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Head in the Clouds

A quantitative study on cloud adoption in a industrial setting

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Abstract

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The purpose of this study is to investigate which factors that influence cloud adoption and contribute to existing research about cloud computing. Ten hypotheses were derived from the Technological, Organizational, and Environmental (TOE) framework combined with the Diffusion of Innovation (DOI) framework. Data was collected using a questionnaire and 91 individuals working in several industries and different countries participated in the study. The research model was tested using a quantitative approach using partial least squares structural equation modeling (PLS-SEM). The main factors that were identified as drivers for adoption of cloud computing are: digital strategy, competitive pressure, trading partner support, standardization, firm size and network and collaboration. These findings have important implications and great value to the research field, companies and cloud providers as they could formulate better strategies for a successful cloud adoption. The study also provides a new approach in research about cloud adoption where the type of enterprise system migrated to the cloud is taken into consideration. Findings in this study points towards system specific requirements influencing the adoption rate.

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Trenden med molntjänster fortsätter och har förändrat sättet vi använder datorer och internet. Istället för att köra program på en enda stationär dator finns flera applikationer i molnet - en samling datorer och servrar som är tillgängliga via internet. Cloud computing är en innovativ affärsmodell och skapar möjligheter för företag att bli konkurrenskraftiga och möta affärsbehov. Syftet med den här studien är att undersöka vilka faktorer som påverkar företag att förflytta sig till molnet i flera länder och i olika industrier.

Det finns en stor mängd litteratur om cloud computing inom datavetenskap, men det finns fortfarande en liten mängd litteratur inom informationssystemområdet som studerat cloud computing. Därför är målet med denna studie att ge ett helhetsperspektiv på cloud computing. Eftersom datormoln är en unik teknik och på grund av molnets komplexitet är det viktigt att inkludera flera olika synvinklar som kan förklara adoption av datormoln. Studien är baserad på teori om molntjänster, innovation samt tekniska, organisatoriska, och miljömässiga aspekter. Dimensionerna har brutits ned och en teoretisk modell har använts för att beskriva faktorer som påverkar ett företags sannolikhet att förflytta delar av sin verksamhet till molnet. Modellen inkluderar alla möjliga perspektiv som är lämpliga för en undersökning av cloud computing.

Data har samlats in genom en enkät som slutfördes av 91 yrkesverksamma inom IT eller cloud computing. Utifrån frågeställningen, *vilka faktorer påverkar adoption av cloud computing?* härleddes 10 hypoteser som testades med dataanalysmetoder. Resultatet visar att 6 av de 10 undersökta faktorerna har ett betydande inflytande på adoption av cloud computing. Dessa aspekter inkluderar konkurrens, digital strategi, nätverk och samarbete, företagsstorlek, standardisering och support från partners. Den senare var den viktigaste faktorn för adoption av molntjänster och som återspeglade företagens oro att vara beroende av en molnleverantör och att förlora kontrollen över den underliggande IT infrastrukturen. Detta gör det svårt att byta leverantör samt att informationsutbyte, och support blir mer avgörande för en framgångsrik adoption av molntjänsten. Användarna hyr hårdvara och infrastruktur månadsvis, en sådan affärsmodell kan minska synligheten för vad som händer på hårdvarunivån. Denna studie ger också ett nytt tillvägagångssätt inom studier om adoption av molntjänster. Studien utvärderar om vissa aspekter är viktigare för specifika IT-system som företagen väljer att förflytta till molnet. Även om ytterligare forskning behövs för att uppnå en mer omfattande förståelse beträffande adoption av molnsystem, visar denna studie att adoption av molnet förutsätter specifika krav beroende på systemet företaget förflyttar till molnet.

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1. Introduction

Today, the world relies on information technology and online services, such as email, and data storage. Social media, entertainment and e-commerce have become natural parts of everyday life. The trend with cloud computing or cloud services continues and has changed the way we use computers and internet. Instead of running programs on a single desktop computer, several applications are in the cloud – a collection of computers and servers accessible via internet. Cloud computing is a business model and provide opportunities for companies to become competitive and meet business needs (Andrikopoulos et al., 2013). For many companies, this means several opportunities. They have access to all kinds of software and applications without having to install them on their computers (Za et al., 2011). These services allow companies to reduce or eliminate equipment, procurement, and maintenance of servers, systems, and staff that allow them to focus on their operations (Ferrari et al., 2011). For example, cloud offers the ability to make compute power and storage virtually unlimited, fast and on demand (Patrignani et al., 2016). In terms of cost, operations are advantageous as the services are paid according to consumption and move from traditional capital expenditure for hardware and software to operational expenditure, where the cost is variable instead of fixed. In a cloud-based business model, the customers usually pay for how much resources they use (Foster et al., 2008). This type of cost model is beneficial because many customers' resource use is changing rapidly today. For these companies, it is important to have a flexible pricing model to follow customer needs today and in the future. Although cloud computing appears to be an attractive technology, several challenges remain when migrating to the cloud. It is therefore very interesting to study which factors that influence the adoption of cloud computing.

A cloud architect who helps companies migrating to the cloud, shares his insights. According to him, knowledge of cloud computing is the most important factor that influence companies' decision to migrate to the cloud. If there is a lack of knowledge within the company, their perception of cloud computing will be negative. He continues and says that the knowledge could be divided into three sections, security, costs, and how to migrate to cloud. According to him cloud computing is more secure, cost effective and easy to use. Concerns regarding security in a cloud-based environment is something he often encounters in projects. He says that when companies overhear about other companies that are using cloud services and are leaking data or is under a cyberattack, they get frightened and get a wrong perception of cloud computing. But the security is often as good as or better than other traditional systems. Events in cloud-based environments are getting more attention as the big players likes Amazon, Microsoft and Google are involved. Another important aspect is the cloud strategy, some organizations have a clear cloud migration strategy, and this makes the adoption much easier for him as a partner and the company he is working with. But in order to have a cloud strategy, an IT department within the company is required. Companies without an IT department usually do not have a strategy for migration to the cloud. These companies have difficulties in using cloud computing without support from trading partners. They just want their servers up and running, without any goal or where they want to be positioned in the future. This results in them not taking advantage of all the benefits with cloud computing.

Based on these insight and previous studies, it is clear that a study of cloud adoption needs to be based on theory that includes perspectives from several different angles, including the technical aspects about cloud computing, and more organizational specific aspects. There is a great amount of literature about cloud computing in computer science, but still there is a small amount literature in the information system area that studies cloud computing. Therefore, the objective for this study is to bring a holistic perspective on cloud computing. When considering cloud adoption, there are several ways a company could migrate to the cloud. It is therefore important to distinguish these different sorts of adoptions to provide a comprehensive study of cloud computing, which is something that have not been examined in previous studies. For example, this study investigates the adoption of cloud with respect to different information system functionalities or processes (e.g. email or a CRM system) that a firm decide to move to the cloud.

The study is based on theory of cloud computing, diffusion of innovations (DOI), and the technology, organizational, environment (TOE) framework. The idea of the TOE framework is to describe factors that influence technology adoption and its likelihood. The framework is at the firm level and includes all possible perspectives that are suitable for an investigation of cloud adoption. According to the cloud architect the perception of cloud computing is the most important aspect influencing cloud adoption, to extend the TOE framework, the DOI theory is used to also include users perceived usefulness and ease of use of cloud computing. The factors that influence cloud adoption are empirically examined by surveying relevant experts working for companies in several industries. To evaluate the research model, data was collected from 91 professionals, representative for the population in 17 countries.

1.1 Objectives

The purpose of this project is to understand the process of cloud computing adoption and to investigate factors that influence the adoption of cloud computing. Therefore, the research question is:

Which are the aspects influencing cloud adoption?

1.2 Outline

This report is structured as follows, first a background about cloud computing is provided. Second, previous studies are reviewed and relevant literature on cloud adoption. Subsequently, the research model is derived based on two frameworks, the technological, organizational, environmental framework and the diffusion of innovation model. Third, the research methodology is presented, which is followed by empirical results. The report concludes with a discussion about the findings, the shortcomings and suggestions for further research.

2. Theories and literature review

2.1 Cloud computing

Cloud computing is evolved out of grid computing and the result is a shift in focus from an infrastructure that delivers storage and compute power to one that aims at delivering more abstract resources and services (Foster et al., 2008). There are two major trends in information technology that have contributed to the development of cloud computing. First, IT efficiency, where the power of modern computers is more efficiently used through scalable hardware and software. Second, business agility, where IT can be used as a competitive tool by fast distribution, use of business analytics, and mobile interactive applications that responds in real time to user requirements (Marston et al., 2011a). The cloud service model represents a new approach to internet-based services that delivers highly scalable distributed computer platforms where resources are offered as a service.

2.1.1 Deployment models

A cloud infrastructure can be utilized internally by a company or exposed to the public. There are four different cloud deployment models, private, community, public, and hybrid cloud.

