoro *et al*, 2011; Sutherland and Chetty, 2014). Kuyoro et al states that in order to counter interoperability challenges faced by business enterprises, a seamless transition must occur from business enterprise local applications into the cloud. As interoperability is essential for cloud computing, conditions such as optimization of IT asset and computing in-house, as IT assets and capabilities are often associated with those

enterprises core competencies. It proposed that minimal functions such as human resource system can be outsourced to the cloud; also optimization purposes, such minimal functions can be outsourced to different vendors; and standardization to counter interoperability issues (Kuyoro, 2011).

1.2 Small and Medium-sized Enterprises

1.2.1 Definition of Small and Medium-sized Enterprises

Small and medium-sized enterprises, or SMEs, are firms or businesses which are small or medium in size, which arose from entrepreneurial activities of individuals (Lucky, 2012). Several definitions and meanings of SMEs exist and while these definitions are associated with the global diversity and characteristics of SMEs, Arowomole (2000) affirms that a single universally accepted definition of SMEs has not been easy as different countries have different criteria for defining SMEs. Although many countries have defined SMEs in terms of manpower, management structure and capital investment limit, experts have also contributed to the diversity in SMEs definitions (Arowomole, 2000). The most valid measures for defining SME are number of employees and size. Generally, there are three main categories for the SME sector: micro, small and medium enterprises or businesses. The micro SMEs are the smallest among the three categories. According to Darren et al. (2009), they are the businesses that employ up to 9 employees in UK while in Australia; they employ fewer than 5 employees including non-employing businesses. U.S. Census Bureau which tends to categorize business micro business as "SOHO (meaning small office- home office), non-employer business and non-employee business (including business less than 5 employees). Therefore, micro-business should be seen as the small type form of SME that may employ fewer than 9 employees or on the other hand may not have employees at all. The small businesses are business bigger than the micro-businesses in terms of size, number of employees, structure, capital investment and economic contributions.

Globally, several definitions of small businesses have been advanced over the years. In Nigeria, Alarape (2008) defines it as *"an enterprise with a labor size of 11-100 employees or a total cost of not less than N50 million, including working capital but excluding cost of land".* The Nigerian industrial policy defined SMEs as industries with total investment of between N100, 000 and N2 million, exclusive of land but including working capital. One of the most popular definitions of SMEs is given by the American Small Business

Administration (ASBA) as *"that business or firm which is independently owned and operated; it is not dominant in its field and meets the criteria for the SME business administration sponsored loans programme."* (Arowomole, 2000). The medium businesses as the name suggests are bigger than both micro and small businesses in terms of operations, manpower capacity or number of employees, structure, capital investment and size. According to Darren et al. (2009), they are the businesses that employ up to 249 employees in United Kingdom, in European Union, they employ up to 250 employees, in Australia, they employ up to 200 employees wile in U.S.A, they accommodate up to 500 employees.

For multilateral development institutions, such as the World Bank, varied classifications exist for defining SMEs. The World Bank's definition includes businesses three times larger by employees and five times larger by turnover or assets than the largest SME under the Multilateral Investment Fund (MIF) definition. At the same time, the average gross national income per capita (PC-GNI) of the developing member countries of the World Bank Group is significantly less than the average PC-GNI for the countries of Latin America and the Caribbean served by the MIF. Different industries and different countries define Small-medium enterprises differently and they use adverse classification for different fields regarding to employment, sales or investment. Based on this the author agrees there is no common definition for SME. While the European Commission has developed a tangible criteria for defining SME which includes employee numbers, turnover and balance sheet statistics, these criteria were afforded equal consideration and does not include the attributes of a modern day small and medium sized firm such as the backbone of "economy breeding" industrial development. Regarding to size and operations, SME assists endogenous sources and reinforces economy infrastructure. According to the Secretariat to National SME Development Council approved on 9th of June, 2005, SME is based on number of employees and annual sales turnover, and it is employed in three sectors, primary agriculture, manufacturing (including agro-based), and services (including Information and Communications Technology). SME characteristics and market attributes bring some obstacles including limited capital, cash flow and human resource. Cost effectiveness, flexible service and personal accountability are more important for customers.

1.2.2 Recent Trends in the Development of Small and Medium-sized Enterprises

Small and medium-sized enterprises (SMEs) account for a large share of private sector job creation in most countries (ILO, 2012). The private sector is the main engine of job creation and the source of nine (9) out of every ten (10) jobs in the world. Within the private sector, SMEs account for more than half of all jobs worldwide, though as countries become richer the share of larger firms in employment increases. They provide two-thirds of the formal private sector jobs in emerging markets. Informal enterprises provide 48 % of all jobs in emerging market countries, and 25 % of all jobs in developed countries, but only 37 % and 16 % of gross domestic product (GDP) in these two markets, respectively. In developed economies, a relatively small number of fast-growing SMEs account for the majority of new job creation. Firms comprising less than 10 % of the total SME population create 70 % or more of all net new jobs. In emerging economies, SMEs provide the vast majority of those jobs. Yet every second business remains credit-constrained in emerging markets, and struggles to raise the financing necessary to invest and create new jobs. For Jamaica, SMEs is a key segment of the Jamaican economy, making significant contributions of the Gross Domestic Product and employment.

As a small developing country, Jamaica has a population of approximately 2.9 million people (Muir, 2013; CIA, 2013) with over 80 % of employment opportunities confined to small/medium enterprises (SME) (Commosioung, Satchell and Waller 2008). These SMEs are classified as organizations with a gross revenue of less than JMD100 million and less than 50 employees (Commosioung et al. 2008). In order for countries like Jamaica to achieve economic growth, their SMEs must be able to adapt in order to survive and keep pace with the global business environment and the increased use of ICT is essential to achieve this is in a knowledge economy (McNaughton, Thompson and Duggan 2012). Currently, ICT adoption by many Jamaican SMEs is constrained by financial resources, lack of awareness, appropriate training and expertise. However, emerging technologies such as cloud computing can present new opportunities for cost-effective deployment of enhanced ICTs.

1.2.3 SMEs and the Economy

SMEs are important to almost all economies in the world, especially for emerging economies and countries with major employment and income distribution challenges. SMEs contribute to output and to the creation of “decent” jobs. From a dynamic basis, SMEs can be

called the nursery for the larger firms of the future and the next phase for expanding micro enterprises; usually these enterprises contribute directly, often significantly to aggregate savings and investment, and are involved in the development of appropriate technology.

In developing countries with large informal or micro enterprise sectors, SMEs constitute the middle of the size range, a fact that explains much of their strategic importance. In terms of organizational structure, SMEs are, on average, considerably more complicated than microenterprise, which involve largely the self-employed, sometimes accompanied on the job by a few family workers and hence usually having fewer than five (5) workers. On the other hand SMEs are, on average, are less complicated structurally than are corporations and other large firms, with their layers of management, high division of labor, etc. In the past, the weight of the non-agricultural SME sector in output and employment has traditionally reached its peak in the upper income tier of developing countries, where agriculture no longer constitutes a large part of the economy. At still higher levels of development its share tended to wane in favour of larger firms (and the public sector), but the last 2-3 decades appear to have seen an alteration in this pattern, at least as far as employment is concerned associated partly with an at times dramatic fall in the share of total employment found in the manufacturing sector (Palma, 2005) in both industrial and (nearly all) developing countries.

Depending on the case, the output share of SMEs may be greater or smaller than its employment share. Labor productivity rises monotonically with size across broad groups of firms, so whether the SME sector has above or below average labor productivity depends, among other things, on the relative size of the large firm and micro enterprise sectors. As with any other component of an economy, the size and importance of the SME sector varies from country to country; the last few decades have seen an increasing recognition of the role it plays in industrial countries, something already more obvious for developed nations from the 1970s or so. The SME sector, of course, includes firms in all of the major types of economic activity outside agriculture, from manufacturing to services. Despite the natural differences associated with the nature of the final product, SMES across these activities still share distinct features. Policy, including tax policy, can make a considerable difference to how well the SME sector fulfills its potential role in contributing to a healthy economy.

1.3 Small and Medium-sized Enterprises and Cloud Computing

1.3.1 Small and Medium Sized Sector- Strengths, Opportunities and Related Challenges

The importance and potential contribution of the SME sector are supported by both theoretical and empirical arguments and scientific evidence. Theoretical evidence suggests that part of the contribution of the SME sector both to the overall total factor productivity (efficiency) of an economy and to employment generation and distributional equality comes by virtue of its pattern of technology choice. SME technology tends to be intermediate between the highly labor intensive technologies of micro enterprise, which as a result achieve only low average labor productivity, and the highly capital intensive technologies of large firms which thereby achieve high labor productivity, but use more capital per worker than is available for the economy as a whole. Given this correlation between size and capital intensity, it becomes a likely that an economy that applies a high share of its capital to a small group of workers must necessarily have, as the other side of the coin, a large informal or microenterprise sector that uses very little capital, with the large amount of labor not employed by the large firms. A larger SME sector is best thought of as the alternative to a highly dualistic economy with most of the capital in the large scale sector and most of the workers in the very small-scale sector. An economy which is dominated by SMEs, as Jamaica's has been, can generate a low level of inequality in the distribution of primary income (before tax and transfer) whereas the dualistic economy characterized by the combination of much large enterprise and much micro enterprise typically generates a high level of primary inequality.

Another main strength of an SME is its intermediate technology characteristic that gives the sector a special role in the generation of adequate or decent employment. Whilst most jobs are in the micro enterprise sector, too many of them are destined to be low productivity and hence low income in character. SME firms are more productive "hubs", so in terms of the potential to generate "decent" jobs, this sector has the potential to compete against large private firms and the government, but still has the advantage of being able to generate many more such jobs for a modest input of capital. Developing countries without substantial SME sectors tend not only to have capital and the income from it concentrated in the larger firms, but also to have a "labor elite" in that sector, able to bargain for wages much higher than elsewhere in the economy. With the economy's capital stock almost completely used up by the large firms (usually a result of capital market imperfections), there is little

remaining capital to be distributed among the many workers not hired by large firms; this produces a large micro enterprise sector with the SME sector squeezed out for lack of capital. The equilibrium wage in the micro enterprise sector is very low and capital incomes are low there as well. In short, income is very unequally distributed. When the SME sector is large, these extremes in the distribution of both capital income and labor income are avoided.

Apart from being the sector to which one would like to see a high share of resources allocated at a given point of time, for the above reasons, the SME sector also plays a key dynamic role in generating growth, especially pro-poor growth. Nearly all developing economies have large micro enterprise sectors that, like the SME sector itself, are highly heterogeneous in many respects. In most countries for which such data are available it appears that most small firms (of say 6-25 workers) began as microenterprises and then grew. Thus the SME sector is, to a considerable extent, the place where successful micro enterprises thrive through a process which is at least in part one of survival and growth of the fittest. This positive selection process will of course be less prominent if for policy or other reasons it is hard to operate SMEs in a given country. At the other end of the size spectrum, most large firms have grown out of the SME sector, so its health helps to determine the future supply of large firms. Possibly those large firms with an SME background will be more likely to engage in subcontracting with other SMEs, an additional benefit to overall economic efficiency. SMEs tend to dominate a country's new and fast growing industries. Economies which discourage SMEs in any general sense are therefore likely to discourage some newer dynamic industries from putting down the roots they might otherwise do. In this respect, and in others, SMEs are associated with dynamism. An economy composed essentially of older larger firms runs the risk of becoming arteriosclerotic.

Economists emphasize, with the good reason, the importance of competition for efficiency. Except in large markets, there is not enough "space" for many large firms, perhaps only for a couple or perhaps only for one. In such cases, larger firms can exercise monopoly or oligopoly power. If there is to be price-lowering and quality-improving competition, it will come from SMEs. Often, given the relative scarcity of capital in the country, large firms achieve lower productivity than do SMEs. But even when they do have an advantage on that count, there remains the serious possibility that they will lower GNP and social welfare by engaging in monopolistic pricing and practices. Hence, it is not infrequent to see the potential

of smaller firms strangled by the monopsony position of large buyers in the intermediary chain.

Globalization brings the threat of a weakened SME sector, since its role in (direct) exporting is less than proportional to its size; in other words one activity in which economies of scale (based partly on oligopoly positions, brand loyalties, etc.) are important is international commerce. But globalization may also increase the importance of keeping the SME sector strong since its role in providing subcontractors for large exporters may be quite important in cases where transportation costs are not low. In a globalizing world, it is naturally important that as many major categories of firms have the capacity to compete in world markets. The importance of an efficient collaboration between large firms and SMEs through subcontracting is at its peak in outward oriented countries especially those competing in international markets in products involving a good deal of labor. Being able to rely of efficient low-cost subcontractors can substantially increase the competitiveness of the large exporters, and has been an important factor underpinning the successes of Japan, Taiwan and Korea.

On the empirical side, some features are common to nearly all SME sectors. The most important positive features have, naturally, gone with those cases where SMEs have made the biggest positive contribution. Broad empirical evidence highlighting the importance of SMEs includes the facts that:

a) The most successful developing country over the last 50 years, Taiwan, is built on a dynamic SME sector. This has produced both (for its time) record breaking growth and a quite low level of inequality, by comparative standards. The experience of Korea, Taiwan's partner among the Asian Tigers and a more or less equally fast grower, has provided the laboratory to illustrate another point—inequality can fall significantly when the weight of the SME sector rises quickly, as it did for a period after the mid-1970s in Korea.
b) Colombia's golden age of growth, from the late 1960s through the 1970s, coincided with very fast expansion of the manufacturing SME sector and with an apparent decline in urban inequality.
c) SMEs tend to use medium-sophistication technology, which is approximately consistent with the factor endowment ratios in most developing countries.
d) Many firms "grow into" or "grow out of" the SME size range, with both of these transitions having something positive to be said for them.

e) The SME size range is where many important entrepreneurs and firms of the future get their start.

The frequency with which SMEs manifest a capacity to grow fast and to innovate has, partly as the other side of the same coin, higher failure and exit rates than do large firms. In part this reflects a "survival of the fittest" process in which firms lacking strong entrepreneurial skills or simply in bad market niches do not survive. Few estimates have been made of the sort of deadweight loss associated with firm failure and the extent to which it lowers the average efficiency in resource utilization of the SME sector as a whole. The issue is complicated, since sometimes failure is a factor contributing to the longer run development of entrepreneurial capacity, since some of the physical capital of failing firms is not wasted but purchased and used by other firms. Getting the most from the SME sector requires better support systems, either from government or collective action by the SMEs themselves, than those required by larger firms. This is essentially because some needs of SMEs are in effect public goods while the parallel needs of larger firms can be effectively handled privately. The implication is that for countries with Governments of limited competence, the SME sector will not perform to its real potential. Finally, SMEs are simply not an efficient way to produce goods and services characterized by large economies of scale. This places an upper limit on the share of GDP that they can produce effectively. In some cases, where economies of scale are present but not strong, the SMEs constitute the better option because their production cost disadvantage is more than offset by the advantages of having a competitive rather than a monopoly price in the market.

1.3.2 Willingness of SMEs towards Adoption of Cloud Computing Services

Prior research suggests that the way in which adoption of cloud computing can revolutionize the business scenario into different technological innovations, facilities and resources is dependent on how this technology is easily accessed on demand (Tuncay, 2010). From a finance standpoint, Misra and Mondal (Misra and Mondal, 2010) developed two types of business models that can be drawn for companies willing to adopt cloud computing services: business models for companies with an existing IT infrastructure and business models for startup companies (Misra and Mondal, 2010). According to Misra and Mondal, one contemporary survey already suggests that current charging patterns and other factors of the cloud could make it highly suitable for small- and medium-sized firms (Misra and Mondal,

2010). However, firm size can have an effect on perceived strategic importance of cloud computing in innovative technological development. In response, Pyke (Pyke, 2009) affirms that business owners of enterprise applications typically should be in charge of their localized sets of processes during connection to these applications.

Regarding technological context, relative advantage and complexity as defined by Rogers (Rogers, 1983), is: *"the degree to which a technological factor is perceived as providing greater benefit for firms"*. It is reasonable that firms take into consideration the advantages that stem from adopting innovations (To and Ngai, 2006). Cloud computing services that allow operations to be mobilized through internet transactions, can substitute for or complement ERP software. The expected benefits of embedded cloud computing services include the speed of business communications, efficient coordination among firms, better customer communications, and access to market information mobility (Armbrust et al., 2010; Hayes, 2008). However, firms may not have confidence in cloud computing system because it is relatively new technology to them (Buyya et al., 2009) and can take users a long time to understand and implement the new cloud system. Thus, complexity of an innovation can act as a barrier to implementation of new technology; complexity factor is usually negatively affected (Premkumar et al., 1994).

Compatibility of cloud computing services is another main factor considered by SMEs. Compatibility, which is the degree to which innovation fits with the potential adopter's existing values, previous practices and current needs (Rogers, 1983), is a an essential factor for innovation adoption (Cooper and Zmud, 1990; Wang et al., 2010). When technology is recognized as compatible with work application systems, firms are more likely to consider the adoption of new technology. On the other hand, when technology is viewed as significantly incompatible, major adjustments should be made.

From an organizational context, top management support and firm size attributes, such as size, quality of human resources, and complexity of the firm's managerial structure (Hong and Zhu, 2006; Oliveira and Martins, 2010), are key features that are for creating a supportive climate and for providing adequate resources for the adoption of new technologies (Lin and Lee, 2005; Wang et al., 2010). As the complexity and sophistication of technologies increase, top management can provide a vision and commitment to create a positive environment for innovation (Lee and Kim, 2007; Pyke, 2009). Top management plays an important role because cloud computing implementation may involve integration of resources and

reengineering of processes. Moreover, previous research has found that the size of a firm is one of the major determinants of IT innovation (Dholakia and Kshetri, 2004; Hong and Zhu, 2006; Pan and Jang, 2008). Some empirical studies have indicated that there is a positive relationship between top management support and adoption of new technology (Pan and Jang, 2008; Zhu et al., 2004). It is often reported that large firms tend to adopt more innovations, largely due to their greater flexibility and ability to take risk (Pan and Jang, 2008; Zhu et al., 2004). Consequently, firm size is an important factor.

1.3.3 Importance of Implementing Cloud Computing Services

Migration to cloud computing with a standard IT model is difficult for SMEs, although long-term benefits are more tangible in comparison with short-term. IT partners of SME should be swayed about the benefits of leveraging cloud services. The experiences of SMEs investing in innovative technologies, such as cloud computing, should also provide additional evidence concerning patterns of adoption (Levy 2009). It is obvious from the analysis in the previous section that the emerging systems of cloud computing have the potential to multiply the productivity, efficiency and profitability of small scale enterprises. However, some SMEs remain reluctant to avail themselves of broadband services, or consider the possible advantages of cloud computing, due to perceptions (or misconceptions) regarding possible capital investment, fear of complexity, lack of understanding of the potential benefits, and lack of technical resources. Others are more willing to test broadband or cloud applications, but do not see it as part of a larger strategy (Jayakar et al. 2010). Evidence suggests that even large companies (contrary to conventional wisdom) are actually embracing cloud services. Consequently, an increasing number of companies (small and large) are beginning to see some real value in using the cloud (Sultan 2010).

There are many opportunities and advantages for SMEs for using cloud computing. Opportunities to test new software, evaluate third party applications, increase resources on demand to satisfy seasonal or temporary demand and offer software to customers as SaaS, and other benefits including time saved in dealing with technological issues which allows employees to focus on core competencies of the enterprise. As a result, cloud computing is likely to be an attractive option for many SMEs, particularly since the recent global economic crisis. Cloud computing has flexible cost structures and scalable. Cloud computing is likely to be more suitable for SMEs based on the following: availability; user friendliness; ubiquitous

systems; low price; customer support/communication; availability of staff to work with and maintain the system; strategic impact; software already existing to implement customizable Enterprise Resource Planning (ERP); and the existence, in some countries, Government/tax regulation and policies that support cloud computing technology. Specifically, access to cloud services has become critical for assessing SMEs competitiveness and efficiency. Conversely, lack of access would imply that the SME sector will not achieve its full potential. In general, cloud computing services provide an open business platform for everyone, everywhere, for every country, for every company, for every organization and for every kind of business and new opportunities to collaborate and network between business partners, by providing access to sources of information that are time and distance independent.

Social media platforms also allow SMEs to build customer relationships by sending occasional text messages or emails, or by building their profiles through Facebook (and similar) pages rather than conventional websites. Social media, in this sense, adds a new dimension to the "word of mouth" on which many small businesses have always depended to extend their market reach. Following their customers' interests online can even offer SMEs an opportunity to target their own services more precisely on consumer trends. Cloud-based information services also offer opportunities for marketing. Public cloud services can therefore add value to SMEs, particularly those that deal directly with individual consumers, though care needs to be taken to protect the privacy and security of both SMEs themselves and of their customers.

