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Quo Vadis IT Infrastructure: Decision Support for Cloud Computing Adoption From a Business Perspective

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Abstract

Many IT organizations are confronted with the question whether to modernize their IT infrastructure. While most data centers run on a virtualized environment, Cloud Computing technology emerges with new characteristics on fast provision of standardized resources in a scalable IT infrastructure. Public cloud vendors offer IT services on demand, so that IT organizations do not have to operate their own hardware. Moreover, private cloud architectures gain influence, claiming to provide flexible and elastic IT infrastructure. The paper at hand guides the strategic decision for adoption of Cloud Computing on IT infrastructure. Therefore, we first introduce a taxonomy for IT infrastructure encompassing a technological and a sourcing perspective. Second, we evaluate selective areas of the taxonomy adopting the SWOT framework to understand both opportunities and challenges of Cloud Computing for IT infrastructure from a business perspective.

Keywords: Cloud Computing, Cloud Adoption, Cloud Migration, SWOT, Infrastructure as a Service, IT infrastructure

1.0 INTRODUCTION

Today's IT organizations proactively need to support business innovation to keep up with digital transformation in the economy (Urbach & Ahlemann, 2016b). Therefore, a flexible IT infrastructure is necessary which allows a fast provisioning of highly standardized resources (Glohr, Kellermann, & Dörnemann, 2014). The provision of IT infrastructure can take place in two main ways. First, corporate IT organizations can run their services in on-premise data centers using traditional virtualization technology like server virtualization to improve efficiency. Second, Cloud Computing as an emerging technology can improve efficiency of IT operations through flexible resource provisioning over the Internet. Especially public vendors offering commodity infrastructure hardware as a service have recently established their services for mainstream adoption (Doroshm & Toombs, 2016).

Decision makers in IT organizations are increasingly confronted with the question whether and how to provide IT infrastructure for their organizations and what corresponding opportunities and challenges of different provision options are. When it comes to Cloud Computing, decision makers face the question whether to invest in an external public cloud or an internally operated private cloud (e.g., Jirasek, 2014; Barron, 2016; Elumalai et al., 2016; Velten & Özdem, 2016). Deciding for and against Cloud Computing and, if for Cloud Computing, for a public cloud or private cloud is foremost influenced by technological and security aspects (Horlach, Drews, & Schirmer, 2016) and by financial aspects (Longoria, 2016).

Therefore, the paper at hand attempts to answer the following research questions:

RQ1: What are opportunities and challenges of traditional virtualization in comparison to Cloud Computing?

RQ2: What are opportunities and challenges for specific Cloud Computing sourcing options, namely public cloud and private cloud?

To answer those questions, the paper first provides an overview of different technology that enables provision of IT infrastructure for organizations in section 2. Section 3 presents related work on both the same research methodology and alternative classification frameworks for Cloud Computing. Based on the introduced definitions in section 4.1 a taxonomy for IT infrastructure is developed encompassing a technological and a sourcing perspective. Within this taxonomy this paper's scope of investigation is defined with regard to its research questions. Marston et al. (2011) introduced an approach to evaluate the strategic imperatives of Cloud Computing in a Strengths-Weaknesses-Opportunities-Threats (SWOT) framework. Adopting this approach, SWOT as an analysis framework is briefly introduced in section 4.2. Selected areas of the IT infrastructure taxonomy are then evaluated in multiple SWOT frameworks and are subsequently discussed to understand both opportunities and challenges of Cloud Computing adoption in section 5. A critical reflection and deduction of future work concludes the paper in section 6.

The paper at hand follows the constructivist research paradigm and is non-empirical, qualitative, conceptual (Cresswell, 2014), and primarily based on secondary sources.

2.0 Concepts and Definitions

This chapter defines underlying concepts and characteristics for the terms traditional virtualization and Cloud Computing.

2.1 Traditional Virtualization

Before virtualization was uprising, operating systems were directly installed on physical servers. Because running each service on a separate physical machine is an inefficient way to use hardware resources, virtualization was introduced to share resources and run multiple virtual machines on one physical server (Tsai & Liao, 2016).

