Adaptation and Effects of Cloud Computing on Small Businesses

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Abstract: *One of the popular technologies in the industry today is cloud computing and the use of cloud computing in small businesses is now fashionable, it has a remarkable impact on them by bringing a new way of working, accessing their data and storing it. The aim of the study is to examine the impacts and effects of migration to cloud computing on small businesses. The methodology used for this study is based on a review of past studies, which explains in broad terms each research question of this study. The results of this study shows that there are several benefits that cloud computing has to offer small businesses if cloud computing is adopted and that includes flexibility, cost reduction and automatic software/hardware upgrades etc. Cloud computing has a large storage capacity that helps small businesses store and access large amounts of data quickly and easily, and there are a number of cloud computing data recovery techniques that help to recover lost or damaged data in the cloud. In the same way that security is a major concern for all technologies, it is also a concern for data stored in the cloud; security techniques such as encryption, cryptography are mostly used to ensure that key areas of data security (data confidentiality, data integrity and data availability) are protected. The results of this study helps small businesses to understand the impact of cloud computing on their businesses and the various security measures that need to be taken while adapting cloud computing technology.*

Keywords: *Cloud computing; security in cloud computing; small businesses; cloud computing in business; adaptation.*

1. Introduction

Cloud computing is getting more attention and becoming one of the most suitable utility for companies, organizations and users that deal with financial, feasible, adaptable and scalable computing services for its everyday activities. Cloud computing operation is internet based which allows sharing of computer resources with other devices based on user demands of the resources (Ahmed, 2019).

The most widely used definition of cloud computing is defined by (Mell & Grance, 2011) at National Institute of Standards and Technology (NIST). Cloud computing is a model for allowing universal, easy, on-demand network access to a common pool of configurable computing resources (e.g., networks, servers, storage, software, and services) that can be distributed easily and released with minimal management effort or service provider involvement (Mell & Grance, 2011). Cloud computing as defined by the NIST is made-up of five (5) major characteristics, three (3) service models and four (4) deployment models. The first characteristic is, on-demand self-service. In on-demand self-service, the consumer can singularly make available the computing requirements without human intervention or interaction with the service provider. The second characteristic is the broad network access; this means that services are reachable from anywhere via different types of devices such as laptop, mobile device, and workstation. The third characteristic is the resource pooling; in resource pooling, both the physical and virtual resources are pooled so as to serve more than one consumer by using a multi-tenant model. This multi-tenant model uses diverse physical and virtual resources, they can be allotted and reassigned dynamically in accordance to customer request. If the resources are assigned to customers on request, the location of the allotted resources is unknown. Rapid elasticity is the fourth characteristic, which refers to the ability to provide scalable resources when needed. Measured services is the fifth characteristic. Measured services ensure the monitoring, controlling, and optimizing of resources usage by the cloud service providers (Mell & Grance, 2011; Rashid, & Chaturvedi, 2019). Cloud Service Providers like Google, Microsoft, Amazon are vendors that provide their customers with cloud computing resources and services that are used dynamically based on customer demand in accordance with a particular business model (Rashid, & Chaturvedi, 2019).

Cloud computing service models are: Software as a Service (SaaS), Platform as a Service (PaaS), and Infrastructure as a Service (IaaS). The cloud computing deployment models are: private cloud, community cloud, public cloud and hybrid cloud (Challagidad, Dalawai, & Birje, 2017).