1.3.4 Recent Trends in the Adoption of Cloud Services and Implementation by SMEs

Initially, cloud computing was created for commercial purposes in 2007 by industry giants like Google and Amazon, with technology and resources based in centralized data centers, dynamically adjusted and tuned to achieve optimum efficiency and provide an unparalleled economy of scale. The cloud model is delivered to end users (individuals, SMEs and enterprises) as oriented pay-per-use services in which guarantees are offered by the providers by means of customized Service Level Agreements (SLAs) (Yang et al. 2009). This converts computing power into public utilities like water, electricity or gas supplies; this is a profound paradigm change for the IT industry and society as well (Marta et al. 2011).

The type of cloud computing technology likely to be adopted by enterprises are those that offer hybrid "public" cloud and "private" cloud services when appropriate (Goscinski

and Brock, 2010). The concept of private cloud computing involves firms deploying key enabling technologies, such as virtualization and multi-tenant applications, to create their own private cloud database. Individual business units then pay the IT department for using industrialized or standardized services in line with agreed chargeback mechanisms. For many firms, this approach is less threatening than an overall move to the public cloud and should make it easier to hand individual services over to trade partner providers in future (Tuncay, 2010). Moreover, cloud computing is a new business model wrapped around new technologies, such as virtualization, applications (Software as a Service (SaaS)), platform (Platform as a Service (PaaS)), and hardware (Infrastructure as a Service (IaaS)) (Goscinski and Brock, 2010).

From the standpoint of an SME, the benefits of cloud-based technologies are: low start-up costs, low cost for sporadic use, ease of management, scalability, device and location independence and rapid innovation, according to Google (TechRepublic et al. 2009). Therefore, helping businesses to attain the benefits of cloud computing, by taking advantage of its potential for incremental improvement, avoids disruptive transformation of business processes (Skilton 2010). SMEs stand to profit from pay-per-use, high performance computing scenarios (Dimitrakos 2010), enabling them to encourage innovation and enhance their competitiveness (Chen et al. 2011). Nair et al. (2010) states that SMEs can also benefit from the cloud computing service delivery model as it can reduce capital expenditure, create increased IT agility, faster return on investment, removes trade barriers and is likely to offer more robust and resilient infrastructure, which leads to business continuity. Therefore, cloud computing technology and services can generate promising opportunities for SMEs to collaborate and create new competitive advantages in the current digital business context (Petrakou et al. 2011).

Finally the attractiveness of cloud computing lies in its ability to show SME entrepreneurs tangible cost savings, increased productivity and improved responsiveness to the business, when the cloud infrastructure is integrated as part of their IT strategy. According to (Tumer, 2010), cloud computing can act as a key enabler for future innovation, add value and enhance growth, wealth and employment in the global economy, thus creating healthy and sustainable societies.

1.4 The Surrounding Issues Involved in Cloud Computing Adoption by Developing Countries

1.4.1 Barriers to Cloud Adoption in Developing Countries

Most SME businesses in developing economies often face difficulties to invest in ICT. At least two thirds of SMEs are found in manufacturing, finance, mining, and hospitality sectors (Al Berry, Cassim, Kesper, Rajaratnam, and van Seventer, 2002). According to Subashini and Kavitha (2010) small and medium-sized enterprises have started realizing the benefits of cloud computing and they have boosted their businesses by tapping into the cloud infrastructure to gain fast access to the best business applications and ICT infrastructure at a negligible cost. Cloud computing has the potential to bring significant benefits to these small businesses by reducing the costs of investment in ICT infrastructure. Cloud computing allows the access of services such as software, data access, and storage to end-users without the need to know the physical location and configuration of the system that delivers the services. Bakshi (Bakshi and Hemachandran, 2011) have identified the benefits: simplified cost and consumption model, faster provisioning of systems and applications, right size to address business changes, ease of integration, highly secure infrastructure, and compliant facilities and processes.

Despite the advantages that come with cloud computing, its adoption and implementation in developing economies is faced by a variety of challenges. As technology became more pervasive within organizations, the increasing complexity of managing the whole infrastructure of disparate information architectures and distributed data and software has it more expensive than ever. For small and medium-sized enterprise, capital and cash flow is very limited and for most units, making substantial investments in IT is hardly an option. Nevertheless, the promise that cloud computing offers towards delivering all the functionality of existing information technology services is still feasible as upfront costs are reduced (capital investment). Increasing, IT infrastructure actually requires more human resource support as well for training and developing staff to use new ICT tools and technology.

Cloud migration through a third party cloud infrastructure presents many opportunities for enterprises to improve the management of income and outgoings for both finance staff and customers. It also helps enhances more cash-flow management for small enterprises and lessens the variability of expenditure on electricity required to operate in house data centers. These are some of the benefits of cloud computing especially when compared to the in-house

data center, which requires the purchase of expensive hardware, software and increasing human resources; to source cash flow necessary to establish data center can be tiresome, since cash flow from clients can be slow and difficult. The cloud infrastructure is also very helpful for the finance department of enterprises as it has the possibility to reduce administrative costs. Third party cloud infrastructure services can offer new pricing models, which help in managing income for cloud customers. Economics, simplification and convenience in the way computing-related services are delivered, seem to be among the main drivers of cloud computing; cost reduction another key driver for opting to cloud computing technologies as well. In providing a future perspective of cloud computing, Lillard (Lillard *et al* 2010) claims that supplying on demand computing power in a very low-cost fashion was the main driver of cloud computing emergence. Furthermore, Marston et al (2010) highlighted the lower cost of entry for small business as one of key advantages of cloud computing not only for SMEs but for third world countries as well. Cloud computing represents a huge opportunity to many developing countries that have been so far left behind in the IT revolution (Marsten et al, 2010).

The ability to respond to rapidly changing customer needs in today's economic environment is a key competitive differentiator. However, agility for SMEs is not only a competitive advantage rather it is vital for them to survive in nowadays-fast changing business environments. By enabling businesses to rapidly adjust processes, products and services to meet the changing needs of the market, can increase business agility (Berman et. al). Through cloud support, enterprises can offload three kinds of low-level administrations: 1) system infrastructure, which includes hardware maintenance, spare parts, adding ICT infrastructure, and software; 2) once the enterprise define its backup policy, the cloud service provider is responsible to execute it; 3) a single application becomes available to all authorized users. Though the management of the application i.e. application support, upgrade issues and user management is not included during migration to the cloud (Buyya et al., 2009). Outsourcing this kind of low-level maintainability and keeping infrastructure operational, often brings the business agility to enterprises and helps them to focus on improving other business processes. Cloud computing also lowers IT barriers to innovation, as can be witnessed from the many promising start-ups.

The scalability of services, various types of billing for cloud computing services also makes possible new classes of applications and services that were not possible before. Some

these include mobile interactive applications that are location-, environment- and context-aware, with real-time response to information provided by human users or artificial technologies. Another type of new applications that cloud computing has made possible is parallel batch processing that allows users to take advantage of huge amounts of processing power to analyze huge amount of data for relatively small periods (Heiser and Nicolett 2008). These business analytics use vast amount of computer resources to understand customers, buying habits, supply chains. In addition, cloud computing offers offloading sophisticated technical IT related tasks and management that needs normally requires deep knowledge and skills to maintain IT infrastructure. By hiding those complexities, the end user can produce sophisticated products or services without need to high level IT knowledge (Cooper, 2009).

Establishing a fair competition environment and lowering the barriers is another benefit of cloud computing technology. In the past, large corporations have had an advantage over small corporations in terms the unlimited access to capital and their ability to leverage their existing human resources, software, and hardware infrastructure to support new marketing and strategic initiatives. However, since the advent of cloud computing, the barriers to entry for a particular market or market segment for a start-up company have been dramatically reduced and cloud computing may have tipped the balance of strategic advantage away from the large established corporations towards much smaller or start-up companies (Cooper, 2009). Another benefit that is available by cloud computing is “green computing”. As environmental issues gain more importance nowadays in the decisions of firms and businesses, greener alternatives in regards to electricity usage by servers and cooling devices in data centers should be utilize more. Traditional data centers consist of server, cooling units and other overhead power consumption can be expensive. It can be worse when power management is not well done or is not efficient. Cloud vendors are managing these much better when compared to data centers where cloud vendors tend to cluster near hydropower (Rosenthal 2010). Usually data centers of cloud vendors are often located where natural facilities help them do cooling easier and with less energy consumption.

Conventional data centers can have low resource utilization with highest estimates accounting up to 15-20% (Shayan et al. 2013). In cloud computing data centers, this situation is better by having multi-tenants and sharing resources for many customers, increase the resource utilization to 40% by load sharing over time zones, mature virtualization leveraging and fostering more diverse user bases. Consequently, higher utilization means less power

wasting and utilizing valuable power efficiently, which helps the environment to keep safe. Public cloud providers locate their data centers where bandwidth, cheap energy, abundant water for cooling, and proximity to markets are optimal. They have focused on creative approaches to efficient resource usage including not only electricity usage but also water recycling and equipment recycling upon disposal (Zhang et al. 2010).

1.4.2. Main Issues Surrounding Cloud Computing Service Models and Service Level Agreements

The burden of the security lies with the cloud service provider in Software as a Service (SaaS). This is due to the degree of abstraction, with the SaaS model having a high degree of integrated functionality with minimal customer control or extensibility (Winkler, 2011). Most enterprises are still uncomfortable with the SaaS model, due to lack of visibility about the way their data is stored and secured (Subashini and Kavitha, 2010). Consequently, the risk of loss of data and breach of privacy is high in SaaS for organizations. Subashini and Kavitha identified the key security elements directly related to SaaS, some of them are: data security, network security, data locality, data integrity, data segregation and data access.

According to Winkler (2010) Platform as a Service (PaaS) model offers greater extensibility and greater customer control but fewer higher-level features. Consumers are given some control to build applications on top of the platform but still any security below the application level will still be in the scope of the CSP. Extensibility means less complete built-in capabilities that extends to security features, but there is more flexibility to layer on additional security (Subashini and Kavitha, 2010).

The relative low degree of abstraction, Infrastructure as a Service (IaaS) offers, means that greater customer control can be maintain over security than do PaaS or SaaS, as long as there is no security hole in the virtualization manager. This is mainly because the customer has less control over the IT organization. IaaS security issues are based on the cloud deployment model through which it is being delivered. For instance, public cloud poses the major risk whereas private cloud seems to have lesser impact. Physical security of infrastructure and disaster management if any damage is incurred to the infrastructure is of utmost importance in IaaS (Subashini and Kavitha, 2010). Cloud computing is faced with a number of challenges such as: secure data storage, high-speed access to the internet, and

standardization. Security in the cloud is a sensitive issue since the introduction of the concept. A joint survey by IEEE/Cloud Security Alliance (CSA) in 2010 indicate that the need for cloud computing security standards is important and urgent and it can hinder the growth of cloud computing. Armbrust et al. (2010) acknowledges that the availability of the secure service or business continuity as the main obstacle to growth of cloud computing. In addition data confidentiality and auditability is another obstacle, as the loss of data and breach of privacy in the cloud can cause major disruption in the business operations of an organization. This can be even worse for small organizations who may not afford alternative measures such as maintaining legacy systems in case of cloud failure. While cloud computing deployment models are more concerned with data storage security and for delivery models data transmission, security is still the main concern. In addition, security needs varies for each deployment or delivery model. Privacy is also another area of security that concerns CSPs (Bristow, Dodds, Northam, and Plugge, 2010) and more so for the consumers and it is a threat to the success of cloud computing.

When considering how to secure public versus private cloud architectures, the security concerns are more different than common. For instance, if a cloud is private, internal on a customer premises, and owned and managed exclusively by the organization utilizing it, the principles in securing it will vary greatly from those of a public cloud hosted externally by a third party. Winkler (Winkler, 2011) states that a private cloud may not have the data confidentiality and legality concerns that a public cloud might contain. In regards to SMEs in developing economies, all security issues are mostly influenced by the fact that the CSPs are not locally available, hence the lack of specific guarantees and assurances make organizations hesitant to adopt the cloud and trust third parties. Security fears range from the loss of service availability to privacy breach at data centers and how all this affect the final service level agreement (SLA) to be signed by both parties.

Cloud service can be unavailable due to a number of factors. These factors include security breaches at the physical location of data centers, failure of equipment at data centers, consumer site equipment failure, connectivity failure – this is a major issue in developing economies due to distances between the provider's equipment and consumer site. It is made worse by the lack of reliable internet connectivity in developing economies, since cloud computing relies heavily on network connectivity. If there is a pay-as-you-use model for cloud computing service, consumers still have to pay even when the service is unavailable.

Therefore measures need to be in place to manage not only risk of temporary service unavailability but also those situations when a CSP suddenly and unexpectedly stops delivering services. Reputable sites like Google, Amazon, and Microsoft have also been known to have been down and unable to provide services for some time. Another issue to be considered involves is when an organization transfer services to the cloud, the organization or individual no longer retains direct access and control (Bristow et al., 2010). An example of this was in October 2011, Research in Motion‘s Blackberry network service was unavailable for days to users across the globe, causing a major backlog in their messaging service (New York Times, 2011). Therefore, business must have alternative means to deal with such failure especially if it can affect key business processes.

The process of negotiating the SLA is also a cause of concern, since it can result in a compromise between the needs and demands of both the provider and consumer. Although some quality of service aspects that are part of the SLA are difficult to monitor and changes may be caused by external circumstances according to Keller and Ludwig (Keller and Ludwig, 2003). An example of this is where, metrics like response time and output might be affected by network connectivity that is controlled by third parties. Patel, et al (Patel et al., 2009) has highlighted the need for a clear and formal methodology to handle the dynamic nature of cloud computing SLAs. Ultimately, the risk of security and privacy breaches plays a role in SLA negotiation, so does the reliability of the network connectivity.

A reliable identity management ensures accurate pricing of cloud services usage for cloud consumers. Since identity theft is on the increase, cloud consumers need to be sure that reliable verification mechanisms are in place to verify authenticity and to ensure that people are who they say they are, in order to avoid the risk of paying for service consumption that was done by an intruder. In cloud computing, there is a need of multiple layers of security to ensure consumer comfort. Security should be applied from the infrastructure layer (hardware, operating system and storage), and the network layer for data transmission and package applications must ensure that all components of the cloud service offered has no security holes. Regular testing should be done to assure operability in different environments and scenarios, such as, variable networks with low bandwidth. This ultimately allows the provision of binding specific guarantees in the SLAs. In regards to privacy, cloud computing consumers’ data should be protected from access by the cloud service provider other consumers. In terms of competing organizations, this can jeopardize competitive advantages

over rivals. Guarantee that cloud service provider will not use consumers for any unintended purposes should be ensured as well. When services are offered by providers from a different country, there is the risk of an organization‘s data being confiscated by the service provider’s authorities when the regulations of that country have been violated. Hence there should be trust between the consumer and cloud service provider to ensure a workable trust relationship.

1.4.3 Key Issues Surrounding Cloud Computing Adoption by Jamaican SMEs

The main issue adoption of cloud computing service is that the service may lead to a loss in ICT capabilities for adopting organizations. ICT capabilities, as stated by Muir (2013), are the set of abilities and competencies an organization can bear to bring when deploying and managing ICT resources (Amit and Schoemaker 1993; Grant and Liebenau 1997; Schendel 1994). Feeny and Willcocks (Feeny and Willcocks 1998) suggest a set of core ICT capabilities in their framework that organizations are encouraged to foster in order to remain competitive in the modern world. By moving resources to the cloud, organizations may be left with decrease capabilities such as technical skills and ICT management competence that are required to compete in a rapidly changing environment (Willcocks and Feeny 1998). Organizations that consume cloud resources are also faced with the risk of disruption of their activities due to internet disconnection (Armbrust et al. 2010; Cowie 2012). Although Jamaica has several Internet Service Providers (ISP) many of these gain access to the internet using the limited submarine fiber connections located outside of the country (Ryan 2011). Disruptions in electricity supply, which is frequent in developing countries, will also impact these activities. Jamaican SMEs can be subjected to downtime from electricity disruptions and although they can control their own power using small private power generators. Cloud service providers are affected by these power outages and it is even worsen as hydropower source or solar energy as an alternative energy source is limited in Jamaica.

Security is another main barrier for cloud adoption by Jamaican SMEs. Although experts from one side suggest that providing access to critical organizational information to a third party is a major security risk (Armbrust et al. 2010; Jamil and Zaki 2011), other experts suggest that cloud service providers can safely provide access and are better equipped to provide security than in-house IT security specialists (Mills 2009). The author agrees with this as Jamaica a country where the level of IT capabilities typically required by SMEs to support their infrastructure is low and can be a barrier to technology improvement (McNaughton et al. 2012). Another main risk is multi-tenancy (Carlin and Curran 2011;

Mishra, Mathur, Jain and Rathore 2013), virtualization (Mishra et al. 2013) and data management (Jamil and Zaki 2011). Multi-tenancy allows multiple clients to coexist on shared physical resources. This can lead to increased security vulnerability if some of the clients on the shared hosts that have lower security.

Virtualization is the architecture through which discrete operating system instances can be simultaneously enabled on a single physical server and is the means by which multi-tenancy is enabled. The management layer for virtualization called the hypervisor can increase risks as it provides an additional exposed layer through which security can be breached (Armbrust et al. 2010; Krishnamurthy and Wills 2009; Mishra et al. 2013). The methods for managing cloud data can also provide security risks. Clients are typically unaware of these procedures and whether those mechanics are suitable for their security or legal requirements. For example, although the majority of cloud providers use encryption to transmit data, the clients may not be the ones who control the private keys or certificates used. Not all cloud providers encrypt the data stored in their systems and in addition, the techniques used by the cloud provider to delete and back-up data can have a significant impact on a systems' security and ability to recover from incidents (Jamil and Zaki 2011; Robison 2010).

Closely tied to the issue of security, the concept of privacy is another consideration when determining the adoption of cloud solutions. Whereas security is more concerned with the techniques used to protect information, privacy is concerned with who has access to the data in a system (Conway, Maxwell and Morgan 1972; Malhotra, Kim and Agarwal 2004). There are two basic divisions when it comes to cloud privacy – individual privacy and organizational privacy. Individual privacy is the ability to control access to Personally Identifiable Information (PII) most closely associated with names, photographs, messages and government identification (Krishnamurthy and Wills 2009) such as a Social Security Number (SSN) in the United States or the Tax Registration Number (TRN) in Jamaica. Organizational privacy is associated with institutional data that may have strategic, legal and financial considerations such as financial or customer information (Culnan and Williams 2009). To complicate the issue further, the worry is not only if the cloud provider has access to this information, but what third parties may also be able to gain access. Unfortunately, although data protection laws in the developed world exist and have been revised to take into account advances in ICT, the current ICT level in Jamaica is far behind. The discrepancies in the data

protection laws between nations have already become a concern, especially for international cloud providers.

Jamaican SMEs like most organizations globally, also fear vendor locked-in (Armbrust et al. 2010). This makes the purchased services almost completely dependent on that single provider and places those services at risk if the vendor ever closes, or the organization decides to move to another provider (Dhillon and Backhouse 2000). This is due to the fact that there is no common interface or framework used by all cloud providers (Armbrust et al. 2010) or for issues with the contract (Dhillon and Backhouse 2000; Lacity and Hirscheim 1993). This can be a major problem for SMEs although cloud services can be very flexible within their provider's architecture. The service can however be inflexible when SMEs are attempting to migrate to another cloud service provider.