- If the company has a *private cloud*, the infrastructure is provisioned for exclusive use by the organization including several users, such as business units. The infrastructure may be owned, managed, and operated by the organization or a third-party provider, and it may be located on or off premises (Mell and Grance, 2011). Private clouds provide better control over the infrastructure, and the organization have full control over mission-critical activities. If the company has security concerns including data privacy and trust, a private cloud is a good option (Dillon et al., 2010) The company have control, and responsibility over security but there will be initial capital expenses in a private approach. Furthermore, private clouds require more IT skills and expertise. They are also suitable for larger installations (Marston et al., 2011a) as the company can maximize and optimize the utilizations of existing in-house resources.
- A *community cloud* is provisioned for exclusive use by a specific community of users from organizations that have shared concerns, such as security or compliance considerations. The cloud may be owned, managed, or operated by the organization or a third-party provider, and it may exist on or off premises.
- In a *public cloud* the infrastructure is provisioned for open use by the public. It may be owned by a business, academic, or government, and exists on the premises

of the cloud provider. The company only pay for what is used, the maintenance or updates of the hardware is handled by the provider and a public cloud is easier to set up and use, not requiring high technical knowledge.

- A *hybrid cloud* is the most common deployment model and is a combination of two or more deployment models (private, community, or public) that remain unique entities, but are bounded together. This allows data and application portability, for example cloud bursting for load-balancing between clouds (Mell and Grance, 2011). Hybrid clouds represents a perfect balance between control and flexibility but include more complex implementation than a public deployment model. According to Dillon et al. (2010) hybrid clouds have raised issues of standardization and cloud interoperability.

2.1.2 Service models

Cloud computing is a business model that delivers three different service models, Software as a Service (SaaS), Platform as a Service (PaaS), and Infrastructure as a Service (IaaS). These represents different layers in the infrastructure. In a cloud-based environment, the responsibilities are shared among the provider and the user. But the responsibilities and what the users manage, or controls depends on the service models. These models are independent of the deployment model. For example, a SaaS could be provisioned on a public or private cloud.

- In the *SaaS model* the consumer uses the provider's applications running on a cloud infrastructure. The consumers could achieve economies of scale, and optimization in terms of speed, security, availability, disaster recovery, and maintenance (Dillon et al., 2010). Examples could be enterprise systems such as Microsoft 365, Salesforce or Google Apps such as Gmail, and docs.
- In the *PaaS model*, the consumer can deploy its own acquired applications created using programming languages, libraries, services, and tools supported by the provider (Mell and Grance, 2011). The difference between SaaS and PaaS is that a SaaS model only hosts completed applications whereas a PaaS model offers a development platform for applications and applications that are in-progress (Dillon et al., 2010). When a company has a PaaS solution, they are only responsible for the data and the applications. The cloud provider is responsible for the underlying infrastructure like the operating system, servers, storage and networking.
- In the *IaaS model,* the provider only handles storage, compute, and physical network capabilities. Virtualization is extensively used in an IaaS model to meet growing or shrinking resource demand from cloud consumers. The basic strategy is to set up several virtual machines (VM), which reduces the cost associated with power and cooling in data centers (Regola and Ducom, 2010).

2.2 Cloud adoption

There are many theories used in IS research. Since the purpose of this study is to investigate cloud adoption, we are interested in theories about technology adoption. The most popular theories are the technology acceptance model (TAM), the theory of planned behavior (TPB), the unified theory of acceptance and use of technology (UTAUT), diffusion of innovation (DOI), and the technological, organizational, and environmental (TOE) framework. The TOE framework identifies technological, organizational, and environmental contexts of a firm that influence the process by which it adopts and implements a technological innovation. The framework is therefore at the firm level and includes all possible perspectives that are suitable for an investigation of cloud adoption. The other theories derive from social psychology and includes how individuals adopt to new technologies. Since the study investigate factors that influence organization's adoption of cloud computing, these theories are not considered relevant. But using one framework on its own is not considered sufficient for modelling cloud computing adoption because of the novelty and complexity of cloud computing. Several other studies believe it is necessary to include several frameworks when analyzing cloud adoption to bring forth a holistic perspective that has often been lacking in many technological discussions (Marston et al., 2011b). Therefore, the model will integrate the constructs of DOI with constructs from the TOE framework to investigate cloud adoption based on users' perception of cloud computing.

2.2.1 Technology-organization-environment framework

The TOE framework was developed by DePietro et al. (1990). The idea of the framework is to describe factors that influence technology adoption and its likelihood. It provides a holistic view of technology adoption, challenges with adoption, factors influencing innovation adoption decisions, and to develop better organizational capabilities using the technology. DePietro et al. (1990) purposed three elements that influence the way a firm sees the need for, and adopts new technology: the context of technology, organization, and environment. The *context of technology* refers to the internal and external technology relevant to an organization and the technologies that are available for possible adoption. This means both the existing technologies in use and new technologies relevant to the firm. The *context of organization* refers to the characteristics of the firm, such as organizational structure and firm size, but also human resources, and the process of communication among employees. The communication could be either formal or informal. The *context of environment* refers to the market, competitors, and regulatory environment such as interactions with government.

2.2.2 Diffusion of Innovation

The innovation diffusion theory complements the TOE framework. The DOI model was developed by Rogers (1983). The purpose of the model is to explain adoption of an innovation. Rogers describes *diffusion* as the process through which an innovation is communicated through certain channels over time among the members of a social system. It represents a certain degree of uncertainty to an individual firm. The four main elements in the diffusion of new ideas are: innovation, communication channels, time, and the social system. An *innovation* is an idea, practice, or object that is new by an individual or organization. Furthermore, there are five characteristics that determine an innovation's rate of adoption: relative advantage, compatibility, complexity, trialability, and observability. *Relative advantage* is the degree to which an innovation is perceived as better than the practice it replaces. What is important here is whether an individual perceives the innovation as advantageous. *Compatibility* is the degree to which an innovation is perceived as being consistent with the internal organization such as existing values, past experiences, business processes, and needs of potential adopters. It also includes the information system environment such as infrastructure and implementation procedure. *Complexity* is the degree to which an innovation is perceived as being difficult to understand and use. *Trialability* is the ease of experimenting with an innovation. *Observability* is the degree to which the results of an innovation are visible to others. According to Rogers (1983), innovations that are perceived by individuals as having greater relative advantage, compatibility, trialability, observability, and less complexity will be adopted more rapidly than other innovations.

The innovation-decision process consists of a series of actions and choices over time through which an individual or organization evaluates a new idea and decides whether or not to corporate the new idea into practice. The process through which an individual or organization passes first knowledge of an innovation, second, to forming an attitude toward the innovation, and third, decide to adopt or reject the innovation, fourth, implementing the new idea, and finally confirm the decision. In this study, all stages are used to describe the process of cloud adoption. The first stage *knowledge* occurs when an organization is exposed to the innovations' existence and gains some understanding of how it functions. The next stage, *persuasion* occurs when an organization forms a favorable or unfavorable attitude toward the innovation. The third stage, *decision* occurs when an individual engages in activities that lead to a choice to adopt or reject the innovation, where adoption is a decision to make full use of an innovation. *Implementation* occurs when an organization puts innovation to use. The final stage, *confirmation* occurs when an organization seeks reinforcement of an innovation-decision already made, but the company might reverse this previous decision if exposed to problem with the innovation (Rogers, 1983).

2.3 Previous studies on cloud adoption

First, a comparison was made between relevant empirical studies on adoption of cloud computing. The database Scopus was used to search for peer-reviewed and highest reliable studies on cloud computing and adoption of technologies. Table 1 shows the variables used in previous studies and their findings. Factors that influence cloud adoption are marked as a star. But only the most common factors are stated in the table, some of the studies also include variables that are unique for their study. Previous studies that combine the DOI model and TOE framework did not consider observability in their research model and only one study include the factor trialability. Several studies used the following factors: relative advantage, compatibility, and complexity which are derived from the DOI model. Their findings were similar, all three factors showed a significant result in a majority of the studies. Moreover, based on the TOE framework technical competence, top management support, firm size, and competitive pressure are factors that also indicate to influence cloud adoption. The corresponding previous studies' sample, methodology and used framework can be seen in table 2.