In general, virtualization allows to abstract physical components into logical units and so use, and also manage, resources more efficiently (Portnoy, 2012). Key virtualization technology for provision and management of IT infrastructure are separated in three different areas (Santana, 2014): (1) Server virtualization is the most common virtualization layer. Here, the hardware is emulated to run multiple virtual machines on a physical device to increase utilization. (2) Storage virtualization is the differentiation of physical storage into a centralized storage unit that can be connected to multiple resources. (3) Network virtualization allows to manage network connections and to set up new virtual network environments without changing the existing hardware. The combination of those layers can lead to virtualized data centers. A virtualized data center allows to take advantage from pooling technology, abstraction technology, and partitioning technology and it furthermore enables automation and standardization (Santana, 2014).

2.2 Cloud Computing

The concept of Cloud Computing can be defined as "a model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources (…) that can be rapidly provisioned and released with minimal management effort or service provider interaction" (Mell & Grance, 2011). This definition is very similar to other definitions used in the field, e.g., by Vaquero, Rodero-Merino, Caceres & Lindner (2008), Armbrust et al. (2009) or Buyya, Yeo, Venugopal, Broberg & Brandic (2009).

Cloud Computing is characterized by five essential aspects, three service models, and three major deployment models (Buyya, Broberg, & Goscinski, 2011; Mell & Grance, 2011). These five essential aspects are (Mell & Grance, 2011): (1) On-demand self-service – describing the automated delivery of the resources to the consumer without the need of additional human interaction. (2) Broad network access – meaning the ability to access the resources via a network connection which is not limited to a single platform. (3) Resource pooling – being the combination of physical and virtual resources serving multiple customers in a multi-tendency model which leads to a location-independent model where the consumer has no control or knowledge of the abstracted resource. (4) Rapid elasticity – stating that resources can be provisioned or released fast or even automatically and furthermore defining a rapid scalability of the resources depending on the actual demand of the consumer. (5) Measured service – allowing the control and optimization of resource usage. Buyya, Broberg and Goscinski (2011) mention that the shape of these aspects may vary for an enterprise context according to different deployment models. Other definitions mention similar characteristics e.g., Buyya, Broberg and Goscinski (2011) state (1) pay-per-use, (2) elastic capacity and the illusion of infinite resources, (3) self-service interface and (4) abstracted or virtualized resources as common characteristics of various definitions, or Marston et al. (2011) emphasize seven characteristics of Cloud Computing. Leimeister et al. (2010) compare 17 different definitions and classify 14 key characteristics of Cloud Computing.

The actual realization of these aspects is structured in three service models (e.g., Vaquero et al., 2008; Youseff, Butrico, & Da Silva, 2008; Buyya et al., 2011; Mell & Grance, 2011): (1) Infrastructure as a Service (IaaS) – providing virtualized resources in form of processing, storage, network, or other computing resources. In most terms consumers retrieve a virtual machine on which they are able to deploy and run operating systems and applications. Further service models are (2) Platform as a Service (PaaS) – providing a runtime environment for applications developed by the consumer and (3) Software as a Service (SaaS) – providing applications accessible via a network interface.

Most commonly, Cloud Computing is provided in the deployment models of a (1) public, (2) private, or (3) hybrid cloud (Buyya, Vecchiola, & Selvi, 2013). A (1) public cloud provides a cloud infrastructure for open use by the general public. It is owned, managed, and operated by the provider. Consumers access the provided services based on a subscription basis (Mell & Grance, 2011). A specialized form of public cloud deployment is a virtual private cloud where the user operates on a public cloud infrastructure which is separated and isolated from other users by additional security layers (Buyya et al., 2011). A (2) private cloud provides Cloud Computing characteristics on an infrastructure that is exclusively available for a single organization (Mell & Grance, 2011). The environment is thereby owned, managed, and operated by the organization. The organizations still own their infrastructure and all IT services but benefit from the cloud service models. A (3) hybrid cloud is the combination of multiple cloud infrastructures which can be private or public (Mell & Grance, 2011). Similar definitions of depicted deployment models are provided by e.g., Armbrust et al. (2009), Marston et al. (2011).

3.0 Related Work

The following section focuses on related work with regard to SWOT as an analysis method and previous work on the conceptualization of Cloud Computing.

Using SWOT as an analysis framework is not uncommon in IS research. Marston et al. (2011) adopted the SWOT framework to evaluate the strategic imperatives of Cloud Computing. Other researchers adopting the SWOT framework on Cloud Computing technology are e.g., Pandya (2012) evaluating the application of Cloud Computing for libraries, or Ghaffari, Delgosha and Abdolvand (2014) using SWOT to evaluate Cloud Computing adoption in small and medium-sized enterprises. Kuo (2011) mentions the SWOT framework as a second stage to evaluate Cloud Computing for improving health care services.