One of the primary use of cloud computing is the cloud storage (data online storage). Cloud storage system is considered as a circulated data centers which generally uses the technologies of cloud computing and it also offers interface for storage and accessing of data (Venkatesh, & Eastaff, 2018).
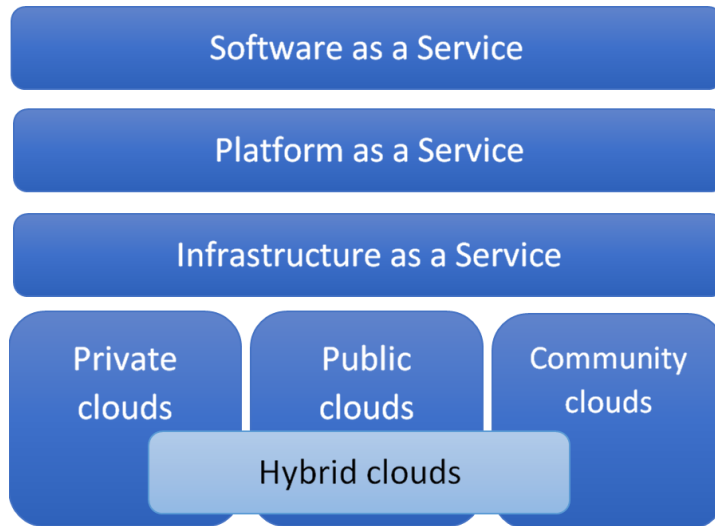

Figure 1. Cloud computing service models and deployment models (Saini, Upadhyaya, & Khandelwal, 2019)

Every organization is liable for dealing with their data adequately, but just those organizations that are of considerable size are competent of suitable resources as a powerful influence for the issue (Clarke, 2017). The Fair Work Act 2009, in Australia defined small business as a business with less than 15 staff (Bahzad, (2010). But realistically, a small business doesn't require a huge amount of money to get started and it can also be part-time based. Private company is additionally appropriate to web showcasing in light of the fact that it can without much of a stretch serve particular specialties.

One overview of entrepreneurs indicated that 38% of the individuals who relinquished their professions at different organizations said their fundamental explanation behind leaving was that they needed to work for themselves (Qing, 2012). Before adopting this technology, companies ask themselves several questions including whether to integrate this technology will be beneficial for them.

Cloud computing gives a business the chances of increasing their productivity. When a business adopts cloud computing, these helps to reduce operational stress and the maintenance costs while providing products to their

customers (Hussainn, Hussainn, Hussainn, Damiani, & Chang, 2017). Cloud computing is an ever-developing technology that is widely accepted in parallel computing. It provides reasonable range of services to consumers, for example, universal processing, dynamic and versatile scaling, access to on-request computing resources, metered asset use, and virtualized assets that can be provisioned and discharged without exertion (Hussainn et al., 2017; Ramezani, Lu, Tuheni, & Zomanya, 2017).

Small businesses have to realize the significant ideas of cloud computing, together with its space, time, costs, accessibility, privacy, and security (Alijani, Fulk, Omar, & Tulsi, 2014).

The aim of this study is to show the impact of a cloud computing adoption on small businesses. To be able to do this, this study is supported by a series of questions as below:

● How can the integration of cloud computing impact a small business?

● What effect can the migration to cloud computing have on the smooth running of a company?

● How are data backup and recovery handled by cloud computing applications?

● How is the security of data guaranteed on cloud computing?

Because of the need to effectively evaluate the application of cloud computing in specific areas, several researchers have developed studies to demonstrate its effectiveness and its many benefits. In this respect, this study focuses on the impact of cloud computing to small businesses. The contributions of this study includes: it proposes the benefits and importance of migrating to cloud computing by small businesses, it proposes the various recovery techniques and security measures to be considered when adopting to cloud computing. This study does not only help small business owners, it also help researchers and individuals inquisitive about the effectiveness and reliability of cloud computing in the context of small businesses.

2. Research Methodology

The methodological technique used in carrying out this study's bibliometric evaluation is based on articles selection process. A search for existing literature reviews was carried out. The articles selected were mainly based on studies that have been published from the year 2014 to year 2020. Articles from year 2014 to year 2020 were selected in order to discover the current developments in cloud computing although articles published in previous years were also used.

2.1. Documents Selection Process

The databases used for this study are IEEEexplore, Web of science, ScienceDirect and Scopus. Other search engines like Google scholars.com, Ecadamian.com were also used. In carrying out the literature search, few steps were taken. The keywords used for searching related articles to this study are "cloud computing", "small business", "adaptation", "security", "data backup and data recovery". These keywords were typed in to find related articles to the scope of this paper.