Table 1. Previous studies on cloud adoption using the TOE framework

Authors	Rel. adv.	Comp.	Complex.	Trial.	Observ	Sec.	Cost red.	Tech comp.	Mgmt. supp.	Firm size	Comp. pressure	Reg. supp	Trad. part supp.
(Sabi et al., 2016)	X*	X*	X	X*	X	X	X			X			
(Senyo et al., 2016)	X*	X				X*		X*	X*	X	X*	X	X*
(Gangwar et al., 2015)	X*	X*	X*					X*	X*		X*		X*
(Gutierrez et al., 2015)	X	X	X*					X*	X		X*		X*
(Safari et al., 2015)	X*	X	X	X	X	X*		X			X*		
(Hsu et al., 2014)	X	X	X*			X*	X*	X*	X*		X*	X	
(Oliveira et al., 2014)	X*	X	X*			X	X*	X*	X	X*	X	X	
(Alshamaila et al., 2013)	X*	X*	X*	X*				X*	X*	X*	X		X*
(Borgman et al., 2013)	X*	X	X					X	X*	X	X	X	
(Low et al., 2011)	X*	X	X					X	X*	X*	X*		X*
(Zhu and Kraemer, 2005)								X*		X	X*	X*	

Table 2. Previous studies on cloud adoption with corresponding used framework, and method

Authors	Framework	Industry and country	Method
(AlBar and Hoque, 2019)	DOI and TOE	Mainly education, financial services and manufacturing in Saudi Arabia	Online questionnaire, Partial Least Squares Structural Equation Modeling PLS-SEM
(Sabi et al., 2016)	DOI and TAM	Educational establishments in developing countries	Questionnaire and partial least squares (PLS)
(Senyo et al., 2016)	TOE and DOI	Different industries in Ghana (developing countries)	Survey, confirmatory factor analysis and logistic regression
(Gangwar et al., 2015)	TAM, DOI and TOE	IT, manufacturing and finance in India	Questionnaire, exploratory and confirmatory factor analyses, structural equation modeling
(Gutierrez et al., 2015)	TOE	Several industries in UK	Survey, principal component analysis (PCA), and logistic regression
(Safari et al., 2015)	TOE and DOI	University experts, 30 IT professionals in 15 IT enterprises that had adopted SaaS	Questionnaire, fuzzy analytic hierarchy process (AHP) and linguistic preference relations
(Lian et al., 2014)	TOE and Human-Organization-Technology fit (HOT-fit) model	Hospitals in Taiwan	Questionnaires and Analysis of variance (ANOVA)
(Alkhater et al., 2014)	TOE and DOI	20 different IT experts at different companies in Saudi Arabia	Semi-structured interviews
(Hsu et al., 2014)	TOE and DOI	ICT manufacturing, ICT service, general service, and general manufacturing in Taiwan	PLS and discriminant analysis
(Oliveira et al., 2014)	DOI and TOE	Manufacturing and services in Portugal	Questionnaire, PLS-SEM
(Alshamaila et al., 2013)	TOE and DOI	SMEs in England	Semi-structured interviews
(Borgman et al., 2013)	TOE	24 global enterprises across various industries	Structured interviews
(Lin and Chen, 2012)	DOI	IT industry in Taiwan	Interviews
(Low et al., 2011)	DOI and TOE	High-tech in Taiwan	Questionnaire, factor analysis and logistic regression
(Zhu and Kraemer, 2005)	TOE and RBV	Retail in several countries	Questionnaire, confirmatory factor analysis (CFA), and PLS

2.4 Research model

Based on the literature review, relevant cloud adoption variables are used to reinforce a research model for this study. The research model includes the technological, organizational, and environmental context as they are considered as important aspects of cloud computing adoption. A combination of the DOI and the TOE framework is considered suitable for this study as the DOI framework can extend the technological context to include other features relevant for an innovative technology like cloud computing. Tornatzky and Klein (1982) showed that compatibility, relative advantage and complexity are related to adoption while observability and trialability are not influencing technology adoption. Similarly, these dimensions of the DOI framework are factors that previous studies about cloud adoption have not considered as important factors, therefore, these aspects are not included in the research model. According to Baker (2011), the three dimensions in the TOE framework must be uniquely operationalized in each specific innovation context. Therefore, the variables are operationalized according to literature about cloud computing. In this study, four new factors are investigated which extend previous literature: network & collaboration, and concerns regarding availability & quality of service, loss of control, and vendor-lock. These issues have been addressed in literature about cloud computing (Dillon et al., 2010; Marston et al., 2011b; Trigueros-Preciado et al., 2013) and will be explained in the sections below. Furthermore, the variable complexity is modified to raise the issue with standardization in a cloud-based environment. The framework for this research is shown in figure 1.

2.4.1 Adoption of cloud computing

It is possible to adopt to cloud computing in several ways, for example a company can choose to use a specific deployment model (public, private, hybrid, and community), and a specific service model (PaaS, SaaS, or IaaS). The different service models could influence the cloud adoption, for example, Safari et al. (2015) investigated which factors that influence SaaS adoption. But a company might choose to have several service models. That is, a firm might have both a PaaS and an IaaS model. Therefore, cloud computing adoption is described as migration to either a PaaS, SaaS, or IaaS model in this study.

Furthermore, not all applications are suitable for moving to the cloud. General-purpose applications (such as office, email, and collaboration technologies) are good candidates, since these functions are not tailored to only one organization. Moreover, applications like CRM (customer relationship management) systems such as Salesforce could be easily deployed standalone but might be much more difficult when there are several different software and legacy systems that are all internally integrated with different dependencies (Marston et al., 2011b). Therefore, cloud adoption of different systems probably varies between them. A recent study (AlBar and Hoque, 2019) investigated which factors that influence cloud ERP adoption. This study evaluates the cloud adoption of office automation, IT-services support, human resources, enterprise resource systems (ERP), customer relationship management (CRM), and governance, risk, and compliance systems.

2.4.2 Technological context

The technological dimension covers features of the technology itself that could influence the adoption (DePietro et al., 1990). In this study, this incorporates the features of cloud computing that influence the adoption in organizations.

Relative advantage

Relative advantage is the degree to which an innovation is perceived as better than the practice it replaces (Rogers, 1983). Several previous studies, have concluded that the relative advantage is a very important factor influencing the adoption of cloud computing (Alshamaila et al., 2013; Gangwar et al., 2015; Low et al., 2011; Oliveira et al., 2014). Therefore, we propose that this specific aspect need a more detailed investigation. According to literature, examining benefits of cloud computing (Dillon et al., 2010; Trigueros-Preciado et al., 2013), there are mainly four key advantages over other technologies: First, cost reduction. The users only pay for the resources (e.g. servers, software, storage, and networking) they use, so the IT cost becomes a variable cost instead of fixed cost as for the traditional IT resources (Foster et al., 2008; Marston et al., 2011a; Trigueros-Preciado et al., 2013). Second, cloud computing makes it easier for firms to scale their services according to client demand. In fact, the goal of cloud computing is to scale up or down the resources dynamically depending on the needs of business (Dubey and Wagle, 2007). For example, the power of servers can be automatically or manually increased by adding more CPUs, memory, or servers. Third, firms can focus on their core business. Cloud computing is outsourced, which allows the enterprise to use the IT as a utility and therefore freeing technical and human resources and instead focus on its real business core (Trigueros-Preciado et al., 2013). Forth, cloud computing delivers services that were not possible before. For example, mobile interactive applications that are location-, environment- and context-aware, and that respond in real-time. Another example is parallel batch processing, that allows enterprises to take advantage of huge amount of processing power to analyze huge amount of data for a small period of time. Furthermore, cloud computing makes business analytics easier, companies can use computer resources to understand customers, buying habits, or supply chains from data (Marston et al., 2011a). According to Marston et al. (2011b) cloud computing can deliver new value for customers through innovative applications along the value-chain. Based on these arguments, a hypothesis can be formulated:

H1. Relative advantage will positively influence cloud adoption.

On the other hand, literature, examining potential barriers of cloud adoption have argued that there are three difficulties with cloud adoption: The first barrier is security, according to several previous studies (Dillon et al., 2010; Foster et al., 2008) security is one of the most important concerns for adoption of cloud computing. Security issues such as data loss, phishing, or botnets result in threats to the organization's data and software. This is because corporate information often contains data of customers, employees and business critical properties (Xu, 2012). These issues derive from the multi-tenancy model where the infrastructure is shared (Armbrust et al., 2009; Dillon et al., 2010; Marston et al., 2011a). This is also supported by Ackermann et al. (2012) which stated that cloud computing adoption is associated with different types of risks such as perceived IT security risk. A second barrier is the availability and quality of service (QoS). Organizations need guarantees that the services are always available with sufficient quality and performance. But cloud services do not yet have these guarantees that some organizations demand from their IT vendors (Armbrust et al., 2009; Marston et al., 2011a), making companies less likely adopt cloud computing. Third, for a company it is a difficult decision to transfer its data and not have control over the infrastructure. Users are concerned that they lose control over data or the underlying hardware since they are outsourcing (Clemons and Chen, 2011). Therefore, the loss of control could be a potential barrier. Based on these arguments, the following hypotheses can be formulated:

H1a. Concerns regarding IT security will negatively influence the relative advantage

H1b. Concerns regarding availability and quality of service will negatively influence the relative advantage

H1c. Concerns regarding loss of control will negatively influence the relative advantage

Compatibility

Compatibility is defined as the degree to which an innovation is perceived as being consistent with existing values, past experiences, business processes, and needs of potential adopters (Rogers, 1983). How to migrate existing systems or applications to a cloud-based environment is a critical factor that companies need to consider. For example, companies usually need to keep some resources in-house while other functions and activities could be outsourced. In this case, the communication between the in-house systems and the cloud services becomes crucial to run the business. Interoperability issues and unclear data structures will increase the difficulties of the integration, putting the IT department into a difficult position. Moreover, an organization might also want work with several cloud providers. For example, if the firm uses Gmail, they probably want to have that email functionality on Google's cloud while they want to have Salesforce for the HR service. This means that these different clouds need to be connected, they need to be compatible with each other.

