

Towards Cloud Computing: A SWOT Analysis on its Adoption in SMEs



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ABSTRACT: *Over the past few years, emergence of Cloud Computing has notably made an evolution in the IT industry by putting forward a ‘everything as a service’ idea in which resources are provided as general utilities that can be leased and released by end users through the Internet in an on-demand mode. Cloud Computing is of growing interest to companies throughout the world, but there are many barriers associated with its adoption which should be eliminated. This paper aims to investigate Cloud Computing and discusses the drivers and inhibitors of its adoption. Moreover, an attempt has been made to identify the key stakeholders of Cloud Computing and outline the current security challenges. A SWOT analysis including strengths, weaknesses, opportunities and threats has also carried out in which Cloud Computing adoption for SMEs is evaluated. Finally, the paper concludes with some further research areas in the field of Cloud Computing.*

Keywords: Cloud Computing, Cloud Computing Adoption, Cloud Security, SWOT Analysis, SMEs

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1. Introduction

Quite recently, considerable attention has been paid to Cloud Computing which is a new paradigm transforming the information technology industry and reshaping the way enterprise services are developed, deployed, sold, delivered, and consumed [1]. In Cloud Computing, new IT services come into view from the collaborative convergence of business and technology perspectives; moreover, enabling users to gain accessibility of explicit knowledge, services could effectively make a contribution to information and knowledge sharing [2].

In the light of cloud technology, practically it would be a good opportunity for SMEs; because they do not have a significant amount of resources and technical expertise to set up the appropriate infrastructure so as to compete with their larger competitors. The benefits of Cloud Computing for small and medium-sized enterprises seem to offer returns on investment that have never been possible before. The main purpose of Cloud Computing is to reduce complexity, minimize costs, and improve organizational agility [1]. The tangible benefits, such as costs savings through a lower budget for information technology staff, services, and equipment are the most noticeable ones.

Although there is a great potential for success, SMEs should be aware of the risks involved. Similar to other outsourcing services, care must be taken to protect the business from the potential risks if the provider fails to come through [3].

Cloud Computing decrease the obstacles to conduct information process intensive activities; Indeed, people do not need to maintain their own technology infrastructure as they transfer the burden of system management and data protection to the cloud computer service provider [4].

It sounds that Cloud Computing has all the features of a new market disruptive innovation if one is to deploy the theory of disruptive innovation as a point of reference [5]. This IT delivery model has the potential to modify many aspects of organization's operations, attitude, culture and procedure. Despite the fact that Cloud Computing offers immense opportunities to the IT industry, the development of it is currently at its infancy, with many issues still to be addressed.

The goal of Cloud Computing is to deliver all the functionality of existing information technology services as it dramatically reduce the upfront costs of computing that inhibit many organizations from deploying many cutting-edge IT services [6]. Gartner research expects Cloud Computing to be a \$ 150 billion business by 2014 and according to AMI partners, SMEs anticipated to spend over \$ 100 billion on Cloud Computing by 2014.

The paper is organized as follows. Section 2 presents a variety of definitions toward cloud computing; section 3 introduces the main stakeholders of Cloud Computing; sections 4 and 5 are dedicated to investigate drivers and inhibitors of its adoption for SMEs and discuss about the affiliated advantages and drawbacks of it; section 6 explores some of security challenges; section 7 presents a SWOT analysis on Cloud Computing adoption for SMEs; section 8 concludes with a summary and finally section 9 outlines some issues for further and future study.

2. Definition of Cloud Computing

Cloud computing is defined as a novel model where it doesn't require user's ownership of necessary resources such as hardware and software, and instead the users can use them over the internet. Such resources are proposed, maintained and upgraded by third parties who own and handle them without any attempt or participation of the end users who just need to have minimal knowledge about the definite methods of its accessibility and deployment; this is the simple definition of cloud computing approved by many authors [7].

A recent McKinsey and Co. report makes statement that "*Clouds are hardware based services, offering computer, network, and storage capacity in which Hardware management is effectively abstracted from the buyer, buyers incur infrastructure costs as variable OPEX, and infrastructure capacity is significantly elastic*" [8]

Vaquero in [9] reports that "clouds are a large pool of readily, usable and accessible virtualized resources like hardware, development platforms and/or services. Such resources have the ability to be dynamically reconfigured to adjust to a changeable load (scale), allowing further for an optimized resource utilization. This pool of resources is typically extracted by a pay-per-use model in which guarantees are offered by the Infrastructure Provider through customized Service Level Agreements".

Buyya in [10] expresses an alternative definition as follows: "*Cloud is a parallel and distributed computing system comprising a set of inter-connected and virtualized computers that are dynamically provisioned and presented as one or more unified computing resources based upon service-level agreements (SLA) developed via negotiation between the service provider and consumers*".