The search was done using the "AND" and "OR" Boolean operator in order to get the relevant articles for the purpose of this study. After searching with the keywords, type of document was specified and only articles were selected. Articles written in English were considered and articles written in other languages were eliminated. Articles identified with relevant information based on the aim of this study and the formulated research questions were considered. Figure. 2 explains the inclusion and exclusion criteria of the studies used for this paper.
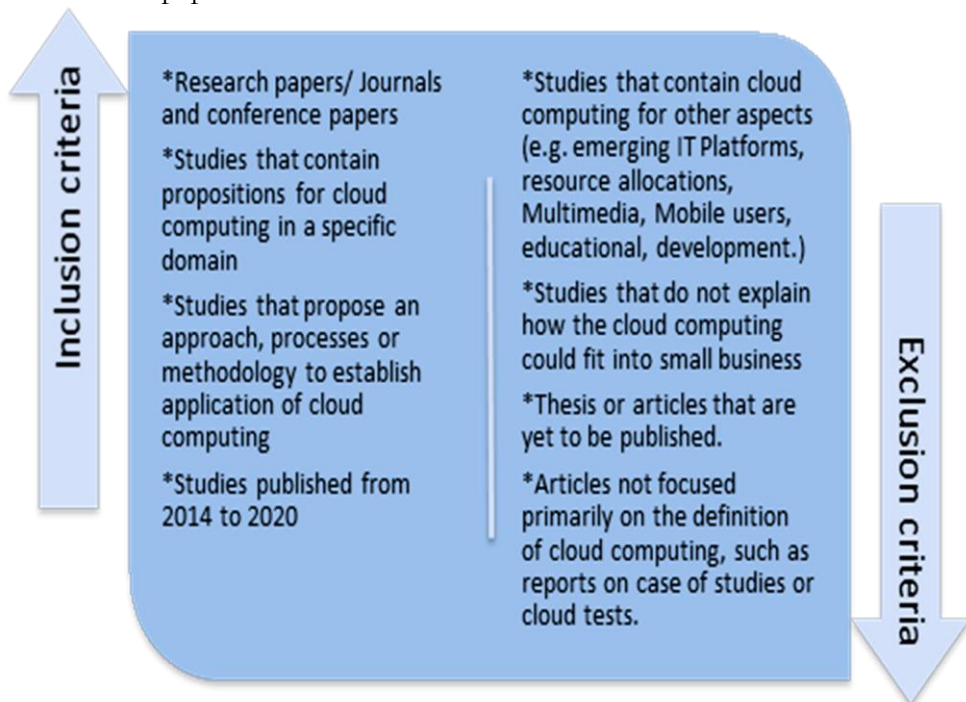

Figure 2. Inclusion and exclusion criteria of the studies.

3. Results and discussions

This section presents the findings conducted from reviews based on the research questions of this study.

3.1. Impact of Cloud Computing Integration on Small Businesses

To demonstrate the impact of integrating cloud computing into a small business, the concept of cloud computing must be understood. Buyya et al, described it as follows: "The cloud is a parallel circulated computer framework comprising of a lot of interconnected and virtualized computers, progressively provisioned and exhibited in the form of one or multiple unified computing resource(s) based on service-level agreements established over negotiation between the service provider and customers" (Parikh, 2014: 110).

The benefits of cloud computing in business are flexibility, cost reduction, automatic software/hardware upgrades, agility, and scalability (Xue, & Xin, 2016).

● *Flexibility:* cloud computing is being adopted by many organizations because of its flexibility. Most of the organizations choose to adopt cloud computing as it increases the business flexibility. It allows every staff to be more flexible in or out of their working environment. The only thing needed is an internet connection. Diverse cloud computing systems help companies cope with business demand. Cloud storage allows the workers to concurrently exchange information and files over the Internet. And every employee will be able to get the updated version. In addition, it helps the workers to access the same services simultaneously due to the data and information being stored remotely on the Internet.