Another aspect that previous studies have not considered in the context of compatibility is the linkage between business objectives or values and cloud computing. Several companies might not realize their business strategies can be extended with a cloud solution. Both IT and business units need to understand the value of cloud-based services and create a cloud strategy. This is supported with Kane et al. (2015), who concluded that a digital strategy drives digital maturity and digital strategies are developed with an eye on transforming the business. A full technology transformation is not about moving to the cloud or embracing new IT solutions. It also involves infusing technology into every strategic decision and process throughout the organization. This does not just mean explaining how the technology is better, but also how it drives business goals and how it could be implemented (Dhasarathy et al., 2020). The strength of digital technologies such as cloud does not lie in the technology alone, it also gives rise from how companies integrate them to transform their business and how they work (Chesbrough, 2010).

Organizations can benefit from cloud computing in different ways: internal business processes, collaboration with business partners, and for customer-faced services. An important question is to what extent a cloud computing service should be integrated into the organizational structure, and how the solution might be used to leverage communication and collaboration with business partners and customers (Klems et al., 2009). Companies need to change the traditional business models and take advantage of new agile, scalable and efficient business practices. With a cloud-based solution some applications can be customized according to the firm's business needs. This solution can enable better integrated and more efficient business processes (Xu, 2012). For example, to achieve this the firms could decide to deploy common business assets to the cloud that could be used across business units (Iyer and Henderson, 2010).

H2. Compatibility will positively influence cloud adoption.

But vendor lock-in limits portability of applications and the choice of vendors. According to Chaddha and Parameswaran (2009), interoperability and standardization have a huge impact on the cloud usage. Services with interoperability allow applications and data to be ported between clouds, or multiple cloud infrastructures. Interoperability is an essential requirement for enterprises (Xu, 2012). There is no standardization of cloud computing resulting in data and applications being dependent on one vendor (Dillon et al., 2010). Moreover, today enterprises might need to commit to cloud subscriptions for approximately three years because of the pricing model. This limits the possibilities to change to another provider's cloud. According to Chaddha and Parameswaran (2009) cloud adoption will be hindered if there is not a good way of integrating data and applications across different cloud provider's clouds. According to Dillon et al. (2010) hybrid clouds have raised the issues of standardization and cloud interoperability.

H2a. Concerns regarding vendor lock-in will negatively influence the compatibility of cloud computing

Complexity

The compatibility and interoperability issues with cloud computing is linked to the complexity of cloud computing. Complexity is defined as the degree to which an innovation is perceived as being difficult to understand and use.

Vendors like Microsoft and Amazon make their own interoperability agenda, and this makes standardization more difficult and could lead to multiple standards. Another challenge is that there are many service models (SaaS, PaaS, and IaaS), and standards are required for each model. Furthermore, migrating one application from one cloud to another could be a complex process as there could be several requirements relating to security, availability, reliability, performance, scalability, etc. (Chaddha and Parameswaran, 2009). Previous literature (Chaddha and Parameswaran, 2009; Dillon et al., 2010) supposed that standardization will pave the way towards realizing the true potential or benefits of cloud computing. Furthermore, Lin and Chen, (2012) found in their study that the lack of standardization between application program interfaces can prevent companies from adopting cloud and that also explains why companies are waiting for an agreed and used standard before the decide to adopt. This study was conducted eight years ago, the question is whether companies today perceive the standardization of cloud computing as sufficient, if so they would therefore more likely adopt cloud. Thus, a third hypothesis could be formed:

H3. Sufficient standardization of cloud computing will positively influence cloud adoption

2.4.3 Organizational context

Organizational factors include the firms' characteristics and resources available that affect the adoption of cloud computing. In this study, these include size of the firm, IT human resources, and top management support.

Firm size

According to Rogers (2003), the size of a firm is an important factor that influence adoption. But whether the firm should be small or large have been widely discussed in previous literature and the findings also differ between them. Some studies claim that large firms will more likely successfully adopt an innovation because it has more IT capabilities, more resources, financial support, and will therefore more likely survive failures than smaller firms (Zhu et al., 2003). But other studies have argued that smaller firms are more innovative and flexible and are therefore able to adapt to changes (Thong, 1999), while larger firms tend to have bureaucracy which could slow down the decision-making processes. In the context of cloud computing, this is applicable. First, cloud computing is a small capital investment which is attractive for small companies, start-ups or firms in developing countries (Marston et al., 2011b). This is supported by Alshamaila et al. (2013) who found that small size companies are more likely to adopt cloud computing. Second, smaller firms have much less old IS infrastructure to handle, which will makes it much easier for them to migrate to the cloud (Marston et al., 2011b), thus,

H4. Small and mid-size companies will more likely adopt cloud computing

Technology competence

The firms' technological capabilities and competencies will impact the adoption of a new technology. If the staff has sufficient knowledge about other technologies, the firm will more likely successfully migrate to the cloud. If the company want to reinvent the role of technology, they need tech stars, particularly the best engineers. By hiring the best tech people, companies reduce their technology costs while maintaining or improving the productivity (Sambamurthy et al., 2003). But it does not matter if the company get good people if they cannot keep them. It is therefore important to develop career paths so that they can advance in their own areas of strength. Training based on the employees' goals and learning needs is also important to keep the employees while getting top talent individuals. Furthermore, nowadays people want to work for a digital enabled company or a digital leader. Employees will be looking for the best digital opportunities, and businesses will have to keep up with the digital game to retain and attract them (Kane et al., 2015).

H5. IT capacity will positively influence cloud adoption

Network and collaboration

Having a high level of technology competence support an in-house expert network that people could take advantage of on specific topics. Promoting collaboration across technology teams and between business and technology is another crucial factor for a successful transformation. It is a key driver of innovation (Kane et al., 2015). According to Cooper (2001) a cross-functional organization is a key component to successful product innovation. Cooper (2005) defines cross-functional teams as those that have full-time team members from different functional areas in the organization such as sales, engineering, marketing, and operations, working on a project under a project manager. Previous literature have argued that companies that employ cross-functional teams to develop new products positively effects the project performance (Barczak and Wilemon, 2003; Takeuchi and Nonaka, 1986; Wheelwright and Clark, 1992). These kinds of teams foster collaboration among team members, removing out-of-date barriers that constrain innovative solutions (Cooper, 2001).

H6. Collaboration across tech teams and between business and technology will positively influence cloud adoption

The role of the digital leader

Top managers' support refers to the executives understanding of the nature and functions of cloud computing. With a better understanding, managers will be able to fully support the development of cloud computing. According to McKinsey (Dhasarathy et al., 2020) CIOs need to accept the degree to which their role needs to be expanded beyond cost and performance responsibilities in order to transform IT into a core driver of business value. For IT to become a driver of value, the CIO also needs a new set of skills and capabilities that embody a more expansive role. When considering a shift to cloud, executives tend to understand it first as a cost-saving opportunity. But executives who understand the full range of cloud benefits, such as improved speed to market, better productivity, and improved resiliency and disaster recovery could help them see how cloud can unlock new revenue. This is supported by Kane et al. (2015) who claimed that digital leaders do not need to master the technologies but instead understand the value of digital technologies to the organizations' future. In the past, IT transformations have often been expensive, and time consuming, and this has made some companies unwilling to undertake them again. It is therefore important that the leaders are educated about technologies and their applications to address this issue. Furthermore, leaders need to be comfortable taking risks. They need to embrace failure as a prerequisite for success and need to support employees to be as risk taking and become bolder (Kane et al., 2015).

H6. Top managers' support will positively influence cloud adoption

2.4.4 Environmental context

The environmental dimension refers to the industry, competitors, and regulatory environment the firm is currently operated in (DePietro et al., 1990).

Competitive pressure

Competitive pressure is recognized as an effective motivator for companies to follow a trend. Some companies could be mainly driven by competitive pressure, while other firms would adopt because they need the new technology in their business processes. It is defined as the degree of pressure that the company perceives from competitors within the industry. Competition is generally perceived to positively influence the IT adoption. This is applicable in the context of cloud computing. Cloud computing can provide an almost immediate access to hardware resources, with no initial capital investment, leading to faster time to market in many business (Kim, 2009). Cloud computing is not just a way of reducing cost, it also important in terms of competitive advantage that it delivers (Bloch and Hoyos-Gomez, 2009). Migrating to a cloud-based environment is therefore a way to provide better services and gain strategic advantages.

H7. Competitive pressure will positively influence cloud adoption

Regulatory environment

As the internet becomes the pillar for transmitting all types of digital content, the government will increasingly decide how the internet can be used. Cloud computing are affected of such regulation and the success of cloud computing largely depends on how regulatory authorities, both national and international, formulate laws to regulate this. There are many other problems that arise in a cloud-based environment since the information and data can be stored in a country that differs from the owner of the data. Companies that transfer their computer activities to the cloud may run the risk of following different countries' data protection laws. The distributed nature of cloud computing is changing many perceptions about data ownership and information. Data privacy, confidentiality, and law requirements are potential barriers for cloud adoption (Armbrust et al., 2009; Marston et al., 2011a). This problem makes it necessary for an active role of these authorities. Unlike traditional internet services, cloud services may require further review of agreements. Parties to an agreement should pay attention to their rights and obligations related to security, data transfer, and access to data. Organizations need to follow the current law regarding privacy, access, protection and data location and firms demand the cloud provider to complies with them (Armbrust et al., 2009; Marston et al., 2011a). According to Marston (2011) there is a need for a consistent IS policy across the usage of cloud computing, and this will reduce the organizations' concerns regarding security and privacy. This could be a challenge for the providers, but it would help the companies' decision towards a successful adoption.