1.5 Conclusions and Summary

Given the positive economic impact of cloud computing, but also the challenges inherent to cloud computing, policy makers of Jamaica have an important role to play in a multitude of areas:

a) *Spurring the use of cloud computing:* the Government of Jamaica have a role to play to spur the use of cloud computing, for instance, through removing unnecessary legal and regulatory barriers, being lead users, through fostering skills and education, through supporting ICT related-projects and establishing public-private partnerships.
b) *Establishing standards:* One of the major challenges facing the development of cloud computing is the lack of appropriate standards in some areas, the lack of widespread adoption of existing standards and the potential for vendor lock-in due to the use of non-interoperable solutions. The Government of Jamaica should encourage and support the continued development of open interoperable standards for business support, provisioning and configuration by, for example, coordinating with different standards institutes or by mandating open standards in public procurement.
c) *Measurement of cloud computing:* to date, there is little publicly available data in the area of cloud computing. Jamaican policy makers, in consultation with stakeholders, could play a role in identifying relevant criteria and developing a standard framework for the measurement of cloud computing.

d) *Cloud computing for development:* cloud computing provides a very interesting means for SMEs in Jamaica to access powerful computing resources at low cost. However, some challenges must be overcome to allow this to happen, such as ensuring the availability of broadband network infrastructure. This is where Jamaican policy makers have an important role to play in: *expanding fixed and wireless broadband access in developing countries*; encouraging the development of cloud computing and the adoption of cloud services in Jamaica in order to take advantage of cloud computing resources to spur economic growth; enhance educational capabilities, provide online tools for open government, and enable the free flow of information for overall societal development.

e) *Broadband infrastructure:* with the growth of cloud computing, the demand for bandwidth is expected to increase significantly. Policy makers in Jamaica should take steps to help accelerate broadband infrastructure deployment, including by freeing up additional spectrum for mobile broadband. They should promote the most flexible network technologies and spur competition so that reliable solutions that promote the most bandwidths can develop.

f) *Trade and competition implications:* it may still be too early to evaluate the trade and competition implications of cloud computing. However, policy makers should keep in mind the possibility that anti-competitive practices result from market domination by a few companies in the future and avoid harmful barriers to competition. They should also keep in mind the relationship between the efficient flow of data across jurisdictions and the growth of cloud computing.

g) *Tax implications:* as this work focuses on migration to cloud computing services to improve efficiency for SMEs in Jamaica, the policy makers will need to consider the tax implications that can result. These can be foreseen as being mainly related to record keeping requirements and possible evasion of taxes by both cloud parties (providers and consumers alike).

h) *Contractual issues:* standard cloud computing contracts can present some challenges. Standard contracts between service providers and SMEs and consumers are often non-negotiable and offer "take-it-or-leave-it" terms- this is normally the case when the business enterprise is small. The details of the contract terms may not be well understood by novice users with limited legal expertise or the terms may not provide the expected legal coverage for providers in certain jurisdictions, resulting in risk and uncertainty for

both providers and users that could inhibit the growth of cloud computing. Additionally, service level agreements should also address service outages and provide concrete remedies should an outage occur. Policy makers could urge and assist the development of industry codes-of-conduct and improved delivery methods (e.g. video) for standard, non-negotiable contracts.

i) *Security and risk management:* cloud computing leverages many forms of existing hardware and software technology and the OECD Guidelines for the Security of Information Systems and Networks - Towards a Culture of Security (OECD, 2002) provide a relevant approach to deal with, if not all, at least several cloud computing security challenges. Four of its principles should be applied in particular: risk assessment; security management; security design and implementation; and risk re-assessment. In addition, authentication and identity management challenges need to be addressed as individuals conduct more of their online activities through cloud-based services.

j) *Privacy:* In the area of privacy, a globally interoperable approach by governments would facilitate the deployment of cloud computing. More particularly, policy makers should address the questions of whose laws apply to the data stored in the cloud, including who can access this data, and under which circumstances processing of data in the cloud amounts to a cross-border transfer.

Cloud computing service is a very important ICT resource that can have a great impact on Jamaican SMEs. It can massively build and bridge the digital divide for Jamaica. Cloud computing offers major benefits, even if some areas are cause of concern but SMEs can ultimately benefit from using the cloud. For these organizations that consider adopting the cloud there is a need to address the infrastructure problem which to larger extent is the responsibility of Government. Considering the contributions made by small informal business sector, developing economies' governments can benefit significantly through unemployment rate reduction and increased tax collections. The main inhibitor of cloud computing worldwide is security and in Jamaica this concern can be more worrying. The loss of control over infrastructure, services, and data, once cloud models are adopted, are the key risks causing local business to take a guarded approached to cloud. Cloud providers need to guarantee some aspects of security in the SLAs for organizations to be more comfortable in service consumption. Service availability and business continuity are the major concerns of businesses in case of security and privacy breaches. Small businesses in developing

economies need to take seriously the security issues in cloud computing when planning cloud migration and sufficient provisions must be in place to continue with business operations should there be a failure in the cloud services infrastructure.

2. CLOUD COMPUTING IN DEVELOPED AND DEVELOPING ECONOMIES

2.1 Overview and Situational Analysis

For most developing economies, the adoption of cloud computing technologies is still relatively low as the evolving cloud comes with many challenges as well as opportunities (UNCTAD, 2013). Cloud computing can vary between countries in terms of the types of cloud services provider and the cloud services offered. Although, developing economies have recently captured the attention from global and local IT players, national governments, and international agencies- in terms of the establishments of cloud computing centers, and new opportunities such as cloud-related venture capital and investments, these countries should seize the opportunities afforded by the cloud computing (ITU, 2012a). Cloud computing can provide access to advance IT infrastructure and data centers, protect sensitive information while minimizing the associated risks involved. Most analysts have predicted that developing countries will be attractive markets for cloud services and have suggested that cloud computing technology has the ability to change major industries such as healthcare, finance and banking, and education, towards more advance industries such as "healthcare 2.0", "banking 2.0" and "education 2.0" and so forth (The Economist, 2008). In addition the cloud can offer the possibility for closing the digital and technological gap between developed and developing economies in that more access is available to the same IT infrastructure, data centers, and applications. The analysis in the previous sections already indicates that the cloud arguably reduces infrastructure costs and levels the playing field for Small and Medium-size Enterprises (SMEs). In addition, cloud services provides SMEs more flexibility for scaling up when demand increases and opportunities to decrease software piracy as software becomes free via Web-based applications or available in software as a service (SaaS). Although these are the arguments from Cloud proponents, little, if any, existing empirical evidence shows how effectively these theories, ideas, and speculations can translate into practice. For some developing countries, cloud-related activities are mainly concentrated in big economies such as China, India, Brazil, South Africa, and Vietnam. Nonetheless, the cloud is gradually making an inroad into smaller economies as well. Therefore, this section is dedicated towards analyzing how key factors that determine the cloud-readiness of countries, the status of cloud computing for developed and developing economies as well as the perceived implications of cloud adoption for these economies.

2.1.1 Key Factors that Determine the Cloud Readiness of Countries

Before conducting the situational analysis of cloud adopting in developing countries, a review of the broadband landscape that may affect the ability of developing countries to adopt and benefit from cloud-based applications, will be done in order to analyze the "cloud readiness" of developing countries. From this evaluation the author intends to highlight the requisite ICT network components and services that are important for the use of cloud services. In addition the author intends to illustrate in this section the required broadband infrastructure, quality and pricing that impacts the utilization of cloud services.

Several indices from different methodologies have been used to assess the "cloud readiness" of different countries and economies. While some have focused on the infrastructural related aspects of cloud computing, others have relied on a broader set of both qualitative and quantitative indicators (UNCTAD, 2013). As there is no true index for showing the actual levels of cloud adoption for countries, as geographical coverage is still limited (UNCTAD, 2013), the author strongly validates and support the use of these indices as they are applicable and relevant for evaluating the level of readiness for countries. Therefore, the following indices developed by major cloud industry giants can be used to assess the cloud readiness of countries:

- *The Enterprise Cloud Readiness Index*, designed by Pyramid Research, defines the degree of enterprise cloud readiness *"as the degree to which service providers in a given country can potentially leverage cloud services for the enterprise segment"* (Pyramid Research, 2012); This index which is purely quantitative covers 49 countries, and is established on economic, demographic and ICT indicators (UNCTAD 2013).
- *The Global Cloud Computing Scorecard of the Business Software Alliance* uses qualitative and quantitative data to rank 24 developed and developing countries in seven categories. These categories measure the *"preparedness to support the growth of cloud computing"* (UNCTAD, 2013; Business Software Alliance and Galexia, 2012).
- *The Asia Cloud Computing Association Readiness Index* which includes qualitative and quantitative factors, ranks 14 economies in the Asian region across 10 categories critical to the *"successful deployment and use of cloud computing technology"* (UNCTAD, 2013; Asia Cloud Computing Association, 2012).

- *The Cisco Global Cloud Readiness* tool is based on only three indicators all related to broadband: download and upload speeds and latency. These indicators are seen as reflecting a country's ability to optimally support different levels of cloud services (basic, intermediate and advanced) for both fixed or mobile broadband (Cisco Analysis, 2012).

Kshetri (Kshetri, 2010) states that given the novelty of the cloud computing phenomenon, more time is needed to refine assumptions about what drives cloud computing and to establish the best indicators for representing it. The author agrees with this as none of the indices include statistics related to actual cloud adoption; furthermore it is difficult to develop a model that shows objectively the impact and thus relevance of specific factors. However, broadband speed and latency are included in the Asian index and by Cisco tools. Infrastructure-related factors that influence the rate of cloud computing development will include international and national backbones that collect user data for transmission back and forth to cloud services, and end-user broadband access or connectivity. For cloud services are hosted domestically, international connectivity may not be as critical however the next subsections of the work will pay special focus on the key indices such as international broadband connectivity, national backbone and Internet exchanges, broadband penetration, quality of service (QoS) and the affordability of broadband that are used for evaluating the cloud readiness of countries.

International Internet bandwidth, a critical element for accessing data servers located abroad, has increased annually by 53 % between 2007 and 2012 according to the telecom market research firm TeleGeography. The construction of new fiber optic networks and the upgrading of existing ones has facilitated as much as 54 terabits per second (Tbps) of capacity during that period. As the demand in developing countries increased, the need for cloud services was amplified as new traffic to data centers over international connections between users and overseas locations where applications and data are located augmented (TeleGeography, 2013).

For Africa, the availability and affordability of international broadband bandwidth increased enormously as a result of the landing of competing submarine fiber cables on the continent's eastern and western seaboards (UNCTAD, 2013). The principal barriers to affordable connectivity now received a massive upgrade, in addition to the significant

improvements to terrestrial infrastructure, including regions where submarine connectivity was established.

2.1.1.1 Government Support, Internet Exchange Points and Data Centers

Government support, Internet exchanges and data centers are key elements required for transmitting and processing cloud data streams. Government support is vital for ensuring that data is transport to their destination; if national support is not strong the result is that the users will not achieve the full speed of their local connection. For developing countries extensive empirical and anecdotal evidence states that the lack of connectivity to high-speed national backbones in rural areas is a major concern in many countries (Fall, 2015). However, Hamilton (Hamilton, 2011), maintains that unlike international bandwidth, globally agreed metrics and country data for quantifying and comparing national backbone capacity is also lacking as well.

The establishment of IXPs can help build national human capacity in networking skills. As a facility, IXPs guarantees that ISPs co-locate equipment to exchange national traffic as a way to reduce the cost of international bandwidth; usually domestically destined traffic does not necessarily require overseas transition (Ryan and Gerson, 2012). The key function of an IXP is that it ensures that once Internet traffic reaches a certain level content providers are allowed to cache data in the country. However with increased expertise and Internet traffic, the next step will be to locate data servers at IXPs and offer domestic cloud services.

Since June 2013, up to 397 IXPs have been installed worldwide, with more than 60 % located in Europe and North America; only 6 % IXPs are located in Africa. Although, having such a small %, the IXPs in Africa have dramatically improved web experience through better performance. Similar to public IXPs, private peering facilities offer exchange of traffic but generally charge a service rate to some if not all participants. Furthermore, according to PeeringDB, private peering facilities have outnumbered public IXPs with more than 1,221 facilities around the world since July 2013.42 In addition, private peering facilities are also equipped with data centers where companies can lease or co-locate data servers. Such data centers are the concrete manifestation of the cloud, as they host the servers that store and process cloud data. They also require special operating conditions such as a stable energy supply to keep the servers available non-stop and cooling systems so the servers do not

overheat (Cisco). Although several demanding conditions should be met before determining if data centers are financially viable in a particular location, risk factors including constant power supply on a regular basis are some of the key decisions companies need to consider in regards to the right location for their servers or building data centers; in this instance, many developing countries are perceived to pose a higher risk level. Moreover, the cost of energy and ensuring constant supply of electricity can easily outweigh the demand for data centers. According to one source, as much as 85 % of data centers offering co-location services are in developed economies (Cisco,). This massive digital divide between high-income countries and LDCs are also reflective in the availability of servers; is as early as 2011 it is recorded that there are over 1,000 secure data servers per one million inhabitants in high-income economies while for LDCs there are just one per million inhabitants in LDCs. For those countries without local data centers have increased the need to access overseas servers for cloud services, which thus increases international bandwidth costs and latency-related performance. For governments In LDCs and developing economies the need to establish secure cloud environments increases significantly especially when protecting highly sensitive data, and this can only be best provided through national data centers.

2.1.1.2 Broadband Infrastructure

Statistics show that since 2012 an estimated 2.1 billion broadband subscriptions have been recorded, with mobile broadband subscriptions accounting for more than 70 % of the total ITU, 2012a). In terms of relative importance for cloud access, the statistics should be interpreted carefully, as the number of subscriptions for developing economies keeps surpassing those in developed economies in 2012. This indicates that the gap in penetration keeps getting wider as broadband penetration in developed economies was five times higher than in developing regions in 2012. For LDCs, the total number of fixed broadband subscriptions was only 1.3 million, with an average penetration of just over 0.2 per 100 people (UNCTAD, 2013). For transitional economies the rate of penetration remained significantly below developed economies during 2012 as well. Three main fixed broadband technologies, digital subscriber line (DSL), cable modem and fiber optic, used around the world can impact user experience. Even though these three account for majority of subscriptions, satellite remains important for isolated rural areas where terrestrial based broadband is not available. While DSL is delivered over copper telephone lines and accounts for the largest share of fixed

broadband technology, the speed for this technology often varies according to certain factors such as hardware versions used and distance of user from exchange. Although maximum theoretical speeds often vary between technologies, with fiber supporting the highest velocity, upload and download speeds is usually symmetrical. Other technologies are predominantly asymmetric, with higher download speeds, but average speeds in most countries are usually far below theoretical maximum speed. In highlighting the attributes of fiber optic technology, the author would like to point out that fiber is the most cloud-friendly of the fixed broadband technologies since the higher the speed, the better cloud services will perform as up 1,000 megabits per second are already available in several economies. Although these speeds in theory are available, bottle necks still exists due to the inability of backbone networks to handle large amounts of data traffic. Economies with a high proportion of fiber have high incomes and are densely populated, thus making them more conducive to higher investments in fiber. For developing countries, purchasing power is quite limited and thus leads to private operators having little incentives for investing in fiber technology central business district areas. The author therefore contends that based on this assumption, public involvement is required to ensure that fiber technology achieves widespread fiber coverage in order to facilitate faster adoption of cloud technologies by developing economies, as coverage is still far from ubiquitous as well.

As connectivity in the cloud is achieved primarily through the Internet, reliable broadband access is imperative. The cloud is quite capable of an array of tasks, ranging from simple webmail and word processing to complicated reporting, visualization, data processing and management information systems, all of which promotes efficiency and quick turn-around time for users. Gonsalves and Bharadwaj (Gonsalves and Bharadwaj, 2009), states that as the need for more reliable and faster Internet access becomes more evident, so does need for higher quality of service (QoS) experience for end-user. Therefore, several dimensions are postulated for assessing broadband connectivity QoS (Gonsalves and Bharadwaj, 2009): *download speed* the time taken to transfer data packets from a server to an end-user device, measured in kilobits per second (kbps) or Mbps; *upload speed* the time taken to transmit data packets from an end user device to a server, measured in kbps or Mbps; *latency or round trip time (RTT)* the time taken for a packet to reach the destination server and return to the client (the end-user device); measured in ms; *jitter,* the variation in time of data packets arriving,

also measured in ms; and *packet loss* which is the share of packets that fail to arrive at the destination server, measured as a percentage of the total number of packets transferred.

As seen in Figure 2.1.1.3, the Cisco Global Cloud Readiness tool propose a set of thresholds for quality of service requirements that should be met for cloud services of different levels of sophistication. Based on this tool, low speeds and high latency do not preclude the use of cloud computing, rather the use of different cloud-based applications such as webmail, web browsing and VoIP. For those thresholds with higher speed and latency, advanced applications such as high-definition (HD) video streaming can be used. Another key factor that should be considered for quality of service is the performance level, or instantaneous level of the application.

According to Cisco, the country comparison of broadband quality of service is generalized from data derived from a rough assessment of 138 countries' performance in this area. Table 2.1.1.3 illustrates whether they are able to meet the QoS benchmarks as proposed by Cisco for making use of basic and advanced cloud services. The table further shows in which areas (download speed, upload speed or latency) countries encounter bottlenecks. From the data presented by Cisco, it is observed that only 43 economies that meet all the minimum benchmarks for advanced cloud services. By contrast, no African or Latin American countries were represented in this group. For those countries that met the minimum requirements for cloud services, only nine developed economies, seven transitional economies, six economies from Africa, eighteen from Asia, Oceania and twenty from Latin America and the Caribbean were within that criterion. For final group, developing economies mostly dominated, with Africa leading with thirteen countries, followed by Asia and Oceania with ten, Latin America and the Caribbean- eight, and transition economies- three. In agreeing with the findings from Cisco, the author contends that latency and uploads speed accounts for why group two and group three countries failed to meet the required standards for cloud readiness as per broadband quality of service.

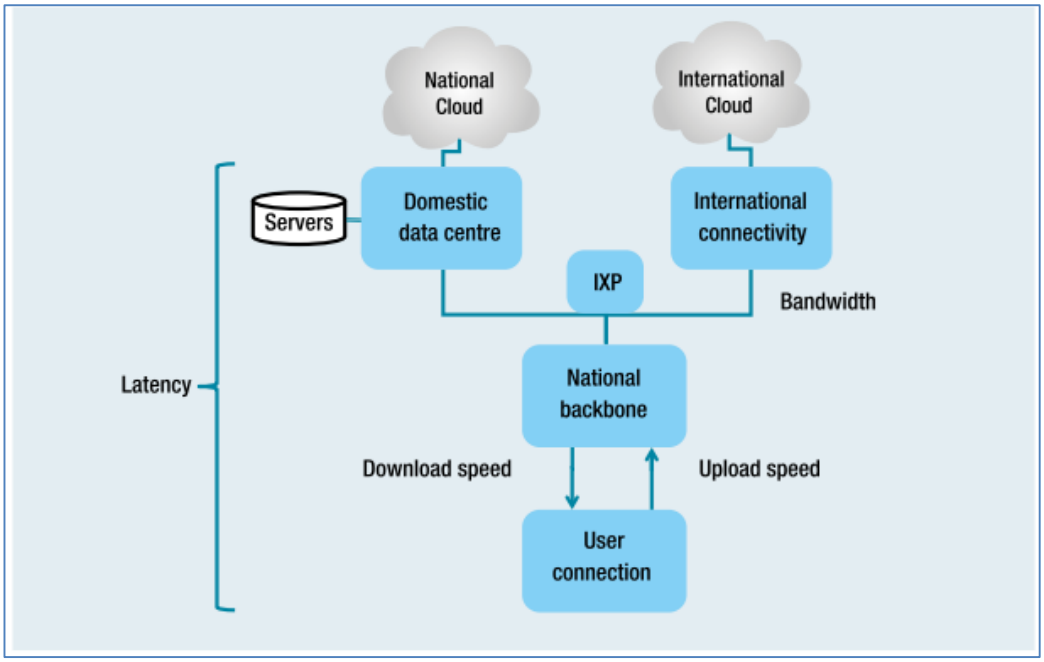

Figure 2.1.1.3: Latency and getting into the cloud
Sources: Cisco Analysis, 2012; UNCTAD, 2013