● *Cost reduction:* a major factor that organizations consider for the adoption of cloud computing in their businesses is that it helps in cost reduction. Organizations only pay for the services being used when they make use of cloud services. In figure 3, the key factor that motivates the company to implement cloud computing is cost reduction which is 45.5 %.
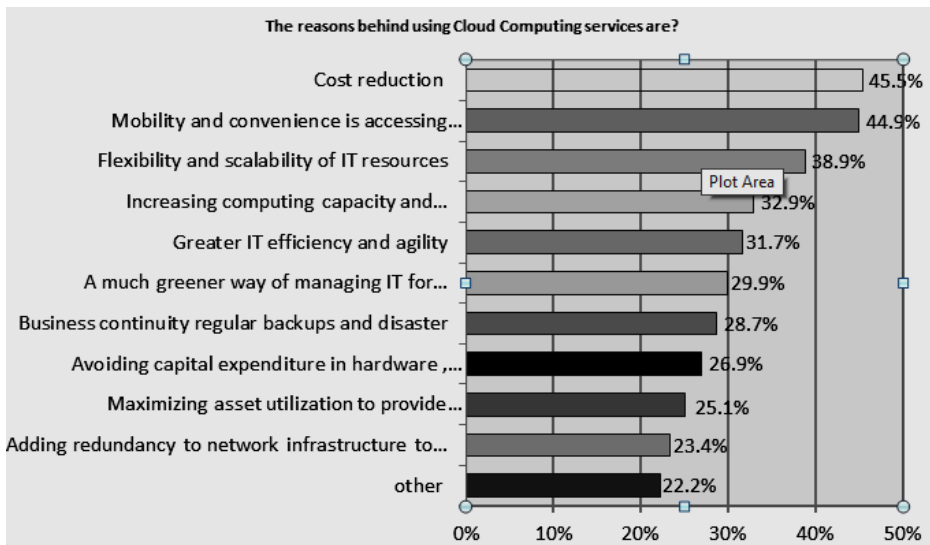
Figure 3. Reasons for the adoption of cloud computing (Xue, & Xin, 2016; Sahandi, Alkhalil, & Opara-Martins, 2013).

● *Software / hardware upgrade automatically:* When an IT solution has been introduced in organisations, it creates a dilemma that cannot be addressed adequately due to the high cost of buying and maintaining hardware and software. This will have a detrimental impact. These problems can be resolved by the implementation of cloud computing. Organizations could transfer their capital expenditures to operating expenses. Not only does it reduce costs, but it also helps to create a stronger relationship, keep ahead of technological developments, raise revenues, offer reliable and low cost services to customers.

● *Agility:* In today's highly competitive market climate, it is important to stay competitive. One of the ways that make the company distinct from the others is the willingness and time it takes that adapt to customers' rapidly changing needs. Cloud computing can do so in a more effective way. Cloud computing is available around the clock thanks to the availability of the Internet. This helps organizations offer services in the shortest time possible so that they can be used as a strategic tool for accelerated growth.

● *Scalability:* Cloud Computing offers services as per consumer or company demand. It allows the upscaling or downscaling of the administrations as indicated by interest, traffic and frequent spikes. Cloud meets the market needs of adaptable technologies. The manner in which companies will increase in the coming years is vital to the size of the industry as it grows (Saini, Upadhyaya, & Khandelwal, 2019).

Cloud computing is an additional benefit, particularly for smaller organizations, because they can increase resources when needed. In addition, cloud computing helps users to access a large amount of data in just a few minutes due to its processing capacity. It has successfully attracted industry analysts to evaluate the market and forecast consumer behaviour and purchasing preferences (Xue, & Xin, 2016).