H8. Support from regulatory environment will positively influence cloud adoption

Trading partner support

The first trading partner in a cloud-based environment is the cloud provider, they own and operate the services to deliver them to customers. They maintain and update the systems used by customers and are also responsible for pricing the cloud services. From the provider's perspective, they have to deal with end-user expectations and how their needs can be met (Marston et al., 2011a). Although cloud users do not have control over the underlying infrastructure, they need to ensure the quality, availability, and performance of these resources (Dillon et al., 2010). In other words, it is important for customers to obtain guarantees from the providers. These are usually specified through a Service Level Agreement that is negotiated between the suppliers and the customers.

Marston et al. (2011) define another stakeholder in a cloud-based environment as an enabler to describe the organizations that sell the products and services. These stakeholders enable the delivery and use of the cloud services. Firms expect enablers to build the infrastructure according to the needs of the company, for example integrating the company's existing IT infrastructure with the cloud. Furthermore, the authors believe that several cloud service providers currently lack the skills to interact with customers and implement them, which is why the role of an enabler in a cloud-based environment is increasingly important. The users need to take advantage of the knowledge and support from the new vendors and the enablers without putting new workloads to the teams. Therefore, a final hypothesis can be formulated:

H9. Trading partner support will positively influence cloud adoption

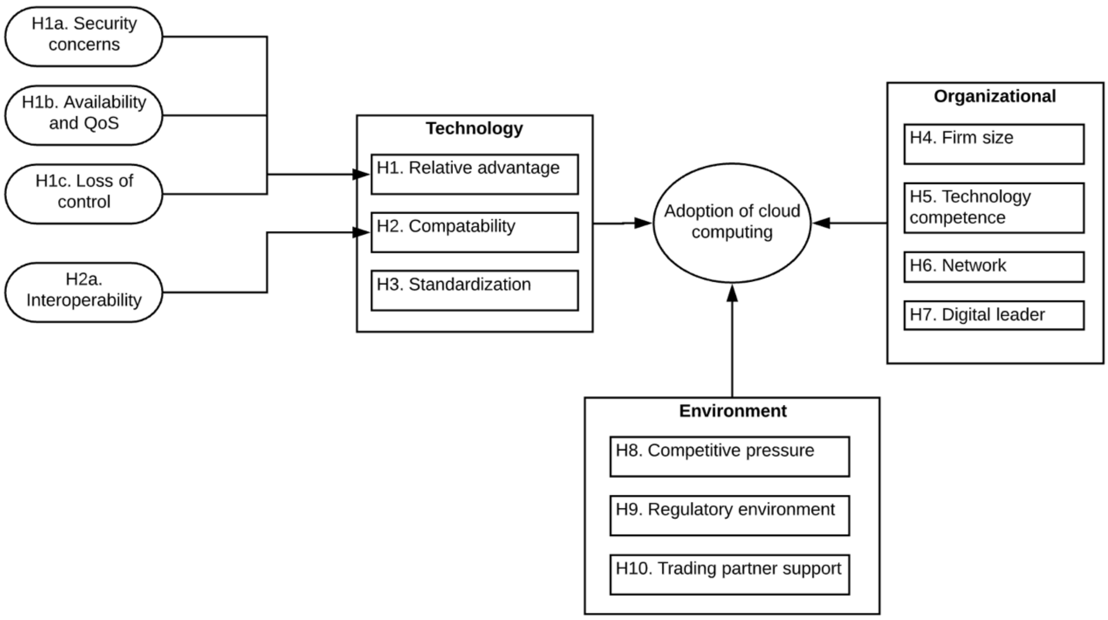

Figure 1. Research model

3. Method

3.1 Research design

The main research objective is to study cloud computing adoption to help companies better plan their journey to the cloud. To answer the research question, *which aspects influence adoption of cloud computing* a deductive approach is considered suitable as hypotheses of existing theories and concepts are tested. A quantitative approach was chosen for the study as it efficiently measures individuals' perception of cloud computing across many countries and industries. Furthermore, similar studies investigating cloud computing adoption have also used a quantitative approach. This approach validates the relationships between the factors in the research model and the dependent variable, cloud adoption. The following sections describe the research methods used to test the hypothesis including data collection, descriptive statistics, data analysis including statistical methodology, and validation of results.

3.2 Data collection

To evaluate the research model, a survey was conducted from Sweden during March-May 2020. Several other studies about cloud adoption have examined specific industries, such as education (AlBar and Hoque, 2019; Sabi et al., 2016), high tech (Low et al., 2011), manufacturing (Hsu et al., 2014; Oliveira et al., 2014), IT industry (Gangwar et al., 2015; Lin and Chen, 2012), hospital (Lian et al., 2014), and retail (Zhu and Kraemer, 2005). In this study, industry-specific characteristics are assumed to not affect cloud adoption.

Instead, the systems that the company move to the cloud are considered as more important affecting companies' adoption of cloud. Therefore, this study is based on a data sample of individuals working at companies that operate in 10 different industries and in 17 different countries. Other previous studies have also considered cloud adoption in several industries (e.g. Borgman et al., 2013; Gutierrez et al., 2015; Senyo et al., 2016).

The questions in the questionnaire are based on prior literature (see table 3). The questions were not translated to Swedish since several people working with IT can be non-Swedish speaking and in addition, most Swedes are fluent in English. According to the innovation-decision process, there are five stages of adoption of an innovation. All participants had an understanding of cloud computing and a short presentation of the technology was also provided in the questionnaire. To measure in which stage of the process the company is currently in, the respondent chose from five options measuring the dependent variable cloud adoption: "Not considering adoption of cloud computing", "Current evaluating", "Have evaluated, but do not plan to adopt this technology", "Have evaluated and plan to adopt this technology", and "Have already adopted services, infrastructure or platforms of cloud computing". The aspects influencing cloud adoption were measured using a five-point Likert scale on an interval level ranging from "strongly agree" = 5 to "strongly disagree" = 1. A tool called Survey Monkey was used to send out the survey. Survey Monkey is a cloud-based software as a service application. First, it is possible to answer the survey using either a phone or computer. Second, an email reminder was automatically sent out to individuals who did not respond and a thank you email was automatically sent out to respondents who answered the survey. The firms were not included in the survey to protect their anonymity in relation to their employers. To encourage people to participate in the study, all respondents were given the opportunity to receive the findings of the study, and they were informed that all responses were handled with full confidentiality. The size of the firms was measured based on number of employees. A small size company was measured between 10 and 50 employees, a mid-size company, between 51 and 250 employees, and a large company was measured as over 250 employees. These measures follow the European commission's measurements (European Commission, 2016). According to previous literature (e.g. Hair et al., 2016), the items measuring one construct should be at least three. In this study, the items stated in table 3 assumes to capture all the variables, therefore we rely on the items used to measure the constructs.

Table 3. Survey questions

Dimension	Construct	Items
Technological context	Relative advantage	RA1: Cloud computing reduces the IT expenses
		RA2: Cloud computing offers new business opportunities
	Security risks	SR: Degree of perceived risks of cloud computing regrading IT security
	Availability and QoS risks	AQ: Degree of perceived risks of cloud computing regrading availability and quality of service regarding internal data
	Risks of loss of control	LC: Degree of perceived risks of cloud computing regrading loss of control over IT infrastructure
	Compatibility	CM1: Cloud computing is difficult to integrate with existing IT systems
		CM2: The company has a clear and coherent digital strategy including how tech drives business goals and how it could be implemented
	Risks of vendor lock-in	VL: Degree of perceived risks of cloud computing regrading vendor lock-in
	Complexity	CO: The standardization of cloud computing is sufficient for deployment within the firm
Organizational context	Firm size	FS: The number of employees at the company
	Technological competence	TC: Degree of digital capabilities
	Network and collaboration	NC: Degree company uses cross-functional teams
	Top management support	MS: The company's top management understand the values of digital technologies to the organization's future
Environmental context	Competitive pressure	CP: Cloud computing is important in terms of competitive advantage for the firm
	Regulatory support	RE: The laws and regulations that exists nowadays are sufficient to protect privacy, access, and confidentiality in a cloud-based environment
	Trading partner support	PS: Support from provider and other trading partners are sufficient to build a cloud infrastructure according to the needs of the company
Cloud adoption	Stage of adoption	SA: At what stage of cloud adoption is your organization currently engaged (Not considering, currently evaluation (e.g. in a pilot study), have adopted, but not plan to adopt this technology, have evaluated, and plan to adopt this technology, have already adopted services, infrastructure, or platforms of cloud computing)
		Your firm's intention to migrate to the cloud ▪ Office automation ▪ IT-services support ▪ Human resources ▪ Enterprise resource planning ▪ Customer relationship planning ▪ Governance, risk, and compliance