National Institute of Standards and Technology (NIST) defines the Cloud Computing as a model for enabling appropriate, n-demand network access to a shared pool of configurable computing resources, such as networks, servers, storage, applications and services, which can be expeditiously provisioned and released with minimum management effort or service provider interaction. NIST presents another scope of basic services that are provided by Cloud Computing, which involve software, platform, and infrastructure [11].

2.1 Cloud Computing Categorization

Cloud Computing is typically categorized on either its deployment or service models. Moreover, deployment models of clouds and cloud service models are listed in Tables 1 and 2, respectively [11].

Public cloud	Is owned by a service provider and its resources are sold to the public .end users can rent parts of the resources and can typically scale their resource consumption up or down to their requirements.
Private cloud	Is owned or rented by an organization for its private use.
Community cloud	Similar to a private cloud but cloud resource is shared among members of a closed community with similar interests.
Hybrid cloud	Combination of two or more cloud infrastructures (which can be public , private or community) /provide extra resources in cases of high demand.

Table1. Deployment Models of Clouds

SaaS	Use of application running on a cloud infrastructure to provide services to end users. It can deliver business applications such as CRM, ERP [12]
PaaS	Use of tools and resources running on a cloud infrastructure to provide services to end users. The applications are developed and acquired by end users on top of the tools provided.
IaaS	Use of fundamental computing resources, e.g. Storage, network, servers to provide services to end users.

Table 2. Cloud Service Models

Parameters	Cloud Computing
Access	Via web
virtualization	Essential
Switching cost	High ,due to incompatibilities
Ease of use	Easy
Business model	Pricing (based on rent rate)
Application development	In the cloud
control	Centralized
openness	Low
Service level agreements	Essential

Table 3. Features of Cloud Computing

2.2 Features of Cloud Computing

Cloud Computing provides a compelling value proposition for organizations to outsource their Information and Communications Technology (ICT) infrastructures [13].

Miller [11], [14] proposes that Cloud Computing is user-centric and task-centric, and distributed computing can provide more effectiveness for sharing resources and collaborations in a group. The report of NIST further presents five essential characteristics of Cloud Computing, which are on-demand self-service, broad network access, resource pooling, rapid elasticity, and measured service. Other features of cloud computing are listed in Table 3.

Providers	Vendors who Perform the maintenance and upgrade of the system and are responsible for protecting consumer's data. Providers include well established companies such as Google, Microsoft, IBM, Oracle, Amazon, Sun, 10Gen, Salesforce, and Dataline to newer companies like Netsuite Corporation, Appistry, AppRiver, Boomi, Carbonite, and Enomaly.
Consumers	Subscribers who purchase and make use of system
Regulators	International entities that permeate across the other stakeholders
Enablers	Organizations that are responsible for selling services, facilitating the delivery, adoption and utilization of cloud computing

Table 4. New Stakeholders of Cloud Computing

3. Key Stakeholders of Cloud Computing

In a traditional computing approach, the principal stakeholders are the providers and consumers in which the consumers are accountable for utilization, ownership, maintenance and upgrade of system while the providers deal with the sale, installation, licensing, consulting and maintenance processes of the technology.

Despite of the traditional approach, in Cloud Computing, role of different traditional stakeholders will be altered. These new stakeholders, which are summarized in Table 4, included not only the providers and receptions of the service, but also, due to the exclusive nature of the delivery model for the service, the regulators who need to find out the effect of the location of the infrastructure of the service providers.

4. Key Drivers of Cloud Computing Adoption in SMEs

Making use of a cloud service will lead to lower capital investments and required costs, yet services are provided in real-time; besides, as mentioned earlier, vendors become responsible for all the maintenance tasks including updating and upgrading. According to Rayport and Heyward [15], major drivers of cloud services are as below: anywhere / anytime accessibility to cloud based software, cloud enabled storage as a ubiquitous service, specialization and customization applications, collaboration among users and cost advantage predicted on cloud efficiencies, warehouse-size data centers, energy efficiency and everything as a service. Moreover, other drivers of cloud services are detailed as follows:

- It remarkably decreases the cost of entry for SMEs which trying to benefit from compute-intensive business analytics that were hither to available only to the largest of companies. Cloud computing also represents a wide opportunity to many third-world countries that have been so far left behind in the IT revolution. Some Cloud providers are using the benefits of a cloud platform to enable IT services in countries that would have traditionally lacked the resources for prevalent deployment of IT services.
- It can present an almost urgent access to hardware resources that not only doesn't require much upfront capital investments for users, but also results in a faster time to market in many businesses. Treating IT as an operational expense (in industry-speak, employing an 'Op-ex' as opposed to a 'Cap-ex' model) also helps in dramatically diminishing the upfront costs in corporate computing. The cloud becomes an adaptive infrastructure that can be shared by different end users, each of whom might make use of it in very different ways. The users are thoroughly separated from each other. It is noticeable that, as the number of users goes up, the demand load on the system gets more balanced in a random manner, even as its economies of scale expanded.
- Cloud Computing can reduce IT barriers to innovation, as can be witnessed from many promising startups, from the ubiquitous online applications such as Facebook and Twitter.
- Cloud Computing makes it easier for SMEs to scale their services according to client demand. Since the computing resources are managed through software, they can be deployed very fast as new requirements arise [16].

5. Key Inhibitors of Cloud Computing Adoption in SMEs

Albeit there are numerous benefits to adopting cloud computing, there are also some significant barriers associated with its

adoption that would be addressed. Security is no doubt one of the main concerns for SMEs contemplating the adoption of this IT service model; Nevertheless, many cloud providers are now offering hybrid solutions where clients are given some level of control over the security of their data. After security, outage (temporary loss of service), interoperability (portability or ability to change supplier), and the reliability are the most significant ones [17], [18].

The inhibitors of cloud computing's adoption are detailed as follows:

- **Reliability:** Enterprise applications are presently so significant that they must be reliable and available to support operations. In the case of failure, recovery plans must begin with minimum disruption. Further costs may be pertaining to the essential levels of reliability; nevertheless, the business can do merely so much to decrease risks and the failure cost. Developing a track record of reliability will be a necessity for the extensive adoption.
- **Connectivity and open access:** The full realization of Cloud Computing is dependent upon the availability of high-speed access to all. Such connectivity, rather like electricity availability, globally opens the possibility for industry and a new range of consumer products. Connectivity and open access to computing power and information availability through the cloud promotes additional era of industrialization and the necessity for more complicated consumer products.
- **Security and Privacy:** For the reason that Cloud Computing denotes a novel computing model, there is a great deal of uncertainty with it, where security issues at all levels (e.g., network, host, application, and data levels) can be attained consistently led information executives to state that security is their first grade concern with Cloud Computing. The capability of Cloud Computing to sufficiently address privacy regulations has been called into question. These days, organizations come across to multitudinous different requisites making effort to safeguard the privacy of individuals' information.
- **Interoperability:** The interoperability and portability of information between private clouds and public clouds are critical enablers for widespread adoption of Cloud Computing by the SMEs. A large number of companies have made remarkably progress toward standardizing their processes, data, and systems by means of implementation of ERPs. This process has been enabled by scalable infrastructures to make single instances, or highly integrated connections between instances, to manage the consistency of master and transaction data and provide reliable consolidated information. Even with these improved platforms, the speed at which businesses alter, may still outpace the capability of IT organizations to react to these changes. SaaS applications delivered via the cloud procure a low-capital, fast-deployment option. Depending upon the application, it is significant to integrate with traditional applications that may be resident in a separate cloud or on traditional technology. The standard for interoperability is either an enabler or a barrier to interoperability, and allows maintenance of the integrity and consistency of a company's information and processes [19]
- **Economic Value:** The development of Cloud Computing is predicated on the return on investment that accrues. It sounds intuitive that by sharing resources to smooth out peaks, paying solely for what is used, and cutting upfront capital investment in employing IT solutions, the economic value will be there. There will be a necessity to accurately balance all costs and benefits relevant to Cloud Computing—in both the short and long runs. Hidden costs could encompass support, disaster recovery, application modification, and data loss insurance. Since usage expands and interoperability requirements for the business process become more onerous, a novel approach is required. This development may be the most economical approach; nonetheless, there is a risk that the business transition costs from one solution to another may alter the cost and benefit equation, and accordingly the solution that should be adopted.
- **Political Issues Due to Global Boundaries:** In the world of Cloud Computing, there is variability in terms of where the physical data resides, where processing takes place, as well as from where the data is accessed. Given this variability, various privacy rules and regulations may utilize. Thanks to these varying rules and regulations, by definition politics becomes an element in the adoption of Cloud Computing. For Cloud Computing to constantly evolve into a borderless and global tool, it necessitates to be separated from politics. Presently, some significant global technological and political powers are making laws that can negatively affect the development of the global cloud [18]. Providers have been unable to assure the location of a company's information on specific set of servers in a specific location. Nevertheless, cloud computing service providers are swiftly employing measures to address this issue. Briefly toward politic issues, Cloud Computing is highly dependent on global politics to survive. Politics are influencing the scalability of the Internet, the availability of Internet access, the free flow of information, and the cloud-based global economy on a daily basis.