This new world of virtualization brings a new way of working for businesses in general and small businesses in particular, because it simplifies the way backup and data manipulation works in a business (Marston, Li, Bandyopadhyay, Zhang, & Ghalsasi, 2011). For example, in the IT infrastructure area, buying of physical servers will no longer be necessary because its data will be automatically saved on the virtual services on which it will be connected (Staten, 2009). Along these lines, the association that controls the information should be possible anyplace and whenever; on the grounds that it is never again important to utilize computers with physical system engineering (Gutierrez, Boukrami, & Lumsden, 2015). The cloud turns into a versatile framework that can be shared by various end clients, every one of whom may utilize altogether in different manners. The clients are totally isolated from one another, and the adaptability of the foundation considers registering burdens to be adjusted on the fly as more clients join the framework (the way toward setting up the framework has become so institutionalized that including processing limit has become nearly as basic as adding building squares to an existing grid (Moura, & Hutchison, 2016). The excellence of the course of action is that as the quantity of clients goes up, the interest load on the framework gets progressively adjusted in a stochastic sense, even as its economies of scale grow, Cloud registering makes it simpler for endeavours to scale their administrations which are progressively dependent on exact data as indicated by customer request. Since the figuring assets are overseen through programming, they can be conveyed exceptionally quick as new necessities emerge (Hosseini, Fallon, Weerakkody, & Sivarajah, 2019). The principle potential advantage of receiving distributed computing is to dispose of the colossal expenses related with the inward upkeep of equipment and programming (Jones, Irani, Sivarajah, & Love, 2017). Cloud Computing goal is to leverage increased computing power to execute millions of instructions per second. Cloud Computing uses a large number of cloud networks with advanced connections to facilitate data processing between the servers (Inukollu, Arsi, & Ravuri, 2014).

3.2. The Effect of Migrating to Cloud Computing on the Smooth Running of a Company

Cloud computing application does not disrupt the smooth running of the business because by using cloud computing, small businesses can support the costs related to skilled labour, deployment, service, repair, update and troubleshooting (Tsao, Venkatsubramanyan, Parikh, & Sarkar, 2011), as cloud computing offers infrastructure, applications and software costumes on a subscription-based pay-per-use model (Armbrust et al,. 2010). Mell & Grance (2011) characterized Cloud Computing as a model for ubiquitous and helpful on-demand access to a common pool of configurable processing assets (systems, servers, storage, applications and administration) that can be delivered and discharged without delay with effort or with insignificant administration. Neighborhood PCs won't need to take the whole weight of running applications again. Cloud computing innovation is being utilized to reduce the use cost of processing assets (Amanatullah, Lim, Ipung, & Juliandri, 2013). The entire cloud, consisting of a PC system, manages the stack. The cost of programming and purchasing facilities at the end of the customer service reduces. The main thing that the client has to do is run the application interface programming to communicate with the server. Cloud computing consists of the front and back ends. The front end includes the user's computer and the programming needed to get to the cloud. Back-end is made up of different PCs, servers and database frameworks that make up the cloud. The client can access cloud-based applications from anywhere by connecting to the cloud through the Internet. Cloud computing is a trend setting innovation that just has the potential for organization coordinated effort, yet the innovation likewise enables organizations to remotely control their assets since their topographical appearance. For example, organizations can stack their site pages by downloading limited data to a pre-doled Internet-based system (Sivarajah, Irani, & Weerakkody, 2015). Subsequently, distributed computing empowers associations to profit by a powerful situation in which private ventures can for all intents and purposes design their business on an adaptable framework (Armbrust et al., 2010).

When adopting to cloud services there are three phases of adoption strategy (Attaran, 2017). The phases are described below:

● *Elementary phase*: Companies begin to learn about cloud technologies and carry out a thorough review of their applications and the resources they need. Cloud computing relies mainly on services, not technology. The services provided vary from automated IT jobs, IT services and digital business processes. The availability of cloud computing services to users is based on their needs. Consumers of the service place requests for service through self-

service and are billed for what they use. The most powerful deployments begins with users actually understanding the intended business outcomes and then identifying the services that will be offered through the private and/or public cloud. Questions such as what services consumers need, how much of the service should be used, when the service is usually used, which consumers consume the service and what is a fair price for the service should be explained.