Several articles evaluate cloud services from a business perspective. Youseff, Butrico and Da Silva (2008) proposed a Cloud Computing ontology categorizing different layers and their inter-dependencies. Rimal et al. (2009) provide a taxonomy to compare solutions based on nine technical features. On a similar level does Hilley (2009) provide a taxonomy of infrastructure- and platform-level services. Li et al. (2011) provide performance metrics to compare IaaS and PaaS offerings. Repschlaeger et al. (2011) evaluate a classification framework for IaaS providers. Siegel and Perdue (2012) introduce the Service Measurement Index which describes a measurement framework to compare cloud services.

Practitioner literature also provides guidance for Cloud Computing migration. Amazon as one of the leading Cloud Computing providers suggests a framework for Cloud Computing adoption (Amazon Web Services, 2016). Furthermore, the German inter-trade organization Bitkom provides guidelines on Cloud Computing for decision makers (Bitkom, 2009, 2010).

While all those frameworks provide different methods to evaluate cloud services, a strategic perspective on technology for IT infrastructure and more specifically for Cloud Computing deployment models is still missing. Therefore, the paper at hand derives a tentative suggestion for an IT infrastructure taxonomy and evaluates it from a business perspective using SWOT.

4.0 Methodology

In this chapter, we first develop a taxonomy for IT infrastructure encompassing a technological and a sourcing perspective in section 4.1. Second, we briefly introduce the adopted SWOT framework used to evaluate the strategic decision for Cloud Computing adoption in section 4.2.

4.1 IT Infrastructure Taxonomy

Provision of IT infrastructure can be perceived along two perspectives: technology and sourcing. From a technological perspective IT infrastructure can be operated using traditional virtualization or Cloud Computing. From a sourcing perspective IT infrastructure can be provided internally or externally. Those perspectives can be summarized in a tentative IT infrastructure taxonomy which identifies five possible implementation options. To answer this paper’s research questions we focus on technology in general and on specific deployment models for Cloud Computing in particular. Figure 1 illustrates the five possible implementation options and the derived areas of investigations answering our research questions.

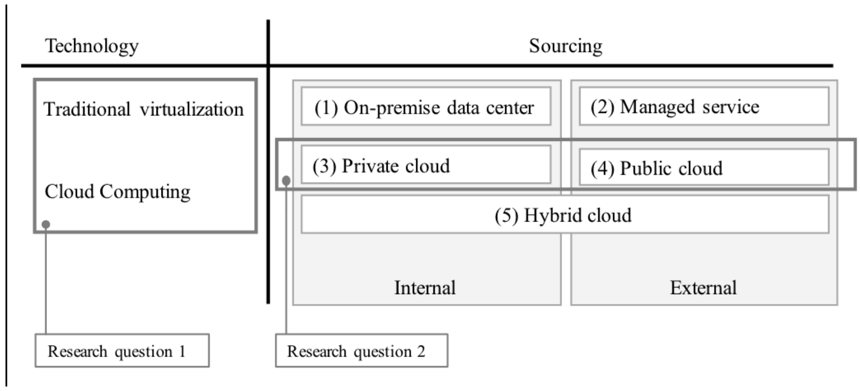

Figure 1. Taxonomy for provision of IT infrastructure

The technological concept of traditional virtualization is currently the most adopted technology in internal (1) on-premise data centers of IT organizations. Outsourced to an external provider, also most (2) managed service providers provide IT infrastructure based on traditional virtualization technology. Leading vendors for the traditional virtualization of data centers, especially server virtualization are, e.g., VMware vSphere and Microsoft Hyper-V (Pittman, Dawson, & Warrilow, 2016).
Operating a Cloud Computing environment internally represents the Cloud Computing deployment model of a (3) private cloud. A widely adopted cloud architecture for private clouds is, for example, OpenStack (Di Martino, Cretella, & Esposito, 2015) which is also adopted by some major public cloud providers. The most common Cloud Computing deployment model is a (4) public cloud provided by an external vendor. The public cloud can be considered as the origin of Cloud Computing. Public cloud providers are primarily successful due to their easy point of entry and flexibility in resource provision. Therefore, public cloud providers are challengers for traditional virtualization vendors. Leading vendors for practical adoption of public cloud are, e.g., Amazon Web Services and Microsoft Azure (Long, Petri, Gill, & Doors, 2016). A third Cloud Computing deployment model is a (5) hybrid cloud which can be a mix of both internal and external provision.
For the purpose of this study, we first compare traditional virtualization with the adoption of Cloud Computing (research question 1). Subsequently, we further evaluate the concept of Cloud Computing along the deployment models of a public cloud and a private cloud (research question 2). We do not consider hybrid clouds in our analysis for two reasons. First, it combines both sourcing perspectives which are already considered with public cloud and private cloud. Second, today's hybrid clouds often have portability and interoperability issues due to lack of homogenous technical implementation and management layers and are thus less relevant from a practitioner's perspective (Di Martino et al., 2015).