Table 2.1.1.3: QoS performance as per developing countries; Source: UNCTAD, 2013

Economies that meet minimum requirements for advanced cloud services	Economies that meet minimum requirements for basic cloud services	Bottleneck			Economies that do not yet meet requirements for basic cloud services	Bottleneck		
		Download speed	Upload speed	Latency		Download speed	Upload speed	Latency
Armenia	Albania		X	X	Afghanistan	X		X
Austria	Argentina		X		Algeria	X		
Belgium	Aruba		X	X	Angola			X
Bulgaria	Australia		X		Antigua and Barbuda			X
Canada	Azerbaijan	X	X		Bangladesh	X		
China	Bahrain	X	X	X	Belize	X		X
Hong Kong	Barbados		X	X	Bolivia (Plurinational State of)	X		X
Taiwan Province	Belarus	X	X		Cayman Islands			X
Czech Republic	Bermuda			X	Côte d'Ivoire			X
Denmark	Bosnia and Herzegovina		X		Haiti			X
Estonia	Brazil		X		Iraq			X
Finland	Brunei Darussalam	X	X	X	Lebanon		X	X
France	Cambodia	X			Maldives			X
Georgia	Chile		X		Mauritius		X	
Germany	Colombia		X	X	Mozambique			X
Hungary	Costa Rica	X	X	X	Myanmar			X
Iceland	Croatia		X		Namibia			X
Japan	Cyprus		X		New Caledonia			X
Republic of Korea	Dominican Republic	X	X	X	Nigeria			X
Latvia	Ecuador	X		X	Paraguay			X
Lithuania	Egypt	X	X	X	Peru			X
Luxembourg	El Salvador	X	X	X	Samoa			X
Malaysia	Ghana		X	X	Senegal			X
Moldova	Greece		X		Sudan			X
Mongolia	Guatemala	X	X	X	Suriname	X		X
Netherlands	Honduras	X	X		Syrian Arab Republic	X		X
Norway	India	X	X	X	Tajikistan			X
Poland	Indonesia	X	X	X	Turkmenistan	X	X	X
Portugal	Iran (Islamic Republic of)	X	X	X	Uganda			X
Romania	Ireland		X		United Republic of Tanzania			X
Russian Federation	Israel		X		Uzbekistan			X
Singapore	Italy		X		Yemen			X
Slovakia	Jamaica		X	X	Zambia			X
Slovenia	Jordan	X	X	X	Zimbabwe			X
Spain	Kazakhstan			X				
Sweden	Kenya			X				
Switzerland	Kuwait	X	X	X				

Table 2.1.1.3: QoS performance as per developing countries (cont'd); Source: UNCTAD, 2013

Economies that meet minimum requirements for advanced cloud services	Economies that meet minimum requirements for basic cloud services	Bottleneck			Economies that do not yet meet requirements for basic cloud services	Bottleneck		
		Download speed	Upload speed	Latency		Download speed	Upload speed	Latency
The former Yugoslav Republic of Macedonia	Malta		X					
Ukraine	Mexico		X					
United Arab Emirates	Montenegro		X					
United Kingdom	Morocco	X	X	X				
United States	Nepal	X	X	X				
Viet Nam	New Zealand		X					
	Nicaragua	X	X					
	Oman		X					
	Pakistan	X	X	X				
	Panama	X	X	X				
	Philippines	X	X	X				
	Puerto Rico		X					
	Qatar		X					
	Saudi Arabia		X					
	Serbia		X					
	Solomon Islands			X				
	South Africa	X	X					
	Sri Lanka	X	X	X				
	Thailand		X					
	Trinidad and Tobago		X	X				
	Tunisia	X	X	X				
	Turkey		X					
	Uruguay	X	X					
	Venezuela (Bolivarian Republic of)	X	X	X				

2.1.1.3 Affordability of Broadband Services

One of the key barriers to cloud adoption by some countries is the cost of Internet services. Although fixed broadband prices have declined sharply in the last few years, it still remains high in many developing countries. While, a monthly fixed broadband rate can be equivalent to 40% of per capita income in developing countries in 2011, it usually is significantly less than 2% in developed countries, as seen in the chart, Figure 2.1.1.4. In the case of mobile broadband, prices are usually lower but, the cost of mobile broadband is high

for developing countries, with 20% of income for a post-paid package and 31%

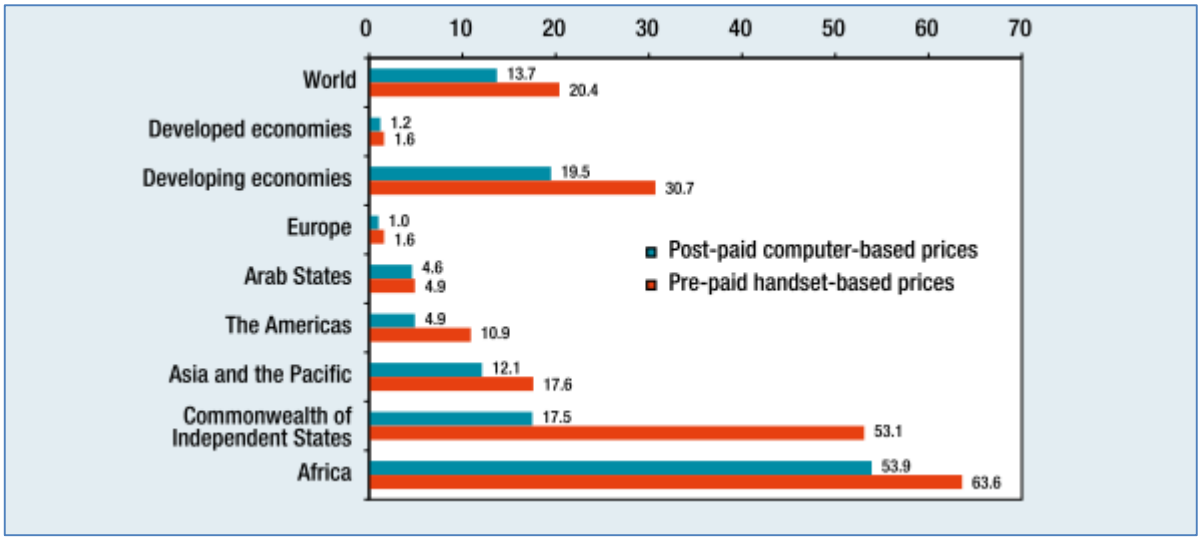

Figure 2.1.1.4: Mobile broadband as compared per gross national income per capital
Sources: ITU; UNCTAD, 2013

for pre-paid; moreover, mobile broadband plans tend to have lower usage ceilings than fixed broadband. For many developing countries, the majority of broadband users rely on either ADSL or mobile broadband for the "last-mile" connectivity (UNCTAD, 2013).

Although concerns regarding the QoS and limited deployment have been raised, ADSL access still remains relatively expensive. Recent studies have confirmed that at low usage, mobile broadband tends to be cheaper than ADSL (Stork et al., 2013), yet at higher usages, ADSL is still the more competitive option. Fixed broadband tends to be packaged with higher volume limits than mobile, and this advantage increases with greater usage. This then implies that in regions where mobile vastly outnumbers fixed subscriptions, cloud access will tend to be constrained by the usage limits in mobile broadband pricing structures. While the author agrees, it is important to point out that as ADSL tends to have much bigger price divergence between countries with a lower usage rate mobile broadband prices can also diverge more sharply at higher usage levels as well (UNCTAD, 2013).

2.2 Status of Cloud Computing Market Penetration, Diffusion and Traffic Density in Developing Economies

As mentioned in Chapter one and the first section of this chapter, although the market for cloud services has grown throughout the year, it still remains relatively small for many developing countries. Notwithstanding the fact that the cloud economy is still dominated by

global cloud service providers headquartered in the United States, various regional and local players have emerged in different parts of the world, recently. Nevertheless, the quality of ICT infrastructure still plays a key factor for leveraging the opportunities created by cloud computing especially in regards to the supply and demand side. However, as the shift towards the cloud continues, it is predicted that the digital divide will become less, and questions regarding basic access, quality of use and services will become more principal.

At the outset, cloud computing in the developing world is in its infant stage; surveys conducted by Gartner (Gartner, 2009), indicate that a lack of cloud awareness exists even among large companies. According to Burt and Hewitt (Burt, 2009; Hewitt, 2009) more than half of respondents from large enterprises in emerging markets responded that they had never heard of cloud computing or were even aware of what the concept was. Notwithstanding this many IT-intensive areas such as offshoring and software development are enthusiastically embracing clouds. For emerging economies such as India, the demand for cloud services has increased especially in the offshore industry and technology hubs. Another example is seen where in South Africa, the call center industry has experience fast growth particularly in cloud services. Likewise, the IBM Cloud Center in China's Wuxi City has been fervently targeting software developers (IBM, 2011). Through these examples, the author demonstrates although there is a lacking in awareness for cloud services by users from large enterprises, it still has not hindered economies where these enterprises are located from adopting and ultimately expanding cloud services rapidly. An IDC study further suggests that emerging markets such as Brazil and Russia, India, and China (BRIC countries) are likely to be the future important forces that will drive the global shift toward the cloud, with China and India having the greatest potential for the cloud (Smith, 2008); in addition it is predicted that the Indian SaaS market will continue to experience a compound annual growth rate of 77 % from 2006 onwards.

The value of the global ICT sector in 2011 is estimated to increase up to €3.2 trillion by 2014 (IDATE Foundation, 2012; Burt, 2009). Telecommunication services accounts for 36 % of this figure, while software and computer services make up the remaining percentages. The demand for equipment and computer hardware, particularly data servers and network equipment, continues to rise as more services are moved. In addition, media services including television will be moved to the cloud as the demand for video streaming increases.

For cloud markets, there are basically two main models for generating revenue. These are: 1) service provision against a flat-rate and 2) variable subscription fee dependent on the level or extent of service use, and advertising. Since 2012, worldwide public cloud services have been estimated to worth more than $111 billion. According to Kshetri (Kshetri, 2010), the largest revenue segment from that figure was from advertising, which accounted for more than $53 billion; with regards regard to the fee-generating revenue for the three main cloud service deployment models, SaaS was by far the largest with around $17 billion, followed by IaaS around $6 billion and PaaS $1 billion.

In regards for market penetration, forecasts on the future growth of cloud computing suggest that cloud adoption will continue to expand rapidly over the next few years. For private cloud services, the estimates vary as the revenue estimates was predicted to be around only $5 billion in 2012; however this figure is expected to grow up to around $24 billion by 2016 (Grossman, 2009). Conversely, private cloud provisioning is also predicted to generate more than €40 billion ($53 billion) in 2012, and expects to continue rising to about €75 billion ($99 billion) by 2016 (Pierre Audoin Consultants, 2013). As SaaS continues to dominate the market for public cloud services, IaaS will be the dominant feature for private cloud services. For cloud service customers, it is reported that preferences vary according to geographical regions. An example is seen where public cloud provisioning, and SaaS in particular, is most frequently used in North America and the United Kingdom, whereas French enterprises invest mainly in private clouds, preferably hosted by French companies (Pierre Audoin Consultants, 2013; Kshetri, 2010).

The shift to the cloud has generated a huge growth in data traffic; an example of this is seen where in 2012, Google has received more than two million search requests, while Facebook users shared around 700,000 content items and Twitter sent out 100,000 tweets (Smith, 2008). Furthermore some estimates already predict that cloud services have crossed the zettabyte milestone in 2012 (Mwaniki, 2009) Figure 2.1.3, with an annual growth rate of over 40 % since 2011 (Cisco Analysis, 2012). Already 40 % of all traffic reflects storage

requests (retrieving or sending data from/to the cloud). By 2016, cloud traffic is expected to

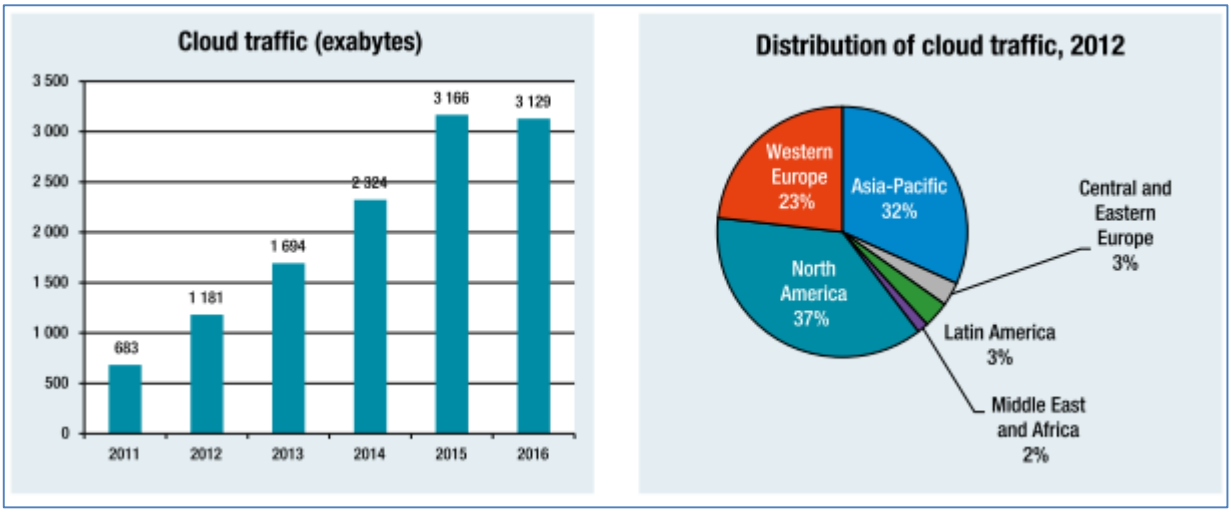

Figure 2.1.3: World distribution of cloud traffic
Sources: Cisco Analysis, 2012; UNCTAD, 2013

represent as much as 64 % of all data center traffic (Kannan, 2010) with a majority of such traffic emanating from the Europe and North America. Asia-Pacific will be responsible for another third, while Latin America and the Middle East and Africa together will only accoun for only 5 %. Meanwhile, the highest growth rates are expected in the Middle East and Africa between 2011 and 2016, albeit from a low base.

2.2.1 Opportunities Provided by the Cloud for Developing Countries

Anecdotal evidence already suggests that the cloud has opened a wide range of opportunities for users and developers in developing countries. From countries such as South Africa to India, depending on the IT capabilities, firms can develop their own platforms or use applications on platforms provided by global players. Opportunities and prospects for the cloud, however, differ across economic sectors. Despite this one of the most fascinating and important aspects of the cloud is that it lets businesses lease storage and computation resources as needed. The cloud can therefore help overcome the small-size disadvantage and might provide opportunities for improving SMEs. One example is seen where in Vietnam, the Vietnamese telecommunications giant, Vietnam Technology and Telecommunication (VNTT) have been using cloud services to offer server storage capacity and system capabilities for its clients, which are mainly SMEs. Through these cloud services, clients have the ability to expand these cloud services as their needs grow at a low relative cost. VNTT as a strategy for

increasing client base plans to launch applications designed for construction and real-estate companies as well. It is important to point out however, that while no concrete scientific evidence exists to prove that the cloud can contribute to business productivity, the anecdotal evidence presented indicates that the cloud has the potential for increasing productivity for SMEs (Firth, 2009; Kshetri, 2010).

The cloud can also provide opportunities for developing applications on established cloud platforms provided by cloud giants such as Microsoft and Salesforce (The Economist, 2008). Additionally the cloud can be a channel for facilitating and developing innovative products and services. One good example of this is where industrialized world-based healthcare providers have accessed offshored services such as medical transcription, billing and insurance claims, tele-imaging, and tele-pathology to India (Kshetri, 2010). Another innovation provided by the cloud is the development of private cloud products based on Azure; to date relatively four thousand applications have been built on Azure in India (Kannan and Kshetri, 2010). The cloud also provides opportunities for improving IT security in developing countries up to the standards of their developed counterparts in North America. From a global scale countries differ in the deployment of security products. North America accounts for fifty-eight percent of the 2002 global IT security market, while emerging economies such as Brazil and Kenya either lacked antivirus software or have insecure systems for their banking sectors (BusinessWire, 2006; Kinyanjui, 2009; Kshetri, 2010). Cloud computing can enhance security for these companies in developing countries that lack technological and human resources to focus on security. As a result some ISPs in industrialized countries usually block content that originated from problematic networks in developing countries. Through the cloud, economies of scale can allow third parties to provide low-cost security for SMEs that could potentially address some of the security-related human concerns and technological issues (Evans and Otis, 2003).

2.2.2 The Use of Cloud Services by Key Stakeholders

For developing economies the key stakeholders that use cloud services are mentioned in this section; it should be highlighted that while there are four key stakeholders, that is, Governments, large companies, SMEs and consumers, for the simplicity of this study only

business enterprises will be discussed. To illustrate the role and relationship of each stakeholder to the use of cloud services, the cloud ecosystem will be discussed as well.

A cloud economy ecosystem normally encompasses and includes a complex set of relationships, synergies and interactions between technology and business, governance and innovation, and production and consumption, which involve different stakeholders and which contribute in different ways to economic and social development (UNCTAD, 2013). Figure 2.2 illustrates the various relationships that connect cloud service providers with cloud service customers and other entities in the cloud economy and how those relationships can influence the cloud's potential in developing countries. This ecosystem also illustrates how components such as legal and regulatory frameworks, constant energy supply, and the availability of communications networks affect the rate cloud adoption by key stakeholders as well.

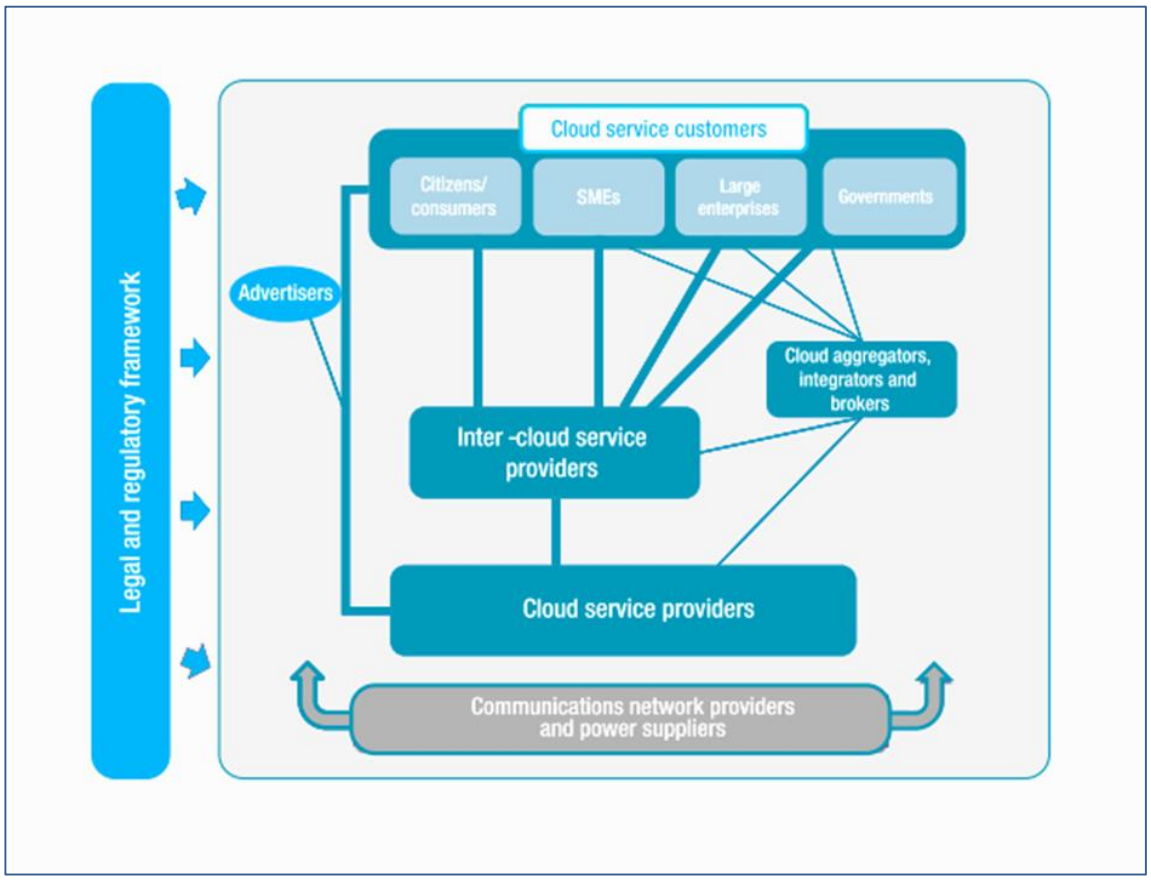

Figure 2.2: Getting into the cloud
Source: UNCTAD, 2013

2.2.3 Trans-national, Multi-national Companies and Small and Medium-sized Enterprises

Since 2012, up to eighty percent of fortune 1000 companies, mostly major Trans-national Corporations, (TNCs) have been paying for and using cloud computing services(UNCTAD 2013) In utilizing the cloud strategy for business operations in developing countries, most cloud services used are usually determined at the global rather than national level. Similar to governments, TNCs often rely on private cloud arrangements with global providers for meeting business needs, customer demands and for maximizing the value of their economies of scale. For some TNCs and multi-national companies (MNCs), the use of local cloud providers and cloud services have enabled these enterprises in developing countries to access and to extend beyond their own marketing and customer relations operations that mostly based in domestic markets. This gives a competitive advantage for these companies competing at the domestic level (Gentzoglanis and Kituku, 2012). As mentioned in the previous section and similar for Governments, anxieties about reliability, security and control of data also influence the decisions by major corporations to adopt cloud services (Kituku, 2012). For these enterprises, it is significant to analyze the relative merits of different cloud solutions, including the competing benefits of traditional and cloud-based approaches to business management, and the various approaches to cloud deployment.