● *Phase 2 (intermediate phase)*: Users must document and analyze the internal processes that the chosen cloud services will affect. The users will examine the internal IT processes involved in providing the services during this research. This can reinforce the need to flatten, reconfigure, realign, optimize or remove inefficient processes and aim repetitive manual processes to be automated. It also needs to discuss the type(s) of security that will be applied to cloud deployment.

● *Phase 3 (Final phase)*: Users should link applications and related workloads to their cloud services. Each workloads should: Review the internal IT processes involved in the delivery of services, analyze every workload for both its relevance to cloud computing and its location environment, decide the general workload architecture of the applications, and decide the security profile for each workload. After the user analyzes the workload, decisions should be taken as to what cloud-based deployment model is best suited to the organization's applications and workloads.

3.3. Data Backup and Recovery in Cloud Computing

Backups have two main purposes: Backups main purpose is to recover loss data that may occur due to corruption, damage, or deletion. Backups other purpose is to restore stored data from an earlier period of time (Laxmi, Deepika, Pranay, & Supriya, 2018). Data backup is a way of restoring disaster. Issues relating to data recovery process are (Venkatesh, & Eastaff, 2018):

Data storage: in order to provide security to data stored in the cloud, computing is distributed while storage is centralized and due to this, storing data in the cloud is correlated with single point failure and data loss.

Data security: It is essential to provide data protection, since certain data can be confidential and sensitive.

Lack of redundancy: when the cloud is damaged for whatever cause, and the primary storage fails to provide the data, the secondary site will be enabled to provide the data to the customer.

Dependency: Customer has no control over their system and their data. Backup service is provided to address this drawback.

Over the years, a lot of techniques for cloud backup service have been discovered.

A. Remote data backup server: Remote data backup server is a type of server that represents the main cloud. It contains the copy of the main clouds entire data. Remote data backup server is kept far away from the main cloud. The central repository is known as the main server, while the remote backup system is known as the secondary repository (Sambrani, & Rajashekarappa, 2016). If any occurrence happens like data loss, security breach, natural disaster etc. from the main cloud, then it makes use of the data stored in the remote repository. This also lets customers to access data from the remote server in a situation where network availability is not available or where the main cloud cannot provide customers with the required data (Sharma, & Singh, 2012). Remote repository services should address consecutive concerns, including: privacy and ownership, server-to-cloud transfer, data security, reliability, and cost effectiveness (Monisha, & Venkateshkumar, 2018).

B. Data recovery: The reason why clients would want to recover data is mostly due to disaster. Disaster is an unexpected event caused by environment, software or hardware failures. Challenges of disaster recovery includes: cost, dependency, failure detection, and security. Disaster recovery solutions: Local backup, inter-private cloud storage (Monisha, & Venkateshkumar, 2018). Until now, various methods have been proposed in cloud computing for data backup and recovery. Some of these approaches include:

Seed block algorithm (SBA): The architecture of the seed block algorithm comprise of the central repository, its clients and the remote data backup server (also known as the remote repository). SBA makes use of remote repository. Remote repository is a server that stores the entire data of the main cloud and it's located far from the main cloud. SBA ensures the simplicity of data backup and its recovery procedure. It uses the idea of the logic exclusive OR (XOR) operation. The advantages of SBA are: takes less time to recover data from the remote server, it ensures data integrity, and it doesn't require network connectivity to recover data from the remote location. The disadvantage is that the remote repository uses the same storage space as the central repository (Gharde, & Ghaormare, 2016).

Parity cloud service (PCS): PCS uses a novel cloud infrastructure data recovery service framework, and also offers a privacy-protected personal data recovery service. PCS does not require the uploading of user data to the server for data recovery. All the resources required by the server are within reasonable limits (Badhel, & Chole, 2015). The advantage of PCS is that it is reliable and it is less in terms of cost for data recovery. The disadvantage is that it has a high implementation complexity.

High security distribution and rake technology (HSDRT): HSDRT uses a wide-spread data transfer strategy and high-speed encryption technology. The system has both the back-up and recovery sequences. The backup sequence is used when data is saved for back up purpose while the recovery sequence is used when there's loss of data and the data needs to be retrieved. Advantage of HSDRT is that it can work efficiently for movable clients like laptops and smart phones. The disadvantage is that it is costly and data redundancy (Jayalakshmi, & Mathuramgbigai, 2017).