4.2 SWOT Analyses

To guide the decision which technology for IT infrastructure and more specifically which deployment model is best for Cloud Computing adoption in IT organizations, we follow the methodology by Marston et al. (2011) who applied a SWOT framework to evaluate the strategic imperatives of Cloud Computing.
In general, a SWOT analysis is a methodology for strategic planning used to assess complex decisions and alternatives in a simplified framework (Helms & Nixon, 2010). The evaluation is grouped into internal and external issues both evaluated from

a helpful and a harmful perspective. First, internal strengths and weaknesses are considered, second external opportunities and threats. The condensed evaluation on multiple perspectives allows to draw conclusions for the initial business matter. Table 1 illustrates the basic structure of the SWOT framework. Alternative evaluations for the decision support would be scoring methods like a cost utility analysis or a cost comparison approach (Brugger, 2009).

Table 1. SWOT framework

	Helpful	Harmful
Internal issues	**Strengths**	**Weaknesses**
External issues	**Opportunities**	**Threats**

While a SWOT analysis is traditionally applied as a method in corporate strategy development processes (Hill & Westbrook, 1997), it is also a suitable framework to evaluate the strategic fit of technological models (Marston et al., 2011). Therefore, we apply four SWOT analyses to evaluate the strategic decision of Cloud Computing adoption for IT infrastructure in the next chapter.

5.0 Evaluation for Cloud Computing Adoption Using the SWOT Framework

In this chapter we first compare the technological perspective of traditional virtualization and Cloud Computing in section 5.1. We then comparatively analyze different sourcing perspectives with the specific Cloud Computing deployment models of a public cloud and a private cloud in section 5.2.

5.1 Technology

5.1.1 Traditional Virtualization

Strengths:

Virtualization enables consolidation and thus reduction of physical servers in order to increase the utilization of data centers. Compared to separate physical servers this reduces the costs for hardware equipment, energy, and maintenance. (Portnoy, 2012)

Virtualization also improves the availability and reliability of a data center. High availability decreases service downtimes by combining servers into a virtual server cluster. Fault tolerance increases availability and reliability by duplicating virtual machines on multiple physical host machines. (Portnoy, 2012)

Traditional virtualization enables basic resource scheduling of computing resources on a scheduled or manual basis (Santana, 2014). This can be used to balance utilization or for maintenance purposes.

Weaknesses:

Any type of virtualization results in a performance degradation because the additional abstraction layer is consuming some resources itself which can lead to increased latencies (Buyya et al., 2013). However, due to technological advancements performance degradation becomes less important.

Even though virtualization increases the utilization of a data center compared to single physical machines, the total utilization of a data center is nowadays still low. This is because approaches like high availability, fault tolerance, and disaster recovery rely on a duplication of resources. Additionally, resources must be able to process peak loads that can exceed more than tenfold of the average load, which keeps the average utilization low. (Meinel, Willems, Roschke, & Schnjakin, 2011)
Adopting the different virtualization approaches also increases complexity of IT infrastructure because different virtualization technology is handled unique and lacks a unified management. For provisioning of resources and adjustments of the virtualized components often multiple components must be configured which increases data center complexity and impedes fully automation. (Meinel et al., 2011)

Opportunities:
Traditional virtualization provides a huge opportunity to reduce operational costs of a data center. Due to Moore's law computing power grows, which allows to further increase the consolidation ratio of virtual machines on a physical host and so to decrease data center costs. (Portnoy, 2012)
Another opportunity of virtualization is to extend the lifetime of an application. Legacy software can run on emulated resources. (Buyya et al., 2011)