Two ways of collecting data were carried out, first the online questionnaire was emailed to qualified respondents in the authors personal network, like CIOs, cloud architects, IT managers, and team leaders. Only people with an understanding of IT operations or have been part of the company's migration to the cloud were targeted as respondents as they have a better understanding of the company's digitalization. The questionnaire was sent out after first round telephone or email contact to confirm the respondent's commitment and intention to participate. If the questionnaire was not responded within two weeks, a second-round reminder was conducted accordingly. For those respondents claiming that they had either not received or lost the questionnaire, the questionnaire was sent again. After the data collection was finished, a thank you email was sent to express my appreciation. The survey was also posted in different cloud computing and technology groups on LinkedIn and Facebook (on Facebook: Teknikkvinnor, Microsoft Azure Group (Unofficial), Microsoft Azure, VMware Sverige, Teknikbubblan, Datavetenskap Uppsala, Women in Data Science – Sweden, Amazon Web Services (AWS) – cloud computing services. On LinkedIn: Amazon AWS Architects Engineers Developers Consultants Entrepreneurs Experts Web Services Cloud, Cloud Security Alliance, System Administrator (Windows Linux Unix Apple VMware Oracle EMC Cloud SAP SQL CRM Cisco ITIL SAN), Cloud Computing, Cybersecurity, SaaS & Virtualization, Office 365 | Microsoft 365 | Azure, The Virtualization & Cloud Computing Group, Google Cloud Developers Group, Microsoft Azure & Microsoft Cloud, Google Cloud Platform, AWS Cloud Computing (For Interested Parties & Users)). These groups include members that have an interest in cloud computing and want to discuss, share recommendations or ask for help about the topic. To get a representative sample for the population, the survey was sent to both general cloud computing groups as well as to specific groups for individual platforms. The questionnaire was posted a second time in groups where the responses were high from the first post to get a sufficient large sample. The data was also collected by snowball sampling where some of the participants also contacted other professionals in their network. For an example the non-profit organization Cloud Security Alliance with the mission to promote the use of best practices for providing security within clouds invited to their community, Circle where professionals working with cloud computing participated in the study. 91 valid responses were received out of approximately 1 million members in totally from all groups. All the questions in the survey had to be answered before submission, but with the possibility to opt-out on every categorical question. This led to 104 missing values.

3.3 Descriptive statistics

This section aims to describe the statistics of the variables in the collected data. As seen in table 4, the respondents are mainly working with Microsoft Azure in a hybrid cloud environment. 48 (~62%) of the respondents are working at a large company, 8 (~11%) of them are working at a mid-size company and 22 (~28%) are working for a small company. A majority of the participants have a higher position in the company, like chief executive officer, chief technology officer or IT manager but participants with more technical roles like cloud architects or software developers are also represented in the sample which can be seen in table 5. Furthermore, a majority are working in Sweden and United States, 38 respondents (~42%) are working in Sweden, and 22 respondents (~24%) are working in the US. Other respondents working in countries like United Kingdom, Norway, India and Finland are also represented in the sample. The sample is fairly evenly distributed across firm size and industry sector as seen in table 5.

Table 4. Sample characteristics (*N* = 91)

Deployment model			Cloud provider		
Community	3	3%	Amazon	20	22%
Hybrid	47	52%	Google cloud	6	7%
Private	23	25%	Microsoft Azure	36	46%
Public	12	13%	VMware	4	4%
			Multiple or other	15	16%

Table 5. Sample characteristics (*N* = 91) with number and percentage respondents

Industry			Role		
Construction	2	2%	CEO or director	6	7%
Government or public sector	7	8%	CFO	3	3%
Healthcare	7	8%	CIO	10	11%
High tech	18	20%	CISO	2	2%
Insurance and banking	5	6%	Cloud architect	16	18%
Manufacturing	7	8%	CTO	5	6%
Media & telecommunications	4	4%	IT manager	17	19%
Retail	10	11%	Software developer	11	12%
Service	14	15%	Team leader	5	6%
Other (e.g. pharma, rail, security, hardware, logistics)	16	18%	Other (e.g. R&D, enterprise architect)	16	18%

Office automation systems like Microsoft 365, email or videoconferencing and electronic collaboration are usually in the cloud (see table 6). A majority of the participants work for companies that already use office software tools in the cloud while ERP systems and governance, risk and compliance systems are not widely used in the cloud. But according to the responses, several companies plan to move these systems to the cloud in near future.

Table 6. Companies intention to migrate to the cloud

System	Not considering		Currently evaluating		Have evaluated, but not plan to migrate		Plan to migrate		Already adopted	
Office automation	13	14.44%	4	4.44%	5	5.56%	14	15.56%	47	52.22%
IT-services support	17	18.68%	6	6.59%	5	5.49%	15	16.48%	39	42.86%
Human resources	21	23.08%	5	5.49%	3	3.30%	17	18.68%	34	37.36%
ERP	14	15.38%	9	9.89%	4	4.40%	23	25.27%	28	30.77%
CRM	15	16.48%	7	7.69%	4	4.40%	18	19.78%	35	38.46%
Risk & compliance	19	20.88%	8	8.79%	6	6.59%	21	23.08%	23	25.27%

To measure whether the data follow a normal distribution, the Kolmogorov-Smironov test (K-S test) was applied using SPSS. When using the K-S test, the dataset is standardized and compared with a standard normal distribution. If the data is normally distributed, most of the data points are in the center with decreasing amounts evenly distributed to the left and right. In addition to the K-S test, the kurtosis and skewness of the data can be seen in table 5. If there is a skewed distribution, many data points would be above or less than the average value. If the skewness is less than -1 (negatively skewed) or greater than 1 (positively skewed), the data are highly skewed. Kurtosis is a measure of outliers present in the distribution. If there is a high kurtosis, it is an indicator that the data have many outliers and low kurtosis means that there is a lack of outliers. Kurtosis between -2 and +2 are considered acceptable in order to prove normal distribution. As seen in table 6, all questions except the question measuring the dependent variable cloud adoption are normally distributed. This variable's skewness is less than -1, which indicates that most of the companies in the sample plan to adopt or already adopted cloud computing. The K-S test confirmed that the data is not normally distributed, therefore an analysis method that handles non-normal distributed data was considered.

Table 6. Mean and standard deviation

Constructs	Mean	Median	Min	Max	Standard deviation	Kurtosis	Skewness
Relative advantage	3.885	4	1	5	1.028	0.826	-1.040
Security concerns	3.345	3	1	5	1.388	-1.218	-0.275
Availability and QoS	3.055	3	1	5	1.401	-1.304	-0.026
Risks of loss of control	2.758	2	1	5	1.425	-1.253	0.298
Compatibility	3.264	3	1	5	0.834	-0.652	0.127
Risks of vendor lock-in	3.440	4	1	5	1.268	-0.814	-0.421
Standardization	3.730	4	1	5	1.149	-0.291	-0.807
Firm size	2.303	3	1	3	0.892	-1.459	-0.643
Technological competence	3.714	4	1	5	1.17	-0.984	-0.468
Network and collaboration	3.805	4	1	5	1.183	-0.454	-0.714
Top management support	4.211	5	2	5	1.016	-0.054	-1.084
Competitive pressure	4.216	5	1	5	1.016	1.793	-1.44
Regulatory support	3.079	3	1	5	1.274	-1.244	-0.150
Trading partner support	3.674	4	1	5	1.058	0.030	-0.644
Cloud adoption	4.527	5	1	5	0.942	5.436	-2.369

3.4 Data analysis

Data were analyzed using the Partial Least Squares (PLS) method based on Structural Equation Modeling (SEM). The software tool smartPLS was used to assess the research model, which is a well-known software application for PLS-SEM. First-generation statistical methods such as factor analysis and regression analysis dominated the research landscape during the 1980s. But since the 1990s, second-generations methods such as PLS-SEM have been expanded. PLS-SEM is a multivariate analysis method which means that multiple variables are analyzed simultaneously. The variables typically represent measurements obtained from surveys or observations that are used to collect primary data. PLS-SEM allows estimation of complex models with many constructs and item variables. In this study, the model is relatively complex, there are 4 indirect effects on cloud computing (concerns regarding security, vendor lock-in, loss of control and availability). The use of PLS-SEM is therefore considered a good choice. Furthermore, the method allows for flexibility in terms of data requirements and specification of relationships between constructs and items. PLS-SEM is a non-parametric method that does not require that the data meet certain distributional assumptions (Vinzi et al., 2010). For example, the responses do not need to be evenly distributed across the 5-point scale. The K-S test confirmed that the data is not normally distributed, therefore we rely on the safe use of the PLS-SEM method. Moreover, PLS-SEM becomes a good alternative when sample size is small, applications have little available theory, or when correct model specification cannot be ensured (Bacon, 1999; Hwang et al., 2010; Wong, 2010). Even if the sample size could be small, prior research suggests that a sample size of 100 to 200 is usually a good starting point in carrying out path modeling (Hoyle, 1995). The size of the dataset in this study is 91, which is less than suggested but as the PLS-SEM method handles a small sample size, it is considered a good choice.