As one of the most diverse industries, small and medium-sized enterprises (SMEs) are usually more or less intensive users of ICT tools, when compared to the other stakeholders from the preceding sections. As result, the adoption of cloud services by SMEs is not widely distributed as this is highly dependent on the industry that enterprise is based. However, it is expected that an increase in the utilization of cloud service should occur within the next few years, according to a survey done by Microsoft in 2012 (Microsoft, 2012). The survey states that based from the responses given from SMEs in 13 different countries including Russia, China, Turkey and Brazil, Brazil, China, Turkey, cloud provisioning should replace tradition servers and in-house data management systems, with the majority of the SMEs agreeing that upgrading of local IT facilities will accompany cloud adoption as well. Normal business processes including marketing, sales, human resources and payroll, commerce and trade as well as customer relations management are some of the key functions that were likely to be

migrated to the cloud. It is expected that immediate benefits from migration to the cloud and cloud provisioning enhance businesses, reduce operational costs as well as connecting SMEs to large groups of remote potential customers. However, the challenges associated with integrating the cloud and legacy software as well as the loss of control over data and new unfamiliar applications can make migration undesirable for some SMEs. Some businesses that were surveyed have reported to moving altogether from the cloud based on these experiences mentioned. Although smaller businesses such as start-ups have reported that initial benefits were gained from the cloud, but then found then found it easier to invest in their own equipment as their businesses matured and stabilized 31. For cloud provisioning, it is likely that common services such as webmail, voice communications, instant messaging, data storage and backing up and file sharing are likely to be utilized by SMEs by a rate of up to 40 percent (Microsoft, 2012; UNCTAD, 2012). From that same study respondents conclude to have used a wide range of sources to obtain information about cloud options. Although the information was accessed from websites of cloud providers and other software companies, it is likely that SMEs may not be assessing options systematically and may only benefit from the kind of services offered by cloud brokers and aggregators. For many small enterprises, the cloud can provide free services including e-marketing and e-customer relations management. Medium-sized enterprises operating in complex markets can gain more advantage from using sophisticated cloud services where possible. Overall, it is anticipated that cloud services could equip developing country enterprises with additional opportunities for marketing services beyond their local communities. The economic value gained not only comes not from cost savings achieved but from improved access to international and local markets; this also improves national export performance and revenue generation as well.

Although the key uses and applications of the cloud for developing countries SMEs are highlighted, these enterprises should fully consider the pros and cons of using cloud-based applications for their specific businesses and business models. This should include the overall benefits and potential disadvantages for customers, a cost benefit analysis of cloud services and the risks involved, and also the risks of not using the cloud when competitors do so. Of course, the calculations will depend mostly on the present circumstances of the enterprise, and the wider business and communications environment in which it operates. More importantly, migration of data and services to the cloud may make sense for some companies but not necessarily for other companies. While infrastructural facilities may vary, it is noteworthy to

state that the value of cloud migration may change over time as national communications environments in developing countries continue to evolve.

2.3 Law and Governance of Cloud Services in Developing Countries

2.3.1 Regulatory Trends for the Legal Environment of Cloud Services

Since the early 1970s, concerns regarding data sovereignty and privacy have amplified due to the emergence of more sophisticated telecommunication systems available in certain regions of the world. Since then, trans-border border flows or TDFs, have taken advantage of the advanced technological capabilities that are available in certain regions of the globe (Seidman, 1986). While for some Governments, the transfer of critical commercial data to another country was seen as making an unwelcome dependency and vulnerability for certain states, since implications for paralyzing national security and certain domestic economic activities is increased. Since then, some countries like Canada and Brazil have introduced legislation to prevent the transference of certain data from national territory. Walden (Walden and Savage, 1990) states that TDFs could enable companies to circumvent emerging national privacy laws that were designed to protect the privacy of citizens in regards to cyber law and policy. As such, the economic and data-sovereignty concerns of 1970s received high dissolution especially during the era of the liberalization of trade in services that was manifested in the General Agreement on Trade in Services (GATS) in 1994, of the World Trade Organization (WTO). Furthermore the TDFs that reinforced cross-border provision of services were more offset for greater benefits towards nations than any concurrent enhanced vulnerability. Developing nations have reaped comparative economic advantages in certain sectors in regards to the emergence of certain services such as the offshoring of some business processes. However, data-sovereignty concerns have re-emerged as a governance issue within cloud computing for a number of reasons: 1) high concerns regarding data placed with global cloud service providers could be accessed by law-enforcement agencies of their home country; 2) as Governments seek to improve efficiency and effectiveness of e-government initiatives, concerns regarding data fundamental to the functioning of Governments may move offshore into the cloud (CIO, 2012; United Kingdom, Cabinet Office, 2011); 3) the threat of cybercrime and cyber warfare which could affect national security concerns (Kshetri, 2010). Legal instruments were developed in response to the privacy concerns of the 1970s (Kshetri,

2010). The European data-protection laws were developed to primarily address the possibility of restricting TDFs and to reduce the possibilities that privacy rules could act as a barrier to international trade. Since then concerns regarding the potential erosion or circumvention of national privacy protections continues to remain at the forefront of the policy response to cloud computing. Since 2014, guidelines have been developed by the EU commission to assist business enterprises to achieve more cost savings and benefits from cloud computing. According to the EU Commission Press release (European Commission, 2014), the guidelines were developed by a Cloud Select Industry Group as part of the Commission's European Cloud Strategy to increase trust in these services. This action taken by the EU commission, demonstrates an important step towards developing "standardized building blocks" for establishing Service Level Agreements (SLAs) terminology and metrics for cloud services stakeholders.

While there are no present international privacy framework regulating data transfers across borders, developing countries could benefit from implementing strong domestic privacy regimes. The governing framework for cloud computing can be broadly divided into two parts: public law and private law. Public law consist of all the laws and regulations adopted by Governments, public administrations and independent regulatory authorities that are either directly targeted at the provision or use of cloud services, or impact certain provision and usage that are applicable across a range of similar activities such as data-protection laws (UNCTAD, 2013). To date, the public law response to cloud computing has primarily been of the latter kind which is applying existing rules in a cloud-based environment. Private law on the other hand comprise of contractual agreements entered between the various providers of the cloud ecosystem and the end users of the services (UNCTAD, 2013). While such arrangements are given legal recognition and enforceability by the public-law framework of a State, including the incorporation of national mandatory requirements, the provisions contained within such agreements can impact the general operation of the cloud economy, especially for providers and users. Therefore, regarding the governance of the cloud services, both legal instruments should be viewed as complementary layers of protection, rather than as substitutes.

For developing countries governments that are attempting to regulate the cloud activities, this may involve establishing fundamental distinctions between those cloud activities that are subjected to the general law and those that are subject to specific legal and

regulatory obligations by virtue of the type of activities being undertaken. Therefore, companies that provide PaaS and SaaS, will not be subjected to these the regulations as the services provided are generally viewed as falling outside the regulatory concept of a telecommunication service (UNCTAD, 2013). On the other hand companies that provide IaaS are classified as telecommunication service, as they provide processing, storage and connectivity services to enterprises (ITU, 2012a). On the other hand for developing countries, the regulatory net goes beyond the provision of telecommunication services and includes the provision of data processing services as well for these cases, cloud services such as SaaS, PaaS or IaaS are include in the general regulatory spheres and allows Governments in developing countries impose conditions on the supply of services and might help address concerns including data sovereignty and privacy (Kshetri, 2010). In other countries, while cloud services are not subject to comprehensive sectorial regulatory regimes, they may fall within regulatory concepts designed to shield certain service providers from liability for the content that they make available on behalf of others. However, uncertainties over the regulatory characterization of cloud computing may deter its acceptance until legislators or regulators clarify the situation. If viewed as a telecommunications service, then the telecommunications regulator can exercise jurisdiction. If a cloud service is seen as a data-processing service, then competence may lie with the national ICT regulator, if there is one, or alternatively the media regulator if it is viewed as a content-like service. Such sectorial regulators may also have to operate in conjunction and cooperation with any horizontal national regulators, such as data protection or consumer-protection authorities, in respect of certain issues. To date, few jurisdictions have attempted to draft regulations expressly designed to regulate the provision of cloud services. This probably reflects both the broad range of services that fall within the concept of cloud, as well as the flexibility of scope within existing regulatory concepts. Mexico is the only country that has adopted cloud specific provisions in relation to data protection. While some of the rules governing cloud computing are merely restatements of generally applicable obligations or designed for addressing concerns regarding transparency about the layered nature of the cloud supply chain, as a case example or those that pertain to the treatment of user data following service termination, and regarding law enforcement access. As such the Mexican approach should encourage other developing countries to adopt domestic take-up of cloud solutions (Bradshaw et al., 2011).

As location independence is a key characteristic of cloud computing, the multiplicity of jurisdictions can potentially compete and conflict for governing the various parts of a cloud service (Cairncross, 1997). With cloud services, the movement of data into and out of the cloud could potentially result in data becoming subject to the rules of both the cloud user's jurisdiction and also for providers of the cloud and inter-cloud services. For some regulated sectors, such as financial services, cloud-related transfers and storage outside the jurisdiction of the regulated entity may itself breach national rules by failing to provide national authorities with "effective access" to the data (European Commission) As this has caused major concerns regarding state sovereignty, national regulators are more unwilling to surrender jurisdiction to a foreign authority unless adequate mutual recognition arrangements are in place, see Figure 2.3.1.

Figure 2.3.1: Global Data Protection Map
Source: Global Data Protection Map, 2012

Effective mutual recognition can result and requires greater transparency, more dialogue and closer cooperation between national regulators to resolve conflicts of law and regulation in a cloud environment, and to facilitate the free flow of data. Significant examples of cooperative networks of national regulators and law enforcement agencies already exist in the areas of consumer protection, cybercrime and data protection, while legislative proposals have been put forward to facilitate international cooperation and interoperability with respect to cloud (Cloud Computing Act , 2012). One other dimension of the multi-jurisdictional

nature of cloud is the potential implications of the regulatory regime of the country of origin to cloud providers. As such the European Commission, in addressing the dynamics of the multi-jurisdiction pertaining to the cloud environment, states that "*being born global, cloud computing has reinforced international dialogue on safe and seamless cross-border use"… including the need for legal adjustments to promote efficient and effective cloud roll-out"* (European Commission, 2012).

2.3.2 Public Law Regulations on Cloud Services

The cloud ecosystem is to a high degree built on private law agreements between service providers and cloud service customers. Such contracts offer service providers and customers a self-regulatory mechanism for generating a framework of legal certainty and security in cloud computing. Cloud contractual arrangements come in varying shapes and sizes, but will generally comprise four distinct components: terms of service, detailing the key features of the relationship, both cloud-specific and general boilerplate provisions; service-level agreement, detailing the service features being provided, the standards that they should meet; acceptable usage policies, which details the permitted or impermissible conduct by users; and the privacy policy, detailing the approach taken to the storage and processing of user data, particularly consumer information (UNCTAD, 2013)

The terms of a cloud contract can be categorized either into the standard terms and cloud-specific provisions. The standard terms will include such matters as provider liabilities, dispute resolution and applicable law. Both are of equal importance in terms of defining the provider–user relationship. The cloud-specific provisions generally focus on two key aspects: first, the treatment of the data submitted by the cloud user into the cloud service; second, the specifications of the service being offered to the cloud user. The treatment of data held in the cloud, will include provisions that ensures the users' rights of ownership over the data are not compromised, that the data are secure against inadvertent or unauthorized disclosure, and that they will reside on infrastructure located in a specified jurisdiction or region. For the service users will want cloud-appropriate service levels that address concerns about dependency on the cloud service (European Network and Information Security Agency, 2012) Conversely, providers will generally argue that the utility and commodity nature of a "public" cloud

service must limit their responsibilities concerning issues such as the integrity and backup of user data (Hon et al., 2012).

From a public policy perspective, self-regulation through contractual agreements can raise concerns when market practice facilitates a situation where contracts do not result in a fair balance of liabilities and responsibilities between cloud providers and customers, especially when the latter are SMEs and individuals. In addition, contractual terms can have implications for third parties that not a part of the agreement, particularly regarding privacy and data protection issues. In these circumstances, regulatory intervention in the freedom to contract may be considered necessary to rebalance the relationship with a view to protecting third parties or the wider public interest. For most developing countries, however, the challenge of intervening in cloud contracts is obviously much greater, with domestic consumer laws often being either inadequate or unenforceable. A cloud service customer will only contract directly with the cloud service provider and, usually, a communication service provider, and this customer may be unclear in their understanding of the entire chain of suppliers providing elements of the cloud service, such as IaaS. This may represent a risk, since the customer may not be aware of the layers of contracts that underpin the provision of the service and, significantly, whether commitments entered into by the contracting service provider are adequately reflected at each stage of the supply chain. One proposed regulatory response is to impose transparency obligations on the cloud service provider (ITU, 2012b).

2.2.3 Private Law Regulations on Cloud Services

In regards to private law regulations on cloud services, there are three main overlapping areas: (a) the conditions under which cloud services are delivered to the end users; (b) the provision of cloud services; and (c) the treatment of data in the cloud. Although generic and relevant for all jurisdictions, achieving resolution from private law regulations for cloud related disputes can be quite difficult especially in developing countries.

Governing the right to establish and/or supply a cloud service in the domestic jurisdiction, through some form of prior licensing or authorization requirement, is about enabling regulatory control over market entry. Some components of the cloud ecosystem, particularly the communication network component, already fall within existing regulatory regimes, but those regimes are typically designed to facilitate market entry and competition,

rather than to constrain market participants. For developing countries, while the dominance of foreign companies offering cross-border services may be a concern, it is both practically and legally difficult to address this market reality through regulatory intervention. From a practical perspective, preventing access to foreign cloud services would likely require a radical intervention in the global connectivity of the State, especially in respect of the Internet. From a legal perspective, a majority of developing countries are members of the WTO and signatories to the GATS, committing themselves, at least in some sectors, to liberalized trade in services, including through cross border supply. As such, regulatory intervention is permissible only under limited exceptions, including the protection of the privacy and confidentiality of data. An alternative policy response is to encourage the establishment of domestic cloud services, either by offering Foreign Service providers a favourable environment to invest in the building of local infrastructure (such as data centers) or encourage domestic enterprises to enter the supply side of the cloud economy. However, the former approach would not necessarily overcome the problem of the application of foreign laws, as outlined above, especially if the local entity remains under the control of the foreign parent. Such measures may involve regulatory components, such as imposing "localization" requirements, but would be designed to facilitate the provision of cloud services rather than to constrain them.

Irrespective of whether the establishment and provision of cloud services is regulated, Governments may choose to intervene to impose certain conditions on the supply of cloud services to address specified public policy concerns, such as data security and privacy. Such conditions may be applicable only to certain types of cloud services (for example, SaaS), certain types of end users (for example, consumers or public administrations) or be imposed upon all cloud services. The conditions may directly impose behavioral obligations on cloud service providers, such as requirements to retain some types of data within certain geographical locations or for certain periods of time, or they may indirectly govern the contractual arrangements between the provider and end user, such as rendering certain "unfair" terms unenforceable. Such public law intervention in the conditions of supply may also have an impact on a user's cost–benefit analysis for cloud adoption, if it results in a higher cost service, which should be factored into any initiative. Among developed countries, there has been little adoption of cloud-specific obligations to date (Business Software Alliance and Galexia, 2012). Instead, relevant regulatory authorities have tended to issue opinions as to

how existing obligations, whether for particular sectors (for example, financial services) or of a general nature (for example, data protection) should be applied within a cloud context (United Kingdom, Cabinet Office, 2011) As in the case of the Mexican government going one step further to impose an express obligation for all regulatory authorities to draft guidelines in relation to the cloud (UNCTAD, 2013). On the other hand, other developing countries could view these laws and regulations as an obstacle rather than a facilitator to cloud services, as was the case during the emergence of e-commerce in the latter part of the twenty-first century. Indeed, many e-commerce and cyber law reform initiatives are directly relevant to cloud computing, and the emergence of cloud computing can act as a further spur towards the comprehensive implementation of these reforms (UNCTAD, 2012b). The ability to enforce any regulatory obligations upon a cloud service provider will depend, in reality, on whether the provider is either in some way established within the jurisdiction (such as having a local office, against which any enforcement action can be pursued), or if the provider is prepared to voluntarily submit itself to local rules, or at least comply with them, even though these may be unenforceable. A key example of the latter case are foreign service providers responding to domestic law enforcement requests in relation to content considered illegal, which is held and made available via the provider's remote servers. Companies such as Google and Microsoft have made public their handling of such requests in respect of specific jurisdictions, whilst noting that they are often not legally required to cooperate (UNCTAD, 2012b). Another strategy for regulators in developing countries is to make reference, in laws or regulations, to international technical and business standards that specify certain good practices that are either generally applicable to, or specifically designed for cloud computing. Requiring compliance with such standards, particularly when they are implemented through an external and independent audit and certification procedure, carried out by an accredited certification body can offer end users, third parties and regulators some assurance with respect to the provision of trustworthy and quality cloud services.

In addition to regulating the conditions under which cloud services are supplied to cloud service customers, there are also public policy concerns that extend beyond the relationship between provider and customer. Data placed in the cloud can engage third-party interests that may require regulatory intervention, whether concerning personal privacy, commercial secrecy or national security. Within data protection laws, for example, imposing security breach notification obligations on cloud service providers provides transparency

about vulnerabilities and enables mitigating measures to be taken in a timely manner. Governments will have particular data security concerns where the end users are public administrations, involving data about citizens or data considered relevant to national security, as is the case with Indonesia. In February 2013, for example, the European Commission published a proposal for a Directive on information security that would require member States to designate a competent authority to provide regulatory oversight, establish a national computer emergency response team (CERT) to handle security incidents and risks, and require certain "market operators" that enable the provision of online services, including cloud service providers, to notify the competent authority of security breaches and undergo security audits when required (European Commission, 2013). These proposals are equally valid recommendations for consideration in developing countries, where the vulnerabilities and risks associated with cloud computing are shared. A growing number of developing countries are also establishing CERTs and are at different stages of development in their operations, procedures and related activities. Many of these countries are also faced with challenges, particularly in the areas of capacity building, funding, the legislative framework and other soft and hard resources.

2.4 Conclusions and Summary

Foreign affiliates of TNCs make extensive use of the cloud as part of their parent companies' global networks. With some wariness, Governments in developing countries are also moving towards the cloud. In addition, there is increasingly significant planned adoption of the cloud in small and medium-sized enterprises, though this is less extensive. Nevertheless, the trend is towards more adoption, across a growing range of services. Where government departments and larger corporations are concerned, there is so far a general preference for private over public cloud approaches. Although the cloud provisioning market is dominated by a relatively small number of very large providers, there are opportunities for developing-country firms to participate on the supply side of the cloud economy. These include data-center provision and management, both independently and in conjunction with global cloud providers; cloud aggregation and integration services; and the development and provision of cloud services to different groups, including local businesses and individuals.

Given the undeveloped state of the cloud market, especially in developing countries, considerable caution and care should be taken by both policymakers and regulators in terms of

rushing to legislate for cloud. While there is no imperative to develop specific laws or regulations on cloud computing, some of the areas requiring law reform are relatively clear: privacy, data protection, information security and cybercrime measures (Business Software Alliance and Galexia, 2012). As noted earlier, these are issues of equal importance to e-commerce and other aspects of the networked economy. This, in itself, indicates that approaching cloud computing issues in isolation would not be advisable. Governments and public administrations, can offer leadership to the national market in terms of addressing areas of concern for users. Regulators can also assist, by issuing guidance on the applicability to cloud solutions of the regimes for which they are responsible. This can be done through drafting and ensuring that a coherent and appropriate national cloud strategy is done and should consist of legal and regulatory frameworks as one component; implement more public procurement rules; perform constant monitoring of regulatory improvements in the field of cloud computing; promote awareness-building in government institutions and public administrations on the potential that cloud computing technologies offer; and conduct more reviews and enacting other existing legal frameworks that covers to a minimum, privacy and data protection, information security and cybercrime. For Governments of developing countries, it is essential that appropriate laws and regulations are adopted in these areas and enforced. Such legal instruments can include:

- The United Nations Committee on International Trade Law texts on e-commerce
- UNCTAD
- The United Nations Convention on the Use of Electronic Communications in International Contracts;
- Establishing CERTs at the domestic and international level

3. METHODOLOGY

3.1 Research Purpose

The research purpose is to evaluate how cloud services can improve the efficiency of small and medium-sized enterprises in Jamaica. The research goal is to provide Jamaican small and medium-sized enterprise owners, who are either potential or current cloud computing customers, with the insights and requirements necessary for making informed decisions about cloud services adoption, and achieve the benefits that could potentially improve innovation, productivity, profitability and competitiveness.