Threats:
One threat of virtualization technology is vendor or technology lock-in. Each server virtualization technology relies on different hypervisors and image formats for virtual machines, which reduces compatibility of server virtualization technology. (Portnoy, 2012)
Cloud providers target the same market as traditional IT infrastructure virtualization which results in a threat for both vendors and consumers. The faster and more flexible resource provision of Cloud Computing may lead to a bimodal IT. Characteristics of such a bimodal IT are a (1) traditional IT which has a focus on stability but is inflexible and resources are organized in silos, and a (2) digital IT which is focused on agility and speed with highly standardized resources available on-demand. (Horlach et al., 2016)

5.1.2 Cloud Computing

Strengths:
A Cloud Computing environment provides the ability to scale resources on demand which eliminates the need for peak-dimensioned and thus often underutilized virtual servers. Scalability combined with the ability to distribute resources dynamically across server clusters leads to a much better resource utilization and so reduces the costs of a data center. (Marston et al., 2011)
Cloud Computing also increases standardization and automation of IT infrastructure. Services are available in pre-defined infrastructure and software packages, which simplifies the management and decreases complexity. (Marston et al., 2011)
It is also easier to reach performance and application service level agreements (SLAs) goals with the ability to easily migrate virtual machines on different hardware (Birke, Podzimek, Chen, & Smirni, 2013). Live migration is used for optimizing the utilization in a data center without shutting down virtual machines. (Buyya et al., 2011)

Weaknesses:
Loss of physical control of data is one of the most pertinent issues associated with Cloud Computing. In a cloud environment it is not possible to guarantee the location of the data on a specific server in a specified geographic location which might conflict with the corporation's compliance regulations. (Marston et al., 2011)

Opportunities:
Using a Cloud Computing environment enables new technology and also helps businesses to adopt them more quickly. Big data analytics and machine learning approaches which all require high performance and large capacities can be set up more easily in a Cloud Computing environment. Moreover, new applications for Internet of Things require a highly flexible and scalable infrastructure that allows to interact with distributed and mobile client devices. (Long et al., 2016)
Digitization and Cloud Computing also enable process improvements. Fast provision of standardized services on-demand and a reduced need of maintenance enables a DevOps approach, which improves quality of IT operation, application quality, and a fast development and delivery of software. (Urbach & Ahlemann, 2016a)

Threats:
Even though various forms of Cloud Computing have been on the market for years now, there is still a lack of standards. Different hypervisors, image formats, and incompatible APIs lock organizations into specific providers. Choosing a specific cloud technology and provider might result in a possible vendor lock-in and migration problems. (Di Martino et al., 2015)
Adopting Cloud Computing and new technology also requires new skills of people working in IT departments (Leimeister et al., 2010).

5.2 Cloud Computing Deployment Models

5.2.1 Public Cloud

Strengths:
Public cloud providers provide, at least from a customer's perspective, unlimited resources, so that computing resources are always available on demand (Mell & Grance, 2011). This eliminates the need to plan hardware investments ahead. The infrastructure is also elastic and allows to scale automatically to current needs.
Large up-front costs for hardware are eliminated using a pay-per-use model. Instead of investing huge amounts of hardware up-front, the customer is able to pay just for used resources. This model is ideal for short-term usage of computing resources. Furthermore, hardware investments can be planned to match the average processing workload with extended with the ability to scale for peak loads. (Buyya et al., 2013)
Public clouds are also fully automated and thereby achieve economy of scale. Consumers do not have to buy, store, and maintain infrastructure hardware anymore and do not have to put in time and effort to update and maintain the infrastructure equipment. From a consumer perspective, full automation results in time savings of resource provisioning and improved efficiency due to standardization. (Buyya et al., 2013)
Another advantage of Cloud Computing is the ability to enhance elasticity and disaster recovery. In a public cloud it is easily possible to use elastic computing resources which are highly scalable. (Di Martino et al., 2015)

Weaknesses:
Even though public cloud providers have SLAs committing high availability, those might be insufficient for mission-critical applications of large organizations (Marston et al., 2011). Most large public cloud providers commit to provide a monthly uptime percentage of at least 99.95%. However Gunawi et al. (2016) found out, that for a general selection of cloud services (which also includes SaaS and PaaS vendors) 78% do not even reach 99.9%.