As PLS-SEM is a non-parametric method, the parametric significance test cannot be applied to test whether coefficients are significant. Instead, PLS-SEM relies on a bootstrap procedure (Davison and Hinkley, 1997; Efron and Tibshirani, 1994) to test the significance of various results. Bootstrapping is a method for creating multiple datasets (of size 91) out of one dataset (also of size 91). In bootstrapping, subsamples are randomly drawn observations from the original set of data with replacement, meaning that the resulting bootstrapped datasets may contain multiple copies of some of the original data points. Randomly picking data points from the original dataset is a way to simulate a new dataset. In statistical terms, instead of sampling from the population (collecting more data), we sample from the available data which assumes to provide a good representation of the population. The subsample is then used to estimate the PLS path model. Hair et al. (2011) suggest that the number of bootstrap samples should be 5000 and the size of subsamples should be the same as the number of valid observations. The number of bootstrap samples was set to 5000 accordingly and as the software package, SmartPLS was used, the size of the subsamples was set by default as number of valid observations. To investigate how the variables of cloud adoption differ between the systems companies move to the cloud, each system was analyzed separately. Totally seven analyses were conducted. One for the overall cloud adoption and one for each of the six specific systems, office automation, IT-services support, human resources, ERP, CRM and compliance, risk and governance systems.

Multicollinearity was tested to see if any variables should be eliminated or merged into one. Variance inflation factors (VIF) was used test multicollinearity, which measures how well the constructs and items predicts the dependent variable. VIF has a threshold of 5, and if there are no issues of collinearity, VIF is less than 5. The multicollinearity test could be seen in table 7, and as all VIF values are close to 1, there are no issues with multicollinearity.

Table 7. VIF values

Constructs	RA	SR	AQ	LC	CM	VL	CO	FS	TC	NC	MC	CP	RE	PS
VIF	1.85	1.9	1.93	1.63	1.29	1.00	2.33	1.17	1.52	1.38	1.31	1.99	1.42	1.93

3.5 Validity and reliability

In a survey, the question whether the results obtained are correct always arises, i.e. whether the questions measure some variable with certainty. Validity of a question involves the question's ability to measure what it is supposed to measure (Ejlertsson, 2014). There are several ways to validate the questions in a questionnaire, in this study four types of validity measures are being used: content, face, convergent and discriminant validity. The content validity measures whether the question is "correct" according to experts' judgement. The face validity does not require any expert knowledge, it rather measures whether the respondent understands the questions and how the questions are being asked. The questions in the questionnaire were validated by academics and professionals whose work focuses on cloud computing. They provided suggestions for changes in structure of some of the questions as well as removal of uncertainty. Many questions used were also adapted from previous studies.

Both convergent and discriminant validity are different subtypes of construct validity which means that the questions need to be an operationalization of the theoretical background. Convergent validity refers to the extent to which the items under each construct are measuring the same construct. To check convergent validity, each construct variable's Average Variance Extracted (AVE) was evaluated. If all AVE values are greater than the acceptable threshold of 0.5, convergent validity is confirmed (Bagozzi and Yi, 1988). The convergent validity assessment can be seen in table 9, as all AVE values are greater than 0.5, convergent validity is established.

The discriminant validity refers to the degree the constructs differ from each other. The Fornell-Larcker criterion (1981) and the examination of cross-loadings (Chin, 1998) have been the traditional approaches for evaluating discriminant validity. But according to several recent studies (e.g. Henseler et al., 2015) neither of these criterions allow users of PLS-SEM to determine discriminant validity of their measures. Henseler et al., (2015) proposed a new approach to assess the discriminant validity in PLS-SEM, called heterotrait-monotrait ratio (HTMT) of correlations. The HTMT approach is an estimate of the correlation between the constructs. If the HTMT value is smaller than one, the true correlation between the two constructs is most likely different from one, and they should differ. Using HTMT as a criterion involves comparing it to a threshold. If the HTMT is higher than this threshold, there is a lack of discriminant validity. The threshold whether there is a correlation or not is debatable, some authors propose a threshold of 0.85 (Clark and Watson, 1995; Kline, 2015) and others suggest a value of 0.9 (Gold et al., 2001; Teo et al., 2008). When using the bootstrapping procedure, the confidence intervals should contain values distinct from 1, otherwise there is a lack of discriminant validity. As shown in table 8, discriminant validity is not established between compatibility (CM), complexity (CO), loss of control (LC) and management support (MS) as they have HTMT values higher than 0.9. Reliability was tested to understand whether one variable could be removed or merged into one.

Table 8. Discriminant validity test using the HTMT approach

Constructs	RA	SR	AQ	LC	CM	VL	CO	FS	TC	NC	MS	CP	RE	PS	SA
RA															
SR	0.287														
AQ	0.302	0.649													
LC	0.457	0.558	0.568												
CM	0.866	0.563	0.535	1.184											
VL	0.487	0.499	0.487	0.612	0.698										
CO	0.531	0.319	0.287	0.366	1.146	0.158									
FS	0.092	0.250	0.108	0.056	0.192	0.104	0.101								
TC	0.129	0.228	0.124	0.226	0.820	0.026	0.448	0.158							
NC	0.107	0.082	0.073	0.098	0.489	0.012	0.117	0.075	0.360						
MS	0.146	0.049	0.044	0.076	1.002	0.017	0.352	0.099	0.285	0.261					
CP	0.728	0.251	0.311	0.394	0.517	0.314	0.449	0.141	0.079	0.099	0.115				
RE	0.367	0.321	0.362	0.349	0.493	0.212	0.531	0.092	0.149	0.107	0.276	0.728			
PS	0.407	0.398	0.420	0.414	0.831	0.218	0.611	0.032	0.322	0.017	0.274	0.475	0.436		
SA	0.354	0.202	0.297	0.249	0.400	0.130	0.243	0.248	0.237	0.274	0.111	0.503	0.151	0.394	

Reliability involves whether repeated measures give the same result. If the reliability is high, the random error is low (Ejlertsson, 2014). Two reliability parameters were checked, item and internal consistency reliability. The item reliability describes the relationship between the constructs and their items, e.g. how well the two items RA1 and RA2 measure the construct relative advantage. The item reliability is obtained by the square of the item loadings. Many researchers accept items with loadings of 0.7 or more (e.g. Carmines and Zeller, 1979). Hulland (1999) suggested that all the individual item reliability values should be much larger than the minimum acceptable level of 0.4 and close to the preferred level of 0.7. The item reliability assessment can be seen in table 9, all values except the construct compatibility are close to 0.7. This indicates that the items of this construct do not measure compatibility sufficient well and need to be moved out or removed.

Internal consistency reliability is also measured to get a picture of how good the questions included in the construct are related to each other, and the reliability of the scale. Traditionally, Cronbach's Alpha has been used to measure internal consistency reliability of a survey, but it tends to provide a conservative measurement in PLS-SEM. Prior literature have suggested to use the composite reliability (CR) as a replacement. The composite reliability should be 0.7 or higher (Bagozzi and Yi, 1988; Hair et al., 2012). Maximum value is 1 which means that the questions ask the same thing, e.g. everyone is responding the same thing. A value of 0 indicates that there is no correlation at all between the questions in the construct. The internal consistency reliability could be seen in table 9, and all values except the difficulty to integrate cloud in existing IT infrastructure and digital strategy are close to 0.7 or higher. This is consistent with the HTMT test and the composite reliability.

Table 9. Reliability

Constructs	CR	AVE	Items	Item reliability
Relative advantage	0.862	0.758	Reduces costs	0.949
Compatibility	0.452	0.504	Business opportunities	0.915
			Difficult to integrate	1.000
			Digital strategy	-0.308

Note: composite reliability (CR) and average variance extracted (AVE)

As the validity tests and reliability tests indicated that there was an issue with the construct compatibility (CM). The items CM1 (whether it is difficult to implement cloud) and CM2 (digital strategy) were moved out to meet the required thresholds. When moving out the items all tests showed that validity and reliability are established. The construct vendor lock-in (VL) was assumed to have an impact on CM1 in further analysis.

4. Result

The analysis of hypotheses is based on the examination of the standardized paths and the result is summarized in table 10, 11 and 12. Path coefficient values are standardized on a range from -1 to +1, where coefficients close to +1 represent strong positive relationships and coefficients close to -1 represent strong negative relationships.