Previous research already suggests that access to scalable technologies such as the cloud, can enable SMEs to potentially deliver products and services, in a similar manner like large enterprises (Flow Jamaica, 2011). While this is promising, Jamaican SMEs still lack the necessary ICT infrastructural facilities to implement these services that are presumed to improve those enterprise business efficiencies. It is stated that for Jamaican SMEs, the capability to manage and afford cloud technologies have affected the rate of adoption to cloud services (Flow Jamaica, 2011). Other studies conducted by Muir using the Simple Additive Weighting (SAW) methodology was done to understand the decision for adopting cloud services by Jamaican SMEs (Muir, 2013). While the SAW methodology is credited for the ease and simplicity of application as well as its ability to deal with subjective and incomplete information (Zhu and Buchmann 2002), the main limitation of that methodology is it does not take into account the lack of expertise and knowledge that users in an SME may have or the bias or misconceptions that can occur. Simplicity of application does gives SAW a great advantage as a tool for real-world use (Davidson 2003), however insights on the perspectives on why cloud computing is needed for SMEs is needed in literature for Jamaica.

Therefore, taking this into consideration, this thesis aims to capture and evaluate the key perspectives that Jamaican SMEs owners and ICT experts have towards cloud services adoption. It is expected that the feedback from the questionnaire survey and the ideas and opinions received from the UN ICT specialists should support or refute the possible benefits of cloud computing, and identify trends that could potentially affect or influence the decision of SMEs to adopt cloud computing technologies. These specialists that have been chosen for this study have assisted numerous UN Country Offices and Governments in implementing suitable ICT solutions especially during crisis global situations. Based on the opinions received, this study it is anticipated that the general ICT landscape for Jamaican cloud service

providers and customers would be improved, as factors such as the need and perceived cost effectiveness of cloud services to improve business enterprise efficiencies will be evaluated as well.

3.2 Research Data Instruments

3.2.1 Questionnaire Survey Data Instruments

In order to create the research data instruments, it was first important to conduct the literature research in chapters one and two. This was followed by a further review of industry literature as well as participating in a three month internship at the United Nations Development Programme, Office of Information Systems and Technology, GIA Unit Offices to understand the motivation and real value of cloud computing technologies, its application in business organizations and to understudy that organization procedures and practical applications of cloud computing technologies. With this information, the original survey questionnaire was modified and the questions for the expert interview designed. The questionnaire was then distributed online initially using the online tool, E-survey creator.

The questionnaire which comprised of ten questions, was created according to the following structure: the first two questions focused on the population respondent demographics; the next quarter was about the main reasons for cloud computing adoption, types of cloud services that would be adopted and security concerns about cloud computing technologies; the third quarter consisted of respondents perceptions towards cloud computing and the types of software services from the cloud that would be commissioned; and, the last part of the questionnaire was about the demographics of the SME including the years of operation, size of the SME, its market scope and the status of cloud adoption for that enterprise.

In research methodology, a “survey” is a research tool that is designed to collect data from a specific population, or a sample from that population, and normally consist of a questionnaire, otherwise called the survey instrument (Robson, 1993). Usually surveys are used to collect data from individuals, institutions or business enterprises, and can be used to collecting and analyzing information from selected individuals, called the sample; in this instance the survey is called a “sample survey”. For this study the distinct advantage for using this survey offered the possibility to reach a larger group of SMEs in Jamaica which is improve for analyzing and detecting if there consensus or variance in the findings; in other

words based on certain demographics, if the findings are reliable, valid and applicable as well. With that in mind, the author chose a descriptive research methodology, since the questionnaire survey instrument is better designed to assess the perceptions of SMEs owners and IT professionals towards cloud services adoption for improving efficiency within their SMEs (or the SMEs they represent). Creswell (Creswell, 2005), states that when conducting an in-depth exploration of a central phenomenon, the main intention should not be generalizing a population through quantitative analysis. Based on this, random sampling methods alone can be unsuited and inadequate for this study.

3.2.2 Expert Interviews Data Instrument

Expert interviews are one of the most commonly used data collection methods that exist in qualitative research (Nohl 2009). Expert interviews can be quite flexible where the interviewer may opt to ask questions freely, or inflexible where the questions are structured before the interview takes place (Nohl 2009). For the purpose of this study both approaches were used, to create a semi-structured expert interview design. The main purpose for choosing this data instrument was based on the fact that there is an increasing need for more theoretical reflection in this this area of study. The experts who are more information rich than a random sample can offer their expertise and practical aid towards standardizing empirical research on cloud computing technologies (Bogner et al, 2009). Creswell states that expert interviews should be structured to allow the participants to freely voice their experiences and minimized the influence of the researcher's attitudes and previous findings (Creswell, 2005). The semi-structure design has other advantages for both the interviewer and interviewees, in that it provides interviewees ample amount of time for expressing their views and the information received are comparable with answers from other experts; for the researcher, the key element is that the opportunity to follow up on new ideas and events is presented (Nohl, 2009). In addition, practical evidence provided from the experts can be used for future applications as well. This lowers the possibility of interviewer bias from occurring which can affect the findings (Nohl, 2009). The author realized during the literature research that empirical studies that involved the practical applications of cloud computing technologies to SMEs were lacking, as most were hypothetically-based from qualitative methodologies;

therefore, the author believed it necessary that additional insights from the experts were required for this study area.

The introductory section of the expert interview document comprised of the Name, Profession, Title and Years of Experience of the Expert. For the interview, fourteen questions were asked; the first quarter focused on the potential benefits of cloud services, SMEs requirements for cloud computing technology, key barriers to cloud adoption, and the understanding of what cloud services are, perceived by SMEs; the second quarter consist of questions about the reasons for cloud adoption by business enterprises, how cloud services are measured, and the cost factors involved in establishing data centers versus the cloud; the third quarter focused on the potential challenges faced by organizations that are planning to adopt cloud services, the status of cloud computing technologies in developing countries, and whether organizations are aware that they are using cloud services; the last section will comprise of questions relating to the potential strategies that SMEs in Jamaica can use to achieve business efficiency from the cloud. Therefore the combination of these qualitative and quantitative data instruments can add value and richness to the work (Creswell, 2013).

3.3 Research Population and Sample Selection Strategy

3.3.1 Questionnaire Survey Sample Selection Strategy

The target population for this study comprised of SMEs located in the fourteen parishes of Jamaica. The participants that were invited to participate in the survey mainly consisted of enterprise owners, freelance IT contractors, office managers and operations managers that are employed to an SME or have business connections or legal ties to one. The survey started out using a free online survey tool, Esurvey creator which operated for a period of one month March 15, 2015 to April 14, 2015. However as that service was only for one month, another online survey tool SurveyMonkey was used until a suitable amount of responses was received. It is worth mentioning that both online tools used were credible types of data instrument tools instruments as they ensure only one participant from a particular ISP address are allowed to participate in the survey. From the target population, one hundred and thirty-five SMEs were invited to participate, with total number of eighty-three responses received. However fourteen of the responses were from respondents from other countries, who had no legal ties or associations with Jamaica or Jamaican SMEs. Initially, the response percentage was calculated to be sixty-one percent including the fourteen questionnaire

responses from respondents from other regions. However for the purpose of this study, a further calculation which subtracted those respondents that had no legal ties or business connections with a Jamaican SMEs resulted in a final figure of sixty-nine. The calculated percentage rate for the latter was fifty-one percent, which is suitable, since a lesser percentage could not be used for the purpose of this study. Table 3.3.1 shows the research sample demographics:

Table 3.3.1: Research sample socio-demographics.

Sector or Industry	**Response Frequency (n)**	**Percentage %**
Government	3	13.04
Legal services	0	0.00
Engineering	3	1.45
Information Technology	5	1.45
Manufacturing and Retail	8	11.59
Health services	10	14.49
Energy	6	8.70
Education	7	10.14
Other (Tourism)	27	39.13
TOTAL	**69**	**100.00**
Size of the SME	**Response Frequency (n)**	**Percentage %**
0-10 Employees	26	37.68
10-50 Employees	23	33.33
50-250 Employees	19	27.54
≥250 Employees	1	0.15
TOTAL	**69**	**100.00**
Years of Operation	**Response Frequency (n)**	**Percentage %**
0-3 Years	13	18.84
3-5 Years	17	24.64
5-10 Years	15	21.74
≥10 Years	25	36.24
TOTAL	**69**	**100.00**

3.3.2 Expert Interviews Sample Selection Strategy

The approach used for selecting the sample for the expert interviews was 'snowball method' where the contact of one expert at the United Nations led to the discovery of another. Contact to the experts was first initiated through a personalized email request. Seven experts were contact however five agreed to be interviewed. For those experts that were scheduled to be interviewed an Outlook Calendar invite was sent for April 16, 2015. To ensure that the experts were reflective and true representative for the ICT professional landscape, they were divided into six categories according to UNDP occupation groups (UNDP Human Resources, 2015):

- UNDP Global ICT Analysts;
- UNDP ICT Analyst/ ICT Regional Coordinators;
- UNDP ICT Analysts;
- UNDP Global ICT Specialists/ Connectivity Support Managers;
- UNDP ICT Regional Specialists;
- UNDP ICT Managers;

However as only five agreed to be interviewed, these experts represented the following occupation groups at the UNDP:

- UNDP Global ICT Analyst: **2 Experts selected**;
- UNDP ICT Manager/ ICT Regional Coordinators: **1 Expert selected**;
- UNDP Global ICT Specialists/ Connectivity Support Managers: **1 Expert selected**;
- UNDP ICT Manager, Jamaica: **1 Expert selected**

The reasons for selecting these particular experts for interview were not only to gather their perceptions for this study, but to provide additional support for the questionnaire survey data. It is important to mention that two of the experts selected had over 18 years' experience in ICT technologies, one expert had 26 years in the ICT industry, one expert had 17 years in ICT technologies, and the other expert had 22 years' experience in ICT as well. In addition the wealth of experience possessed these experts can potentially provide new insights for this research which is needed for SMEs.

3.4 Findings and Discussion

3.4.1 Survey Questionnaire

The first question of survey comprised of the gender category of the respondents. As previously mentioned, eighty-three responses were documented initially. However for purpose of this study the data analysis will focus be primarily on those respondents that are employed, legally connected or have business ties to a Jamaican SMEs. Figure 3.4.1 illustrates the response distribution data.

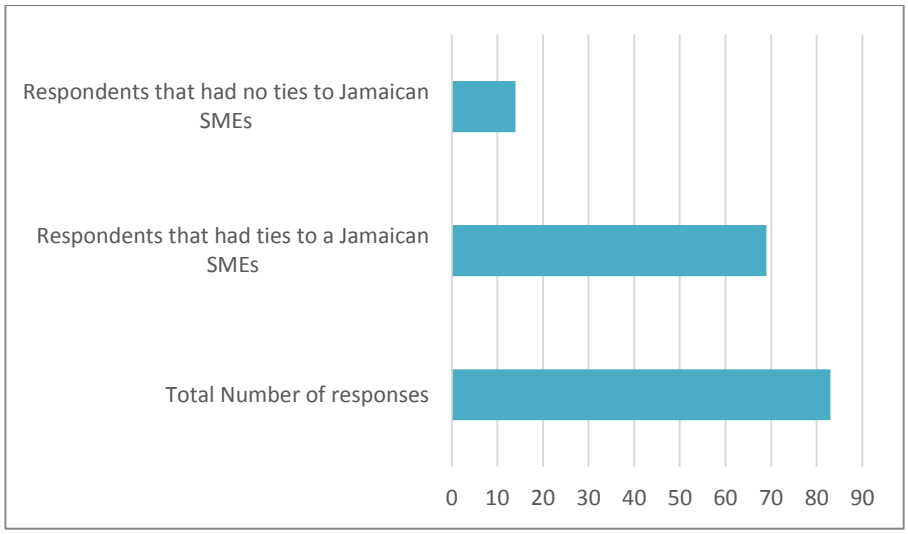

Figure 3.4.1: Questionnaire participants.

The percentage distribution calculated for the gender category was 62% male respondents and 38% female respondents from the total amount of sixty-nine responses. As seen in Figure 3.4.2, most participants were from Kingston and St. Andrew, which is reflective of the amount of privately owned enterprises in Jamaica. The highest percentage rate of responses observed came from other parishes including St. Andrew (25%), Kingston (19%), and St. Catherine (12%). The percentage range for the other parishes varied from as low as 0% (Hanover, Westmoreland and Portland) and as high as 9 % (St. James). As stated earlier, these figures are reflective of the current geographic distribution of where small and medium-sized enterprises can be found in Jamaica. Usually most of these enterprises which are primarily called ‘cottage industries’ are usually located in the urbanized areas of cities and towns of those parishes. The market scope was cited as mainly local markets with up to 45% of SMEs catering to the domestic markets of Jamaica. This means that the type of cloud services likely to be commissioned will be locally based. While 18% of the participants have indicated that the market scope are locally and internationally based, which means that the use

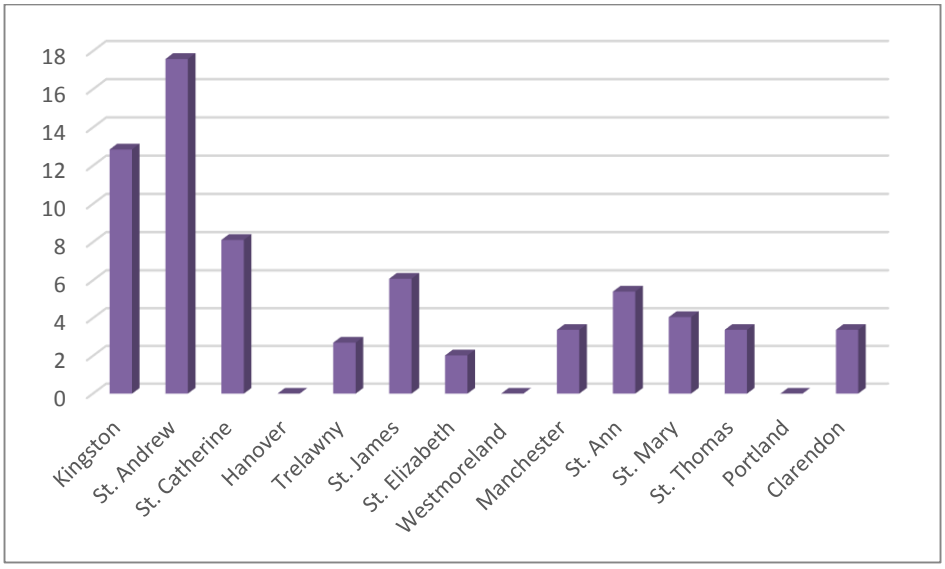

Figure 3.4.2: Parish location of survey participants.

of local and foreign-based cloud services providers are likely to be commissioned. It therefore means that in order for SMEs to exploit the benefits of cloud services, the Jamaican Government will have to enforce legislation and regulations to govern SLAs between cloud service providers and clients, improve the infrastructural facilities such as electricity supply

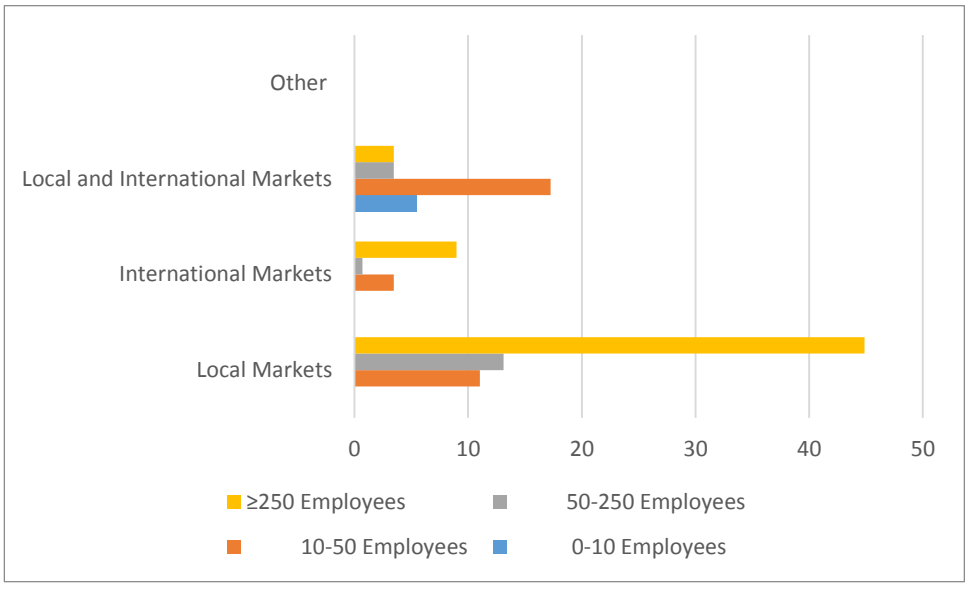

Figure 3.4.3: Market scope.

and increase bandwidth for ISP providers. This ensures that after cloud services are adopted by SMEs, the potential to increase market scope further and to meet current market demand

during operations is still guaranteed. The likely reasons for cloud services adoption by Jamaican SMEs is illustrated in Figure 3.4.3 (on the next page). As indicated, up to 35% of the participants have stated that the main reasons for adoption would be to increase computing capacity, date storage, to avoid upfront capital costs and expenditure on data centres (hardware, software, IT support etc.), flexibility and scalability of IT resources. Other reasons including increasing staff productivity through the range of office suites software available in the cloud, and to support business operations were listed as the motives for considering cloud services adoption. Although participants did not cite 'diversification of IT systems' as the main reason, that feature can be useful, particularly for those SMEs that are planning to implement computing mainly for business purposes rather than for technology. On the other hand 'business continuity' was ranked low with a percentage figure of less than 5%. This finding is interesting especially due to the fact that Jamaica is a highly risked Caribbean nation in terms natural disasters such as earthquakes and hurricanes (ODPEM). From this stance, the cloud is a great advantage, as disaster recovery efforts can be very expensive for SMEs there. On an average, it usually takes several months for small enterprises there to fully recover after these events.

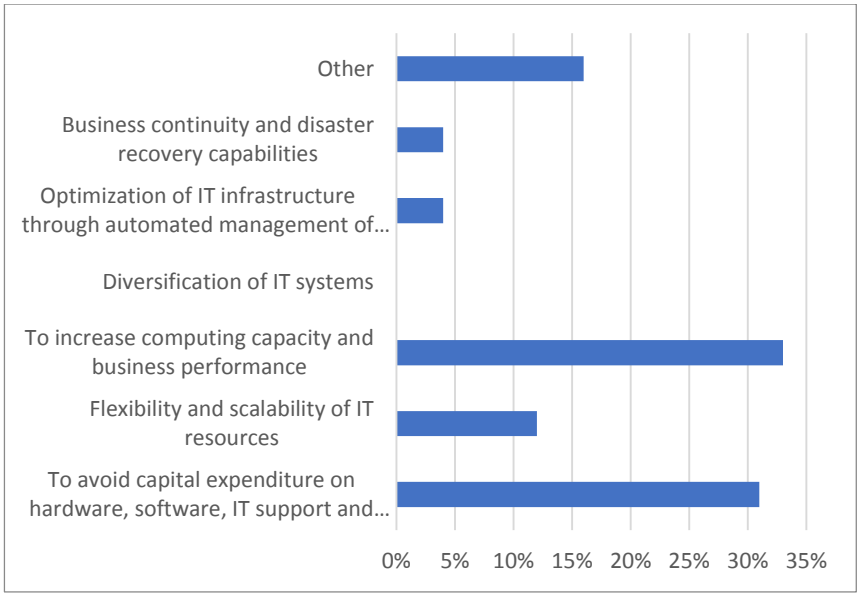

Figure 3.4.4: Main reasons for cloud services adoption.

Table 3.4.1 outlines responses received regarding the associated risks with cloud services. As seen in the accompanying diagram, the chief concerns expressed regarding why cloud services adoption would not be useful, includes 'loss of data control', 'unclear payment

schemes for cloud services' 'potential service and data unavailability' (see Figure 3.4.4). While 'disclaimer services from cloud service providers' were not a key issue towards adoption, 'integrity' of cloud service providers ranked as another key concern. The author presumes that it is more likely that the participants will assume that good integrity of cloud service is highly associated with good quality of the service as well. 'Service availability' was cited as main concern and this can be due to the frequent power outages that affect these businesses in Jamaica. Connectivity is necessary for achieving the benefits of the cloud, however unreliable power supply will be the key factor, especially when key business operations can are done in the cloud. This can result in loss of productivity, loss of income and revenue for these enterprises.