6. Cloud Security Challenges

- **Multi tenancy Issue:** this issue propounds a challenge to protect user sensitive data against unauthorized access from other users running processes on the same physical servers.
- **Authentication of Acquired Information :** as the critical data is located in the cloud provider infrastructure ,the data may be modified without the owner’s consent. The authentication of the data in this case is very crucial, and therefore needs to be guaranteed [19].
- **Resource Location :** End users use the services offered by the cloud providers without by means of being informed about the accurate location of resources .This could cause a potential problem which is sometimes over the control domain of cloud providers [20]
- **System Monitoring and Logs :** As more business critical applications are transformed to the cloud environment ,customers may call for more monitoring and log data from providers for their personnel.
- **Cloud Standards :** standards are essential across different standard developing organizations to gain interoperability among clouds and to enhance their solidity and security [21]

7. SWOT Analysis for Adopting Cloud Computing Services in SMEs

The acronym SWOT stands for Strength, Weaknesses, Opportunities, and Threats. SWOT analysis is a strategic planning method used to evaluate the Strengths, Weaknesses, Opportunities, and Threats involved in any project and has been used extensively in various decision making processes. It involves specifying the objective of the project and identifying the internal and external factors that are favorable and unfavorable to achieve the objective. The approach is a good framework to organize relevant information to be able to develop strategy and facilitate business decision making processes [13].

		Internal			
		Strengths <ol style="list-style-type: none"> 1. Cost effective 2. Flexible and innovative 3. Simplified cost and consumption model 4. Faster provisioning of systems and application 5. Secured infrastructure 6. Compliant facilities 7. Resilient in disaster recovery 8. Maintenance Cost Reduction 9. Convenient level of accessibility 10. Butter control of the resources 11. Independence of time and location 12. Energy saving 13. Environmental protection 14. Friendly utilization 15. expandability 	Weakness <ol style="list-style-type: none"> 1. Post training required 2. Development of applications 3. Increased dependency 4. High- speed Internet connection requirement 5. Difficulty of integration with local software 6. Data transfer bottlenecks 7. Lack of physical control of data 8. Lack of commitment to the highquality of service and availability and availability guarantees 9. Inability of providers to guarantee The location of the company's information 		
Positive		Opportunities <ol style="list-style-type: none"> 1. Pay for use licenses 2. Good chance for SMEs because of making progress without upfront investments 3. Invent scalable store 4. Marketplace enhancement in terms of functionality, innovation & price 5. Adaptive to future needs 6. Standardized process 7. Quick solution of the problem 8. High-tech work environment 9. Offering modern information solutions according the last technology 	Threats <ol style="list-style-type: none"> 1. Security concerns (data security) 2. lack of specific standard regulation (local, national & international) 3. Difficulty from migration from one to another platform 4. Hidden cost (backup, problem solving and recovery) 5. compatibility reduction 6. Possibility of backlash from entrenched incumbents 	Negative	
		External			

Figure 1. SWOT Analysis for Cloud Computing

In order to assess the adoption of Cloud Computing for SMEs in a more comprehensive manner, a SWOT analysis is conducted. The results of the analysis are summarized in Figure 1.

8. Conclusion

In this paper we tried to identify the key stakeholders of Cloud Computing and investigate the different issues associated with Cloud Computing as well as advantages and disadvantages of its adoption. To achieve this, a SWOT analysis was accomplished in which strengths, weaknesses, opportunities as well as threats of cloud computing adoption was appraised.

The results of the analysis indicated that the SMEs are able to take advantage of opportunities that Cloud Computing provides to create value networks and provide global market access to their customers. Nevertheless, Cloud Computing services are not free of risks. There is a real risk of the lack of information and system security if proper actions are not taken to safeguard information and system security. This is a bit more difficult with Cloud Computing due to the potential lack of information and system control compared with traditional computing. More importantly, managers need to carefully evaluate the dependability to external resources and expertise that Cloud Computing creates for SMEs.

9. Further Research and Future Work

Admittedly, in order to extend our knowledge in this field, further research on investigating adoption of cloud computing in SMEs is essential. Hence, on the basis of the promising findings presented in this paper, work on the remaining issues is continuing and will be proposed in future papers. In our further research, we intend to concentrate on PEST analysis so as to investigate effective factors in adoption of Cloud solutions. In addition, regarding the fact that security issues are one of the most crucial concerns which inhibit cloud computing adoption, further research can be dedicated to concentrate deeply on security challenges and explore some solutions to tackle the barriers.

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