Opportunities:
Public cloud provides an easy point of entry to technology for multiple parties. High-end computing resources are not anymore just available for large scale companies. Startups and small business, but also developing countries can gain advantage of the latest technological developments due to the pay-per-use model. (Marston et al., 2011)
Organizations also gain from the pay-per-use model. Resources which are just needed for a short term like for rapid development and test, prototypes or one-time tasks can be rented and simply released when they are no longer needed (Armbrust et al., 2009).

Threats:
Public cloud providers often rely on proprietary technology and interfaces, which lead to a vendor lock-in. This leads to restrictions on the ability to migrate resources from one provider to another. Different hypervisors, image formats, or API incompatibility impede a provider change. (Buyya et al., 2009)
Another threat is, that the pricing situation in public cloud might not be stable. Even though it is more likely that prices fall due to competition and economy of scale, price-quality differentiations may result in sudden price changes. (Kilcioglu & Rao, 2016)
Another issue is loss of logical control. In a public cloud the provider controls the customers' core logic and sensitive data. Also depending on the geographical location of the data third parties like government agencies so might get access to a customer's data. (Buyya et al., 2013)
As shifting resources to a public cloud provider eliminates physical hardware in an organization, employees in corporate IT departments may see Cloud Computing technology as a threat to their jobs (Marston et al., 2011).

5.2.2 Private Cloud

Strengths:
A private cloud has the strength to provide a flexible and scalable infrastructure like a public cloud but is managed and owned by the company itself in a private environment. This eliminates security concerns because all data and process sovereignty is within the company and also latency and bandwidth issues are eliminated as the data does not have to be exchanged via the Internet. (Buyya et al., 2013)
A data center operated in a private cloud may result in a cost advantage compared to a public cloud provider. Resources running long-term without the need of high scalability can be cheaper than an external cloud provider. (Longoria, 2016)
Additionally, the architecture of a private cloud allows to operate IT infrastructure on more heterogeneous and also commodity hardware in data centers of a corporate environment. (Alba et al., 2014; Buyya et al., 2013)

Weaknesses:
One issue of private clouds is, that despite to the defining characteristic of Cloud Computing it is not as scalable as a public cloud. High scalability is only possible with additional resources, though this lowers the total utilization of a data center. Therefore it is an ongoing struggle of capacity guessing for infrastructure resources. (Buyya et al., 2013)

Opportunities:
The implementation of a private cloud brings the opportunity to avoid a vendor lock-in due to data sovereignty and use of rising open standards. Furthermore, an internal operation keeps all data and processes in-house, to avoid conflicts with compliance or security regulations. (Longoria, 2016)

Threats:
The provision of IT infrastructure is often seen as commodity, which does not gain competitive advantage, and hence should be sourced to an external provider (Carr, 2003; Urbach & Ahlemann, 2016a). Private cloud environments are thereby threatened by the fact that infrastructure is a standardized service which can be easily provisioned by external providers without losing any performance to competitors (Gebauer et al., 2016).

5.3 Discussion

The results above indicate that choosing an IT infrastructure implementation option is neither a simple, nor a straight forward decision process. Due to the variety of use cases in practice there is no singular case applicable to all organizations to determine the right Cloud Computing adoption. Organizations have to decide whether to choose Cloud Computing over traditional virtualization and, in case of Cloud Computing, which of the Cloud Computing deployment models is the best option for them. Table 2 summarizes the results of the SWOT analyses for the technological perspectives of traditional virtualization and Cloud Computing in general as well as the specific Cloud Computing deployment models public cloud and private cloud. The applied SWOT analyses provide a guideline for the strategic decision which of the evaluated IT infrastructure implementation options can be applied best for an organization.
Small and medium-sized enterprises can gain advantage from the flexibility of public clouds over traditional virtualization, in particular because these organizations do not have the wherewithal infrastructure and resources necessary for cost efficient large data centers (Marston et al., 2011). Besides the modest investment levels, smaller organizations benefit from an easy adoption on functionality and new technology provided by Cloud Computing. Most large enterprises currently operate a data center that uses traditional virtualization technology, so the arising question is whether it makes sense to adopt Cloud Computing and further whether a public cloud or a private cloud should be chosen. The results presented above can support this decision process to develop an overall Cloud Computing strategy.
On a global perspective, an adoption of Cloud Computing for IT infrastructure provides advantages for organizations. Industrialized countries are easily able to expand their services on a global scale. Furthermore, developing countries and emerging markets can easily adopt new technologies to quickly obtain IT industrialization without significant upfront investments (Marston et al., 2011).