Table 3.4.1: Main concerns associated with cloud services adoption.

Main Concerns Raised:	**1 Not Important**	**2 Slightly Important**	**3 Important**	**4 Very Important**	**5 Extremely Important**
Privacy	0%	0%	17%	13%	39%
Service and data availability	0%	2%	11%	22%	34%
Integrity	0%	3%	0%	20%	46%
Data confidentiality	0%	0%	14%	24%	31%
Disclaimer services by service Providers	22%	0%	31%	16%	0%
Loss of data control and privacy	0%	0%	5%	12%	51%
Non-liability of cloud service Providers	0%	5%	19%	21%	24%
Vendor lock-in	0%	0%	12%	45%	12%
Inconsistency between trans-national laws and local regulations	0%	8%	6%	27%	28%
Non-liability of cloud service providers	0%	0%	33%	27%	9%
Unclear payment scheme from service Providers	0%	0%	7%	3%	59%

As most small enterprises are less likely to have sensitive data in the cloud 'vendor lock-in is not a major concern', according to the participants (12%). However inconsistency between local and trans-national laws were cited as a major concern, especially considering that it was ranked 'important, very important and extremely important' by the participants, 6%, 27% and 28%. In regards to the fact that 'unclear payment schemes from service providers' was cited as another concern, indicates that according to the participants'

responses, that SMEs are highly concerned about the costs involved for commissioning cloud services. While the responses ranged from ‘important’ to extremely important’, it is likely that the onus is one cloud service providers to ensure that costs involved for commissioning cloud

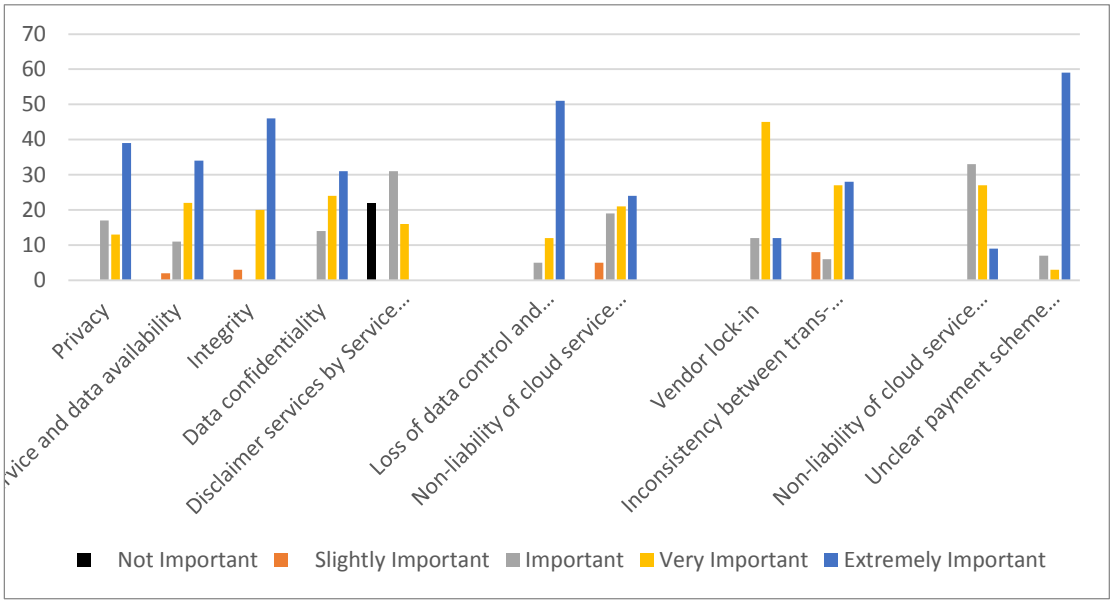

Figure 3.4.5: Key concerns regarding cloud services adoption.

services is reflective to the services deployed.

From Figure 3.4.6, the services that are most likely to be commission by SMEs are private cloud services (45%). Interestedly, respondents indicate that a combination of one or more cloud service is likely to be ideal for business operations (25%) as well. Although hybrid cloud services are usually customized with one more different types of cloud services, designed according to user preferences, the choice for ‘other’ indicates that respondents perceived that more freedom is guaranteed, if one or more types of cloud services are utilized for operations.

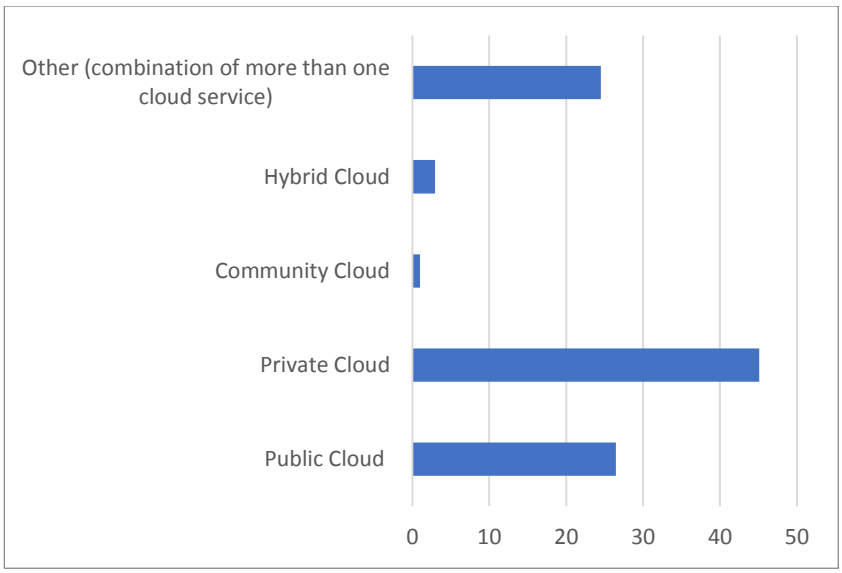

Figure 3.4.6: Cloud services that are likely to be commissioned by Jamaican SMEs

According to responses from the survey participants, Jamaican SMEs are more willing to outsource to more than one cloud service provider. The response percentages indicate that up to 77% of participants were willing to do this in addition to the positive perception they had towards full adoption of cloud services to support key business processes. On the other hand 12% of respondents indicated 'neutrality' towards cloud services adoption. No negative perceptions recorded.

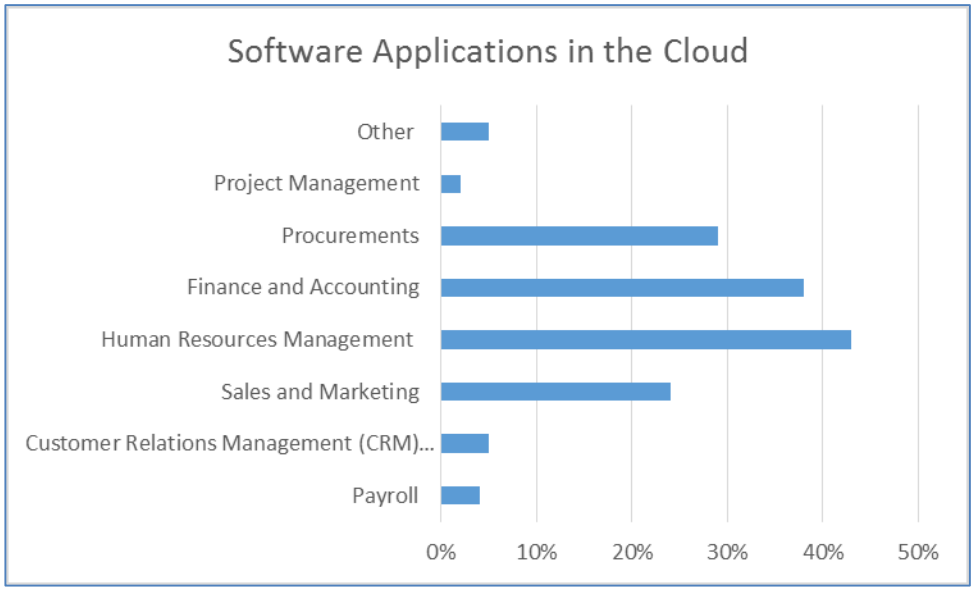

Figure 3.4.7: Software applications and services that are likely to be commissioned from the cloud.

In regards to the types of cloud services and/or software applications (that is PaaS, SaaS and IaaS) that are likely to be commissioned, the participants indicate that 'human

resources', 'finance and accounting' and procurements were most likely to be procured, while on the other hand 'payroll' which is closely linked to 'human resources' were considered as one type of service not likely to be commissioned by SMEs. 'Sales and marketing' were also likely to be commissioned according to the participants and this is likely due the retail and service industry that is predominant in Jamaica. 'Project management' which is an inactively used business function was cited as one of those services that are unlikely to be commissioned, as well as 'customer relations management'.

Table 3.4.2: Main concerns regarding the adoption of cloud computing, per industry.

SME Size and Industry of Operation	0-3 years	3-5 years	5-10 years	≥10 years
Government	0%	0%	0%	8%
Legal services	0%	0%	0%	0%
Engineering	0%	0%	0%	2%
Information Technology	0%	0%	2%	2%
Manufacturing and Retail	0%	0%	13%	13%
Health services	0%	0%	0%	15%
Energy	0%	0%	0%	17%
Education	0%	0%	12%	12%

The main concerns highlighted according to Table 3.4.2, were that SMEs operating for more than five years, had a higher concerns regarding the adoption of cloud computing services. The author presumes that this is may be due to the SMEs' industry of operation. As demonstrated, the Table shows that 17% percent of SMEs operating in the 'energy' and 'health services' (15%) industries are very precarious towards full cloud computing adoption. The author do not support this, especially for the health services industry, cloud computing technologies could play a key role towards improving the 'health service' industry of Jamaica in terms of access to patient care and data around the island's hospitals and medical facilities (Kshetri, 2010). Yet it can be due to the concerns regarding loss and control of data as indicated by participants.

Table 3.4.2 further reiterates the current status towards cloud services adoption in Jamaica; while most respondents have indicate that they are not sure if they intend to adopt cloud services (47%), cloud services are already adopted by 9% of SME. 44% have indicate

that they intend to adopt cloud services in 2 years. These findings can be due to the fact that participants perceive that there should be a critical need for adopting cloud services as part of daily business processes.

Table 3.4.3: Status of SMEs towards cloud computing adoption.

Current Status Towards Cloud Services Adoption:	**Percentage**
Cloud computing services are already adopted	9%
We intend to adapt cloud computing services in 2 years	44%
We do not intend to adapt any cloud computing services	0%
Other (Not Sure or Non-Applicable respondents)	47%
Total	100%

3.4.2 Expert Interviews

According to the experts, business continuity possibilities are enhanced through the cloud as well as the loss of data minimized. The experts confirm that cloud computing is fast evolving from a future solution into a viable alternative for many small to medium-sized businesses in Jamaica. Data availability is increased through the cloud as long as connectivity can be easily established to that data; in addition, accessibility and mobility support is enhanced from the cloud especially for multimedia conferencing among enterprises, business operations are moving as usual despite geographical location, for employees who choose to work from home instead of the office. Three experts confirm that while cloud computing can indeed provide access to productivity tools that can increase efficiency in work tasks one expert claimed that, the initial up front capital investment in cloud services can be very expensive for SMEs from developing countries and should be seriously considered before full migration. It was recommended that a cost-benefit analysis which compares traditional data centers to that of the cloud be done before complete migration is considered. While this can be a major disadvantage of cloud computing for SMEs in Jamaica, all of the experts confirmed that cloud computing can promote business continuity especially during disasters periods such as hurricanes and earthquakes that Jamaica face on a yearly basis. Loss of data is minimized during disaster periods, as well as productivity maintained, as the cloud allows the possibility for business continuity from any location as long as there in internet connectivity. This can be a big benefit for SMEs as the main advantage is reduced infrastructure cost, reduced staff costs in terms of local IT specialists, and no up-front capital investment for data centers as

well. On the other hand, the main challenge faced by small and medium-sized enterprises is connectivity and availability of capital investment for cloud services. It was confirmed that in terms of costs, the public cloud would be ideal for these enterprises due to the relative size availability of funding ICT and IT technologies. It was mentioned that for countries such as Jamaica and other developing economies, connectivity can be a major challenge as well as the cost for connectivity services from an ISP provider. One expert confirmed that main niche or key advantage that the cloud could offer for Jamaican SMEs is relative savings for hosting data especially when compared to the daily, operational costs (recurring costs) involved with maintaining traditional data centers and IT human resources. For a growing business, one of the most difficult things to do is keep capital expenditures under control. SMEs in Jamaica can benefit significantly from cloud computing by leveraging virtualization technology with desktop and server virtualization, and economies of scale, cloud computing is a way to access enterprise-grade IT that would otherwise be too costly to purchase and maintain. Additional benefits are cost, scalability, security, disaster recovery, flexibility, greater functionality as well as mobility.

One expert confirmed that as SMEs in developing economies face more challenges than their developed counterparts, small enterprises that are considering to implement cloud services, should assess the need for these services as it should be based on their business requirements rather than technology; if there is a 'true' need for cloud services a cost-benefit analysis should be done prior to implementation. This statement reiterates the views expressed for the previous question so as emphasized, for larger organizations cloud services can be easily implemented than for smaller enterprises due to available funding. For SMEs, if cloud services do not offer the potential to expand their market strategies, increase their customer-based or provide competitive-edge over competitors then it should not be implemented solely on the basis on technology. One expert reiterated that as connectivity is very important feature of cloud services then the necessary infrastructure facilities should be in place in order to experience the trues benefits of that service.

The key barrier to cloud adoption according to one expert is connectivity especially for developing countries that is. Unreliable connectivity can reduce the potential of the cloud. Moreover, since all cloud services providers are the same, connectivity access can be the main barrier for adoption by small enterprises. Another expert confirmed however for some developing economies Government support can be the main barrier for cloud adoption in

Jamaica since no clear or standardized policies that govern ICT technologies have not been implemented as yet. In addition, security breaches, lack of government policies or organizational policies (non-technical barriers) were cited as the chief barriers to cloud adoption; furthermore this barrier is be peripheral, as it affects, to greater extent affect the rate at which cloud services are implemented. While security can be a main issue for developed and developing economies, connectivity was cited as the greatest one. Technical barriers including sensitivity of data, the reliability of the cloud services provider and connectivity were also cited as the barriers to cloud adoption. For one expert, connectivity is secondary for Jamaica, as reliable power source continues to affect that country; Based on this presumption, power supply was stated as a primary barrier to cloud services adoption in that country. Furthermore, the fact that the country is highly dependent on the electricity supply to conduct business operations, electricity can affect the rate of adoption, especially when that enterprise is highly dependent on the cloud for business operations. Overall the main barriers, as cited by three experts were connectivity and security, while for another expert the main barrier was inconsistent electrical supply. However all experts emphasized that commitment from the cloud service provider as well as reliability in the delivery of services from that cloud service provider and government regulations can be potential barriers as well. In terms of the technical barriers that can affect the adoption rate, bandwidth which has the potential to affect basic key functions such accessing emails, documents and other relevant information, can affect the adoption rate as well. A small bandwidth can affect the internet speed, in terms of the processing time for documents to be uploaded or downloaded from a hosted data center, or for performing financial transactions. The experts recommend that as security is a very important factor to cloud technology, it was recommended for Jamaican SMEs to seek a cloud service provider that has the key securities to safeguard the business, such as the ISO: 27001certification which provides an IT security standard within a company.

According to the experts, the concept of cloud computing has already been filtered into the business processes and activities of Jamaican SMEs. Cloud services models including Paas, IaaS and SaaS are examples of cloud computing that are already filtered into the normal processes for both large and small enterprises. One expert confirmed that these cloud service models already possess the key elements required for establishing a local data system into the cloud. Examples of these systems that were cited by that expert include, email, productivity tools, Microsoft OneDrive, Microsoft Office 365 are systems already hosted in the public

cloud. Based on this three experts confirmed that Jamaican SMEs aware that they are using cloud services and these services are been filtered into their business activities. These experts further claimed that SMEs by their normal nature of their enterprise activities are aware that they are using cloud services and these services. However one expert claimed that there are some businesses who are completely unaware that they are using cloud computing, in fact most users are not aware that by using web-based e-mail services or storing their files in Google Drive or Microsoft OneDrive, that they are indeed using cloud computing services. This is the case with most SMEs in Jamaica because as stated these businesses are using some of the services, but are unaware that it is in fact cloud computing services or cloud computing technologies. Two of the experts on the other hand confirmed that most small enterprises and large enterprises as well were not aware of the term cloud computing as a technology. The most common types of cloud platforms/ cloud services used in Jamaica were cited as email services such as Google Apps, Microsoft Azure and Microsoft Office 365, OpenStack by Rackspace, Gmail, Hotmail and Yahoo; Facebook and Whatsapp Messenger services was also cited as heavily trafficked cloud platforms used in that country. One expert however stated that from an enterprise perspective, productivity tools including Microsoft OneDrive were cited as one of the productivity tools likely to be used by these small enterprises since it is already hosted in the public cloud. In comparing the associated costs involved for migrating cloud services versus building a traditional data center, physical infrastructural facilities including constructing server rooms and the physical data center, IT equipment, skilled and unskilled human resources, IT hardware and software, maintenance costs and operational costs were relatively higher than commissioning cloud services. The experts however cautioned for small enterprises commissioning private cloud computing services can be very expensive in terms of upfront capital investments. Therefore it was advised that utilizing the main Internet and telecommunications service providers can guarantee reliable and affordable cloud services rates. These companies would be LIME, Digicel and FLOW/Columbus Business (now owned by Cable & Wireless, Plc who also owns LIME). Other business providers were cited as intermediaries between the Internet and telecommunications providers and the customers. One the other hand one expert claimed that while it may be true, for SMEs in Jamaica, traditional data centers can be the more economical option in terms of initial capital investment, however the long-term benefits of using private clouds are achieved only after several years of commissioning. Although the experts agree that cloud services have the

potential to increase efficiency for businesses in general as data is centrally stored and can be accessed, the Government has key part to play in terms of revamping and implementing legislation that supports the current ICT environment in Jamaica. In regards to the current legal framework none of the experts confirm or comment on the legal framework relating to cloud computing in Jamaica.

Pricing needs were cited as critical as SMEs will have to know the kind of budget that is suited for adopting the cloud as the solution. Factors such as where the organization is seeking to eliminate costs were cited as well as many other factors that should also be considered and analyzed in terms of cutting costs and managing operations. The type of cloud services that was cited relevant for Jamaican SMEs depended on the size and type of business as that determines which cloud services are most suitable to employ. The expert stated that as one or more cloud services may be used as well or whether to move one or two services to the cloud initially, SMEs need to analyzed how these services can affect business operations. It was further advised by that expert to adopt cloud services according to how the enterprise needs change at a future date. Overall- finding a cloud service provider that is flexible to that SME's business needs is important as well. In addition it was recommended by the experts that as it is easy nowadays to compare different cloud companies using comparison tools, and companies vary greatly in terms of functionality and billing methods, SMEs should ensure that before committing to one cloud service provider, a complete breakdown of the associated costs should be discussed before these services are commissioned. In addition the ease of managing cloud service in-house is important as well. While one expert confirmed that in-house IT personnel are not required to have specialized skills, other experts claim that the degree and level of how cloud services are managed can affect the rate of adoption as well. The author agrees as one of the benefits of cloud technology is the time saved by simplified management of that technology which ensures that perceived benefits are gained.

In terms of how cloud services are measured in Jamaica, one expert confirmed that cloud services are measured according to: "*key performance indicators (KPIs) that are critical for measuring the performance and benefits of cloud computing:*

1. *IT capacity - measured by storage, CPU cycles, network bandwidth or workload memory capacity as indicators of performance.*
2. *IT cost – measured by the cost of moving to the cloud as well as the cost savings.*

3. *IT utilization - measured by uptime availability and volume of usage as indicators of activity and usability.*

However, effective capacity/performance ratios and levels of usage activity do not necessarily imply business benefits. They are just indicators of business activity that are not in themselves more valuable than lower operating cost. There are also business metrics that can help to indicator the direct and indirect benefits to the business:

1. *The speed and rate of change of cost reduction.*
2. *Total cost of ownership optimization.*
3. *Rapid provisioning.*
4. *Increased margin and cost control.*
5. *Dynamic usage.*
6. *Risk and compliance improvement.*
7. *Enhanced capacity utilization.*
8. *Access to business skills and capability improvement.*

These measurements define a new set of business indicators that can be used to create a business scorecard of the current and future operational business and IT service needs relating to cloud computing."