Other recovery techniques include:

Linux Box- advantages: it's simple and low cost. Disadvantages: high rate of bandwidth and complete server backup is done at a time.

Efficient rounding grounded on taxonomy (ERGOT) – Advantages includes: privacy, performs exact match retrieval of data. Disadvantages: increased complexity and cost increases as data becomes larger.

Cold/hot backup service- advantage: immediate availability. Disadvantages: expensive and cost increases as data become larger (Tamimi, Dawood, & Sadaqa, 2019).

All this techniques try as much as possible to solve the limitations of an already existing technique but none of these techniques have been able to resolve the issues regarding the high storage space for remote data back-up.

3.4. Data Security in Cloud Computing

Data security ensures the protection of the data in terms of confidentiality, integrity and availability (Zardari, Jung, & Zakaria, 2014; Chen, & Zhao, 2012).

● *Data confidentiality*: Confidentiality means that the information is kept hidden from unauthorized users. Only an authorized user has the right to access resources up to a specified access limit which is set by the administrator. Data confidentiality is a major concern for cloud users, and this alone can discourage users from storing data in the cloud (Zardari, Jung, & Zakaria, 2014).

The solution for protecting confidentiality before releasing data to service providers is encryption. Providers can't decrypt data for query execution if data is protected by encryption (Samarati, di Vimercati, Murugesan, & Bojanova, 2016).

● *Integrity*: data integrity is data accuracy and continuity in the cloud without modification by any unauthorized party, and guarantees data resource reliability. In the design stage of the database, data confidentiality is implemented with standard rules and procedures (Zardari, Jung, & Zakaria, 2014).

● *Availability*: Availability of data requires that information be accessible when it is requested by authorized persons. Data availability is one of the service providers' main concerns. When a Cloud service is disrupted for whatever reason, it can affect other clients. Contractually, service providers attempt to guarantee a high degree of availability likelihood. There are many threats that may affect Cloud service availability such as storage capacity, internet connectivity dependency, and technological failures. Generally speaking, data availability in Cloud is more secure than on a conventional network, because large providers such as Google, Amazon and Microsoft are better prepared to handle such risks than a single person or business (Kacha, & Zitouni, 2017).

The security architecture for cloud computing can be grouped into four parts (Chen, & Zhao, 2012):

A. Software security issues: (multi-tenant access security, internet application security)

B. *Platform security:* (framework security, environment security, component security, security of the interface)

C. *Infrastructure security:* (security of the virtual environment, shared storage security)

D. *Auditing and compliance:* (user management, authorization management, access management, service level agreement management, monitoring services, auditing services, reporting services)