Table 2. Summarized SWOT analyses on selected areas of the IT infrastructure taxonomy

	Technology		**Cloud Computing deployment models**	
	Traditional virtualization	**Cloud Computing**	**Public cloud**	**Private cloud**
Strengths	Increases utilization due to consolidation of servers Improves availability and reliability Enables basic resource scheduling	Improves utilization due to scalability Supports high automation and standardization Simplifies reach of performance and SLA goals	Provides unlimited hardware resources scaling to current needs Eliminates upfront hardware commitments due to pay-per-use model Empowers economy of scale due to full automation Enhances elasticity and disaster recovery	Provides flexibility and scalability combined with data and process sovereignty Eliminates latency and bandwidth issues Enables use of heterogeneous hardware
Weaknesses	Degrades performance due to abstraction Utilization of the total data center is still low Lacks of unified management	Physical control of the data can be lost	Insufficient compliance of SLAs are possible	Limits scalability due to data center capacity
Opportunities	Reduces data center costs due to less physical hardware Extends lifetime of applications	Enables faster adoption of new technology Empowers process improvements like DevOps	Simplifies entry for new technology Empowers flexible resource availability for short term needs	Avoids vendor lock-in with open standards Meets security and compliance regulations
Threats	Emerges in vendor lock-in due to hypervisor and VM image formats Competition rises with cloud providers and threat of bimodal IT	Lack of standards leads to vendor lock-in and migration problems Requires new skills and organizational change	Proprietary technology of public vendors leads to vendor lock-in Pricing stability is uncertain Logical control of the data can be lost Threatens job security in IT departments	Opinion that infrastructure is commodity and should be outsourced

A Cloud Computing adoption is driven by the intention to save costs or to become more innovative (Amazon Web Services, 2016).

Regarding cost savings, Cloud Computing deployment models have potential for cost-savings for IT organizations. A public cloud eliminates hardware investments for the data center and can reduce the labor costs for IT infrastructure maintenance. It allows a highly scalable IT infrastructure, where consumers pay for actual usage instead of overprovisioned resources. A private cloud does adopt flexible infrastructure programmability which can save cost via a better resource utilization within the data center and reduced efforts for maintenance and operations due to high standardization and automation.

Regarding innovation, Cloud Computing characteristics are a possibility for fast innovation of a business-centric digital IT. Especially the public cloud allows an easy conduction of proof of concepts and a fast adoption of new technology due to resource provision on demand. Also a private cloud enables innovation due to a flexible IT infrastructure and automated resource provision. Innovations like the DevOps approach and concepts like Internet of Things rely on such a highly flexible and scalable infrastructure.

6.0 Conclusion and Future Work

With the rising adoption of Cloud Computing organizations have multiple options how to provide IT infrastructure.

We introduced a taxonomy classifying IT infrastructure from a technology and a sourcing perspective. To evaluate the adoption of Cloud Computing, we derived a two-step evaluation. First, the technological perspectives of traditional virtualization and Cloud Computing were compared. Second, the specific Cloud Computing deployment models of an external public cloud provided by IaaS Cloud Computing vendors and an internal private cloud based on emerging scalable cloud architectures were compared. The SWOT framework was adopted for multiple evaluations to understand both opportunities and challenges of the derived IT infrastructure implementation options.

Methodical limitations of this study primarily stem from its reliance on secondary data and its non-empirical approach. Despite a systematic database-driven search in both academic publications as well as practical reports it is possible that some relevant literature is missing. In addition to that, an empirical study with IT decision makers on the needs and doubts for Cloud Computing adoption could help to triangulate our findings. A further limitation is the selective evaluation of derived IT infrastructure implementation options. A more comprehensive approach could include both sourcing options for traditional virtualization, and a deeper evaluation of the hybrid cloud.

As the SWOT analyses are just a first step towards a practical adoption of Cloud Computing, future work could present a decision model for the derived IT infrastructure implementation options. Therefore, applications of a data center are clustered into associated business services and are evaluated via a set of criteria to derive a suitable level for the IT infrastructure implementation options. Hence, target scenarios for the data center distribution could be deduced. Furthermore, target scenarios could be evaluated from a cost perspective to identify potential cost savings. In addition, as the paper at hand is purely conceptual, further work on empirical testing of the introduced analyses can prove its validity.

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