The experts do confirm that cloud computing is still at the infancy level within the country of Jamaica as major investments have just been made in IT infrastructure and it is taking time to decide what services can be moved into the cloud and how it will affect investments already made. One of the experts perceived that this will change in another 5-7 years. It is predicted by one expert that there will be more adoption of cloud computing within the country as more businesses become aware of cloud computing and will make the decision against investing in new traditional IT hardware or physical data centers. The level of understanding of cloud computing services by SMEs in Jamaica was cited as an environment where once the benefits of cloud computing were presented and explained to the business community, there would be no difficulty in convincing these SMEs the cloud is the 'future of business' in order to reduce cost and increase efficiency .

In concluding it is important to reiterate that that as every business will encounter their own barriers when considering the cloud, in Jamaica, the potential barriers are not that different from in other countries. Loss of control, connectivity, availability of power source,

data security and privacy and costs are common barriers to cloud adoption and for the SMEs operating in Jamaica this can be significant hurdle towards gaining a competitive advantage both locally and internationally. The author is however optimistic and agrees with the experts that significant investment in ICT is required by all key stakeholders in order to sustain and promote ICT technologies that are necessary for the functions of all business enterprises in Jamaica. This can aid in changing the perspectives and perceptions of how ICT technologies and to a greater extent how cloud computing technologies are perceived by all business enterprises and not just SMEs. The author believes that the research study has proven based on the findings from the questionnaire and expert opinions that Jamaican SMEs are unaware of cloud computing technologies, not because of the absence of this technology but cloud computing is often termed or perceived to be a 'complex form of technology' rather than 'simple web-based internet services' such as Gmail, Google Drive and Microsoft OneDrive.

4. CONCLUSIONS AND FURTHER RECOMMENDATIONS

1. This research proved that several components within the political, economic, legal, social, external and technological factors must be considered before cloud computing technologies are adopted. While most factors identified ranged from price, vendor lock-in, tax implications, privacy, to trade and competition implications, the chief factors most applicable to the Jamaican SMEs are those economic, technological and social factors which promote key enterprise operations to be fully utilized in the cloud. However in Jamaica, as there are a lot of SMEs who are completely unaware that they are using cloud computing and that web-based e-mail services or data stored in Google Drive or Microsoft OneDrive are a few of the simplified versions of cloud computing. Consequently, as this research identified these factors, Jamaican SMEs as they become more aware of cloud computing should try to implement cloud computing technologies that ensures the flexibility to achieve their economies of scale in an efficient manner, as well as those technologies that suite and complement the key nature of their business processes.

2. The study also provided the underlying reasons for cloud adoption. Based on the questionnaire findings these reasons were purely based from the ability of cloud computing technologies to potentially increase computing capacity, date storage, decrease upfront capital costs and expenditure on data centres (hardware, software, IT support etc.), flexibility and scalability of IT resources. Other reasons included increasing staff productivity through the range of office suites software and productivity tools available in the cloud, and to support business operations were listed as other motives for considering cloud services adoption. While this is reassuring, the Government of Jamaica still has a major part to play in implementing the requisite legislations, as other reasons including data security and SLA agreements between cloud service providers and customers can potentially affect the decision to adopt cloud computing technologies.

3. This study also proved that cloud adoption can improve key business processes such as Human Resource Management, Finance and Accounting, Sales and Marketing, and

Procurements. This was strongly indicated by the overall response rate from the questionnaire survey, that the commissioning of cloud-based software and applications related to these key business processes can improve these processes. The extent to which cloud adoption improves these processes are highly dependent on the nature of business operations, the size of the SMEs, markets competition and the extent to which SME users become more that aware they are using cloud computing. The main advantage is that the cloud grants the potential to improve the quality of administration and execution of these business processes Through the use of web-based technologies and productivity tools available in the cloud. As there is significant cloud usage nowadays globally, Jamaican SMEs as they become aware and understand cloud computing should start accessing these web-based tools from public clouds that are available at their work places.

4. Finally this thesis proved that based on the insights gathered from the experts and the findings from questionnaire survey, cloud computing technology has the potential to improve the efficiency of small and medium-sized enterprises. From the expert point of view, the cloud do in fact improves efficiency for SMEs however this efficiency is more tangible only for those enterprises operating in developed economies. The experts in endorsing the cloud's adoption, have however cautioned that for Jamaican SMEs, cloud services should only be adopted based on the business requirements of those SMEs rather than for technology, as obstacles including internet connectivity and a reliable source of power supply will first have to be addressed before the economies of scale associated with the cloud are fully realized by these SMEs. In addition, the experts have confirmed that cloud computing technologies, in particular private cloud models are more suited for improving enterprise efficiency better than other cloud models. However as these types of clouds are quite expensive, they are more suited for the operations of larger enterprises operating in Jamaica and not necessarily for small and medium-sized enterprises. The findings from the questionnaire do however state that cloud computing can improve the efficiency of small and medium-sized enterprises efficiency due to the relative degree that this technology promotes and ensures business continuity and disaster recovery for Jamaican SMEs that are prone to natural disasters, annually. In addition this study also confirmed that industry, size, and key services or business processes of those SMEs predominantly influenced by the

perceptions of SMEs business owners, managers, and users, especially in using cloud computing for improving their enterprise efficiencies.

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SUMMARY

Cloud Computing Technologies and Management for Improving Efficiency in Small and Medium-sized Enterprises in Jamaica/ Master Thesis of Social Technologies Management Joint Degree Program. Supervisor Prof. Dr. Darius Štitilis, Consultant Assoc. Prof. Dr. Ana Salazar- Vilnius: Mykolas Romeris University, Faculty of Social Technologies, Institute of Digital Technologies; Porto: Universidade Fernando Pessoa, Faculdade de Ciencias Humanas e Sociais, 2015; – 114 P.

This thesis represents the economic analysis of the role and value that cloud computing technologies and management plays towards improving the efficiency of small and medium-sized enterprises in Jamaica. As one of the most scalable, ubiquitous form of technological innovation, the cloud could potentially bridge the digital divide for Jamaican SMEs. The work presents the major benefits of cloud computing while highlighting the ICT-related infrastructural problems that SMEs from Jamaica currently face. In addition, to the enormous contributions, in terms of being the standard cubicle for innovation and job creation, SMEs still lack the necessary tools to unlock operational efficiency, productivity and profitability. However, the main inhibitor of cloud computing technologies is security and in Jamaica this concern is increased exponentially. Therefore, cloud service providers engaged in the business of providing unique cloud solutions, should guarantee security in the SLAs, which can comfortably assist Jamaican SMEs to make more informed decisions towards cloud adoption. The advent of available cloud computing technologies from cloud service providers means that SMEs can access IT applications that would otherwise require a level of investment that would be beyond the scope of their financial resources. Based on the findings from the questionnaire and expert opinions, Jamaican SMEs are highly interested in adopting cloud computing technologies through the potential it has for increasing operational and business efficiency, reduced costs, promotes business continuity after major natural disasters such as hurricanes and earthquakes the island face, and its degree of scalability. These were discovered as the key reasons for cloud computing technologies adoption by Jamaican SMEs. However connectivity and reliable power source must first be addressed before efficiency can be effectively measure by Jamaican SMEs.

Keywords: Information and communications technology, Data security, Infrastructure as a Service (IaaS) Platform as a Service (PaaS), Software as a Service (SaaS), Small and medium-sized enterprises, cloud computing.

SANTRAUKA

Debesų kompiuterijos technologijos ir valdymas didinti veiksmingumą mažųjų ir vidutinių įmonių Jamaikoje / Socialinių technologijų valdymo bendrosios studijų programos baigiamasis magistro darbas. Vadovas: Prof. Dr. Darius Štitilis, Konsultantas Assoc. Prof. Dr. Ana Salazar- Vilnius: Mykolo Romerio Universitetas, Socialinės technologijos fakultetas, Skaitmeninių technologijų institutas; Portas: Universidade Fernando Pessoa Faculdade de Ciências Humanas e Sociais 2015; - 114 P

Šiame darbe atliekama debesų technologijų ir valdymo reikšmės bei vertės, skatinant mažojo ir vidutiniojo verslo produktyvumą Jamaikoje, ekonominė analizė. Kaip viena paslankiausių ir plačiausiai paplitusių inovacijų, debesų kompiuterija potencialiai galėtų kompensuoti sunkesnį skaitmeninių technologijų prieinamumą smulkaus ir vidutiniojo verslo įmonėms. Darbe apsvarstomi pagrindiniai debesų kompiuterijos privalumai, taip išryškinant su ja susijusias infrastruktūrų problemas, kurias tenka spręsti smulkaus ir vidutiniojo verslo įmonėms Jamaikoje. Greta to, kad smulkaus ir vidutinio verslo įmonės atlieka milžiniškos reikšmės vaidmenį kaip įprastiniai inovacijų ir naujų darbo vietų inkubatoriai, šiam verslui tebestinga priemonių realizuoti darbo efektyvumo, produktyvumo ir pelningumo potencialui. Pagrindinė kliūtis debesų kompiuterijai – saugumas, o Jamaikoje saugumo poreikis ypatingai aukštas. Todėl debesų technologijų paslaugų tiekėjai, siūlantys unikalius debesų technologijų sprendimus, turi garantuoti saugumą per SLAs, padėsiantį smulkiajam ir vidutiniajam verslui Jamaikoje kompetetingiau spręsti dėl debesų kompiuterijos technologijų naudojimo. Prieinamų debesų kompiuterijos technologijų diegimas ir plėtra reikštų, kad smulkusis ir vidutinysis verslas gali naudotis informacinių technologijų priemonėmis, priešingu atveju reikalaujančiomis jų finansines galimybes viršyjančių investicijų. Vadinasi, smulkiajam ir vidutiniajam verslui reikia vyriausybinio lygmens patikinimo, kad imtasi reikalingų priemonių skatinti verslo tęstinumui tuo atveju, jei debesų kompiuterijos paslaugų tiekimas nutrūktų. Remiantis anketavimo rezultatais ir ekspertų nuomonėmis, Jamaikos SVV domisi debesų kompiuterijos technologijų diegimu. Tai lemia potencialūs privalumai: išaugantis veiklos ir verslo efektyvumas, sumažinti kaštai, verslo tęstinumo užtikrinimas po didelių gamtinių katastrofų, tokių kaip uraganai ir žemės drebėjimai, kuriuos dažnai patiria sala. Taip pat ir kompiuterinių sistemų pajėgumai ir veiklos apimtys. Tai pagrindinės tyrimu identifikuotos

priežastys, lemiančios debesų kompiuterijos diegimą Jamaikos SVV. Kita vertus, ryšio ir patikimo energijos šaltinio klausimai turi būti išspręsti pirmiausiai ir tik tuomet Jamaikos SVV galėtų vertinti debesų kompiuterijos taikymo efektyvumą.

Raktiniai žodžiai: Informacinės ir ryšių technologijos, duomenų saugumas, infrastruktūra kaip paslauga (IaaS), platformos kaip paslauga (PAAS), programinės įrangos kaip paslaugos (SaaS), smulkusis ir vidutinis verslas, debesų kompiuterijos

RESUMO

Cloud Computing: Tecnologias e Gestão para melhorar a eficiência em Pequenas e Médias Empresas na Jamaica Tese / Master Degree do Programa Conjunto das Tecnologias Sociais Gestão. Supervisor Prof. Dr. Dario Štitilis, Consultor Assoc. Prof. Dr. Ana Salazar Vilnius: Mykolas Romeris University, Faculdade de Tecnologias Sociais, Instituto de Tecnologias Digitais; Porto: Universidade Fernando Pessoa, Faculdade de Ciências Humanas e Sociais, de 2015; - 114 P.

Esta tese representa a análise económica do papel e do valor que as tecnologias de cloud computing desempenham na gestão, no sentido de melhorar a eficiência das pequenas e médias empresas na Jamaica. Como uma das formas mais escalável, omnipresente de inovação tecnológica, a cloud computing poderia potencialmente reduzir o fosso digital para as PME jamaicanas. O trabalho apresenta os principais benefícios da cloud computing, enquanto destacando os problemas de infra-estrutura relacionados com as TIC que as PME de Jamaica enfrentam atualmente. Além disso, para as enormes contribuições, em termos de ser o cubículo padrão de inovação e de criação de emprego, as PME ainda não têm as ferramentas necessárias para desbloquear a eficiência operacional, produtividade e rentabilidade. No entanto, o principal inibidor de tecnologias de computação em nuvem é a segurança e na Jamaica esta preocupação tem aumentado exponencialmente. Portanto, os prestadores de serviços envolvidos no negócio de fornecimento de soluções, deveriam garantir a segurança nos SLAs, o que pode ajudar as PME na tomada de decisões mais informadas em relação a adoção da cloud. O advento das tecnologias de cloud computing disponíveis a partir de prestadores de serviços significa que as PME possam aceder a aplicações, que normalmente exigiriam um nível de investimento que estaria além do alcance dos seus recursos financeiros. Consequentemente, devem ser asseguradas às PME através dos seus governos as disposições suficientes no local para promover a continuidade do negócio em caso de falha no fornecimento de infra-estrutura de serviços de cloud computing. Com base nos resultados do questionário e opiniões de especialistas, as PME jamaicanas estão altamente interessadas em adotar tecnologias de cloud computing devido ao potencial que estas têm para aumentar a eficiência operacional e de negócios através da flexibilidade, reduçaõ de custos e escala. Estes três elementos foram descobertos como os elementos-chave ou força motriz para a adoção da cloud computing por parte das PME jamaicanas. No entanto conectividade e fonte de energia

confiável deve primeiro ser tratadas antes de eficiência pode ser efetivamente medir pelas PME Jamaicanas.

Palavras-chave: informação e das comunicações, segurança de dados, infraestrutura como serviço (IaaS) Plataforma como Serviço (PaaS), Software como Serviço (SaaS), Pequenas e médias empresas, cloud computing.

SUPPLEMENT

QUESTIONNAIRE SURVEY

This survey is created to provide insights on the perspectives from SME end users on cloud computing adaption for improving efficiency of Jamaican Small to Medium-sized Enterprises. The survey is based on a research study aimed at assessing the requirements engineering, prospects and actual needs that Jamaican SMEs aspire for improving business process efficiency through cloud computing infrastructure. If you are the owner of a Jamaican SME or an individual employed to one, please participate. This survey will not require you to have any expertise or special knowledge about cloud computing and/or social software. Please take a few minutes to complete the questionnaire, as your answers are important and beneficial for the research. Your answers will remain strictly confidential.

Thank you for your time.

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1. Are you male or female
   - ☐ Female
   - ☐ Male

2. From which parish (region) is the SME that you represent based in? If the SME that you represent is not based in Jamaica please still write the country and region in the answer box provided
   _____. Other please specify: _____

3. Which of the following statements represents the main reason for cloud services adoption? (Choose more than if applicable)
   - ☐ To avoid capital expenditure on hardware, software, IT support and Information Security
   - ☐ Flexibility and scalability of IT resources
   - ☐ To increase computing capacity and business performance
   - ☐ Diversification of IT systems
   - ☐ Optimization of IT infrastructure through automated management of virtual machines
   - ☐ Business continuity and disaster recovery capabilities

   Other please specify: _____

4. Which cloud computing service do you think is most suitable for the SME you represent?

☐ Public Cloud

☐ Private Cloud

☐ Community Cloud

☐ Hybrid Cloud

Other please specify: _____

5. For your SME, which of the following are high concerns towards the approach to cloud computing?

	1 Not Important	2 Slightly Important	3 Important	4 Very Important	5 Extremely Important
Privacy	☐	☐	☐	☐	☐
Service and data availability	☐	☐	☐	☐	☐
Integrity	☐	☐	☐	☐	☐
Data confidentiality	☐	☐	☐	☐	☐
Disclaimer services by service Providers	☐	☐	☐	☐	☐
Loss of data control and privacy	☐	☐	☐	☐	☐
Non-liability of cloud service provider	☐	☐	☐	☐	☐
Vendor lock-in	☐	☐	☐	☐	☐
Inconsistency between trans-national laws and local regulations	☐	☐	☐	☐	☐
Non-liability of cloud service provider	☐	☐	☐	☐	☐
Unclear payment scheme from service providers	☐	☐	☐	☐	☐

6. Would your SME be willing to outsource to more than one cloud service provider? If the answer is yes what is the main perception or attitude of the SME or the SME that you represent towards full adaption of cloud computing services for supporting the enterprise business processes?

☐ Positive

☐ Negative

☐ Neutral

7. Which of the following IT services or software applications support would your SME opt to outsource to a cloud service provider? (Choose more than one if applicable)

- ☐ Payroll
- ☐ Customer Relations Management (CRM) System
- ☐ Sales and Marketing
- ☐ Human Resources Management
- ☐ Finance and Accounting
- ☐ Procurements
- ☐ Project Management

Other please specify: _____

8. What is the size of the SME and the industry of operation?

	0-3 years	3-5 years	5-10 years	≥10 years
Government	☐	☐	☐	☐
Legal services	☐	☐	☐	☐
Engineering	☐	☐	☐	☐
Information Technology	☐	☐	☐	☐
Manufacturing and Retail	☐	☐	☐	☐
Health services	☐	☐	☐	☐
Energy	☐	☐	☐	☐
Education	☐	☐	☐	☐

9. What is the market scope this SME and how many years has it been operating?

	0-10 Employees	10-50 Employees	5 0-250 Employees	≥250 Employees
Local Markets	☐	☐	☐	☐
International Markets	☐	☐	☐	☐
Local and International Markets	☐	☐	☐	☐

Other please specify: _____

10. Which of the following statements represents your SME's current situation towards cloud computing?

- [ ] Cloud computing services are already adopted
- [ ] We intend to adapt cloud computing services in 2 years
- [ ] We do not intend to adapt any cloud computing services

Other please specify: _____

EXPERT INTERVIEW

Master Thesis Theme and Topic:
"CLOUD COMPUTING TECHNOLOGIES AND MANAGEMENT FOR IMPROVING EFFICIENCY IN SMALL AND MEDIUM-SIZED ENTERPRISES IN JAMAICA"

Date of Interview:

Programme Name:
Social Technologies Management (Joint Master Programme)

Interviewer:
Keisha LaRaine Ingram

Institution:
Mykolas Romeris University/
Universidade Fernando Pessoa

Name of Expert:_____ **Title: _____**

Profession: _____ **Years of Experience: _____**

Questions:

1. From a business enterprise perspective, what are the perceived benefits of cloud services? What can the cloud offer for SMEs in Jamaica?
2. What are the essentials things that Small and Medium-sized Enterprises (SMEs) should consider before implementing cloud services.
3. What are the key barriers to cloud adoption in Jamaica by business enterprises?
4. Do you think the concept of Cloud Computing has been filtered into the business processes or activities of Jamaican SMEs? What do you think is the current level of understanding of Cloud Computing technologies by Jamaican business enterprises?
5. What are the most common types of cloud platforms/ cloud services used in Jamaica? Which platform is popularly used by business enterprises in Jamaica?
6. What are the main reasons for adopting Cloud services in SMEs?
7. Who are the main cloud service providers in Jamaica and what is the level of risk associated with these services?
8. Explain what are the cost factors involved in Jamaican cloud data centers?
9. For business enterprises, how are cloud services measured?
10. What do you consider to be the main challenges of Cloud Computing services by businesses that have already adopted cloud services?
    - Security
    - Service compatibility
    - Usability
    - Availability
    - Performance
    - Relative advantage for businesses
    - Reliability
    - Cost factors (Jamaican businesses are worried that the technology could cost more)

- Not enough major cloud suppliers in Jamaica
- _____ (other)

11. Do you think these challenges affect the rate of adoption of cloud services by businesses?
12. Explain what are the current security laws enacted by the Jamaican Government that protect data in the cloud?
13. At what at stage (whether it is at the infant or maturity level) are Cloud Computing technologies in Jamaica?
14. Do you think that businesses Enterprises (SMEs or large corporations in Jamaica) are aware that they are using cloud services?
15. Can you explain and rate the level of understanding of Cloud Computing services by SMEs in Jamaica?
16. Explain what optimizing strategies can be used by SMEs to generate more efficiency from cloud services that can improve or promote better business processes for SMEs?
17. How can Cloud Computing Services improve the efficiency and business processes of SMEs in Jamaica?
18. What are legal obstacles that may affect the use and adoption of cloud services by SMEs in Jamaica?