In other to improve cloud computing, and to secure data stored in cloud, authentication, authorization, and access control should be put into practice. The main areas in data security are confidentiality, integrity and availability. Encryption is recommended as a good approach for securing information. Users should encrypt data before storing in the cloud server (Rao, & Selvamani, 2015).
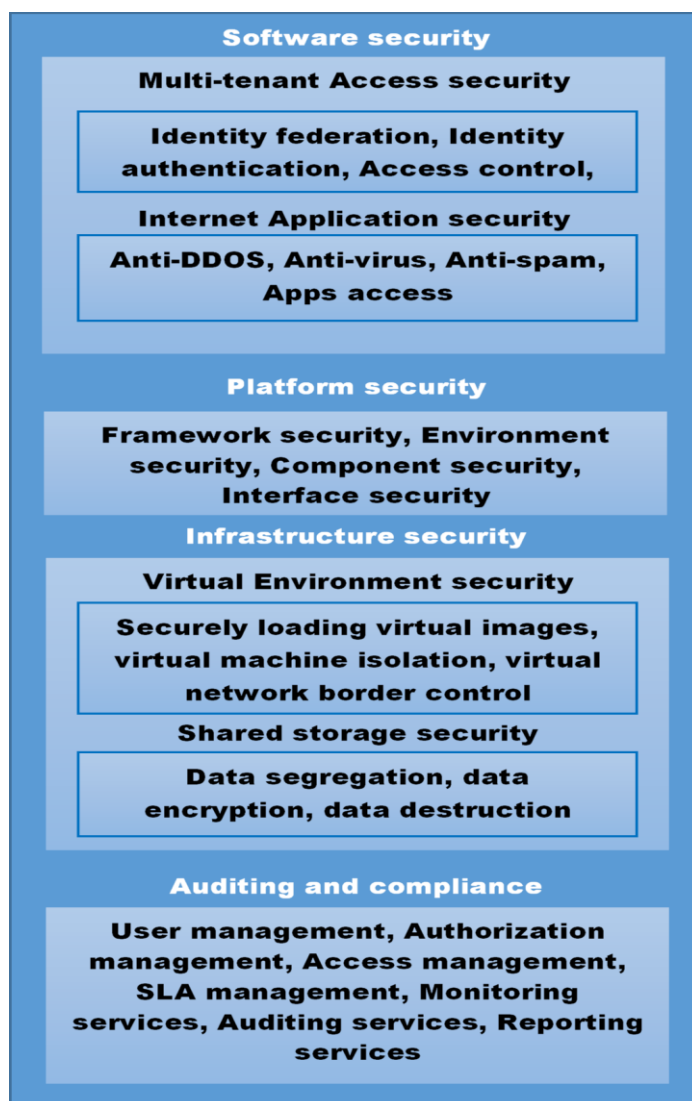
Figure 4. Cloud computing security architecture (Chen, & Zhao, 2012).

Data security in the cloud is better achieved when we have a combination of techniques for encryption, data loss prevention, integrity protection, authentication, and authorization. When providers and companies use cryptographic algorithms, these algorithms are very important and are well known as defined by NIST. It is also helpful to provide an annual re-evaluation of the algorithms and keys used to ensure the quality of the security. It is also very important for companies that use cloud technology to understand the

security controls in the cloud multi-tenant environment that are connected to the data. Recommended for storing the keys are hardware protection modules or Hardware security module (HSMs) (Jakimoski, 2016).

Although, a lot has been done regarding cloud computing security and many techniques has been introduced like encryption method, cryptography etc. but none of these approaches has fully solved cloud computing security problem they've only been able to reduce the problems.

Jakimoski (2016) concluded that if all the necessary steps are taken to ensure authentication, confidentiality, access control and authorization, cloud computing can then be trusted in data security.

4. Conclusion

Cloud computing has been regarded as a growing technological field and it has been adopted by various individuals, organizations, large scale businesses etc. but many small businesses are still unfamiliar with its operation. Discussions on cloud computing, phases involved in cloud computing adoption, cloud computing backup and recovery of data techniques, and data security issues were discussed in this study. This study emphasis was based on small businesses. Individuals, organizations, large scale businesses that adopted the use of cloud computing earlier are pleased with the various benefits involved and it has helped to reduce unnecessary costs.

When a small business decides to start using cloud computing techniques it does not disrupt the way the business has been running before it rather improves the operation of the business. An area of concern to small businesses about adopting cloud computing is the security aspect. Security issues are not only concerned with cloud computing, many IT related fields are faced with the issues of security. From the early use of cloud computing, different approaches and methods have been proposed and adopted for the improvement of cloud computing security problems. Although, cloud computing is still growing but there are lots of effective security solutions which are been used for safe securing of data in the cloud. So therefore, small businesses that wants to migrate to the use of cloud computing should consider the best option for data security for their business before migrating. Reasons for transferring data to cloud computing include availability, speed and ease of data sharing, cost efficiency and reliability.

This study only discussed few aspects of cloud computing techniques as regards small business; the research did not address cloud computing in full context while including large and medium scale businesses.

Future research should address the limitations of this study as described. Future research should also discuss in details how to select cloud providers as regarding the nature of the business.

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