For the overall cloud adoption (see table 10), the PLS-SEM analysis of the measurement model using smartPLS result in an adjusted r-squared value of 0.372. This indicates that about 37 percent of the variance in companies' intention to adopt cloud computing is explained by the constructs in the research model. Security concerns, concerns regarding availability and quality of service, and loss of control explain 12 percent of the relative advantage of cloud computing. Concerns regarding vendor lock-in explain 20 percent of the compatibility of cloud computing. The hypothesis network and collaboration (H6) is confirmed at 0.01 statistically significance level ($p < 0.01$), indicating 1 percent risk that the hypothesis will be rejected. Competitive pressure (H8) is also confirmed at the 0.01 significance level ($p < 0.01$). Trading partner support (H10) is confirmed at the 0.05 significance level ($p < 0.05$), indicating that the likelihood of rejecting the hypothesis is 5 percent. Thus, these aspects influencing cloud adoption reflects the whole population. The hypothesis for firm size (H4) is significant at the 0.05 level ($p < 0.05$) but show a positive relationship between large firms and cloud adoption, indicating that larger firms will more likely adopt cloud computing. For the effects on relative advantage and compatibility, concerns regarding loss of control (H1c) ($p < 0.01$) are confirmed. The aspect regarding vendor lock-in (H2a) ($p < 0.01$) is also significant and confirmed as the relationship between concerns regarding vendor lock-in and compatibility is positive. This indicates that individuals with concerns regarding vendor-lock tend to perceive it difficult to integrate cloud computing in existing IT infrastructure. The indirect effect of these aspects on cloud computing are not statistically significant.

Table 10. Results from structural model

Constructs	Path coeff.	T-value		Path coeff.	T-value
Relative advantage	-0.041	0.370	*Factors of relative advantage:*		
Security concerns	0.000	0.023	Security concerns	-0.013	0.095
Availability and QoS	-0.051	0.314	Availability and QoS	-0.051	0.328
Risks of loss of control	0.010	0.220	Loss of control	-0.346***	3.172
Digital strategy	-0.134	1.316	*Factors of compatibility:*		
Difficult to integrate	-0.066	0.635	Vendor lock-in	0.461***	5.890
Risks of vendor lock-in	-0.038	0.809			
Standardization	-0.135	0.974			
Firm size	0.165**	1.985			
Technological competence	0.155	1.349			
Network and collaboration	0.272***	2.538			
Top management support	0.0265	0.215			
Competitive pressure	0.455***	3.833			
Regulatory support	-0.030	0.293			
Trading partner support	0.245**	2.292			
$R^2 = 0.372$					

* Significance at $p < 0.10$

** Significance at $p < 0.05$

*** Significance at $p < 0.01$

Next, six individual analyses were made by separating the systems the company intend to move to the cloud as dependent variables. The model was re-run six times based on office automation, IT-service support, HR, ERP, CRM and governance, compliance and risk systems. The purpose was to understand whether the aspects will influence the type of systems the company migrate to the cloud as different systems could be more challenging than another and require different factors.

The results show that the research model explains 31 percent of the cloud adoption for office automation systems (see table 11). Concerns regarding security, availability and quality of service, and loss of control explain 12 percent of the relative advantage of cloud office automation adoption. Concerns regarding vendor lock-in explain 20 percent of the compatibility of cloud office automation adoption. The hypotheses for digital strategy (H2) ($p < 0.01$), standardization (H3) ($p < 0.05$), and trading partner support (H10) ($p < 0.01$) are confirmed. Indicating these aspects influence firm's cloud adoption of office automation systems.

For the cloud adoption of IT-service systems, the adjusted r-squared value is 0.265. The sub-constructs of relative advantage explain 12 percent of the relative advantage. The sub-construct of compatibility explains 20 percent of the compatibility. The hypotheses for competitive pressure (H8) ($p < 0.10$), digital strategy ($p < 0.10$), and trading partner support (H10) ($p < 0.05$) are confirmed. Firms with competitive pressure, digital strategy and sufficient trading partner support will therefore more likely migrate IT-service systems to the cloud.

The analysis of cloud HR system adoption shows an adjusted r-square value of 0.124. The sub-constructs of relative advantage explain 12 percent of the relative advantage. The sub-construct of compatibility explains 20 percent of the compatibility. The hypotheses for digital strategy (H2) ($p < 0.10$) and trading partner support (H10) ($p < 0.05$) are confirmed. This shows that firms with a digital strategy and sufficient support from trading partners like cloud providers or consultancy firms will more likely adopt cloud computing.

Table 11. Results from model with cloud system (office automation, IT-service support and HR) adoption

Constructs	Office automation		IT-service support		Human resources	
	Path coeff.	T-value	Path coeff.	T-value	Path coeff.	T-value
Relative advantage	-0.081	0.598	0.090	0.693	-0.071	0.437
Security concerns	0.001	0.047	-0.001	0.057	0.001	0.041
Availability and QoS	0.004	0.149	-0.004	0.159	0.004	0.111
Risks of loss of control	0.028	0.566	-0.031	0.600	0.025	0.414
Digital strategy	0.294***	2.689	0.186*	1.683	0.252*	1.931
Difficult to integrate	-0.130	1.019	-0.029	0.287	0.066	0.569
Risks of vendor lock-in	-0.059	0.995	-0.013	0.283	0.035	0.645
Standardization	-0.366**	2.329	-0.099	0.639	-0.059	0.341
Firm size	-0.029	0.290	0.072	0.795	0.174	1.632
Tech. competence	-0.009	0.071	0.034	0.310	-0.011	0.083
Network and collaboration	-0.090	0.8301	0.153	1.411	0.039	0.315
Management support	0.049	0.383	-0.065	0.544	0.008	0.053
Competitive pressure	0.175	1.217	0.279*	1.851	0.156	0.812
Regulatory support	-0.066	0.656	0.141	1.228	-0.042	0.348
Trading partner support	0.485***	4.077	0.242**	1.979	0.328**	2.170
	$R^2 = 0.309$		$R^2 = 0.265$		$R^2 = 0.124$	

* Significance at p < 0.10

** Significance at p < 0.05

*** Significance at p < 0.01

The model explains 32 percent of the cloud ERP adoption and the sub-constructs of relative advantage and compatibility explain 12 percent, respective 20 percent (see table 12). The hypotheses for network and collaboration (H6) ($p < 0.05$), competitive pressure (H8) ($p < 0.05$), and trading support (H10) ($p < 0.01$) are confirmed. Firms with cross-functional teams, competitive pressure and sufficient trading support will therefore more likely migrate ERP systems to the cloud.

The model explains 19 percent of cloud CRM adoption. Concerns regarding security, availability and quality of service, and loss of control explain 12 percent of the relative advantage of cloud office automation adoption. Concerns regarding vendor lock-in explain 20 percent of the compatibility of cloud office automation adoption. The hypotheses for digital strategy (H2) ($p < 0.10$), competitive pressure (H8) ($p < 0.05$), and trading partner support (H10) ($p < 0.10$) are confirmed. This verifies that firms with a clear and coherent digital strategy, competitive pressure and support from trading partners will more likely migrate CRM systems to the cloud.

The model explains 29 percent of the cloud governance, risk and compliance adoption. The sub-constructs of relative advantage and compatibility explain 12 percent, respective 20 percent. The hypotheses for competitive pressure (H8) ($p < 0.01$) and trading partner support (H10) ($p < 0.10$) are confirmed. All of the different cloud systems adoptions have one confirmed hypothesis in common, concerns regarding loss of control which is significant at the 1 percent level in all cases. Concerns regarding vendor lock-in is also significant and the relationship is positive for all systems.

Table 12. Results from model with cloud system (ERP, CRM, and governance, risk and compliance) adoption

Constructs	ERP		CRM		Risk and compliance	
	Path coeff.	T-value	Path coeff.	T-value	Path coeff.	T-value
Relative advantage	-0.050	0.379	-0.050	0.402	0.126	1.165
Security concerns	0.001	0.029	0.001	0.058	-0.002	0.067
Availability and QoS	0.003	0.117	0.003	0.126	-0.007	0.261
Risks of loss of control	0.017	0.355	0.024	0.488	-0.044	0.983
Digital strategy	0.113	1.061	0.242*	1.824	0.191	1.496
Difficult to integrate	0.045	0.444	-0.040	0.371	0.002	0.024
Risks of vendor lock-in	0.021	0.442	-0.019	0.359	0.006	0.118
Standardization	0.067	0.425	-0.043	0.271	-0.222	1.531
Firm size	0.124	1.196	0.100	0.927	0.034	0.340
Technological competence	0.018	0.160	0.008	0.054	0.118	0.902
Network and collaboration	0.198**	1.942	0.079	0.653	0.120	1.227
Top management support	0.014	0.119	-0.052	0.405	-0.041	0.325
Competitive pressure	0.275**	1.942	0.337**	2.138	0.328***	2.760
Regulatory support	-0.049	0.460	-0.036	0.311	-0.036	0.312
Trading partner support	0.353***	3.160	0.239*	1.703	0.349***	3.247
	$R^2 = 0.319$		$R^2 = 0.192$		$R^2 = 0.290$	

* Significance at $p < 0.10$

** Significance at $p < 0.05$

*** Significance at $p < 0.01$

5. Discussion

The purpose of this study is to evaluate which aspects that influence cloud adoption. Cloud computing is a broad subject, which makes it necessary to examine aspects influencing companies' adoption of cloud computing from several perspectives. Thus, this study is based on technology characteristics of cloud computing combined with the organizational, and environmental context. The results from the analysis indicate that six factors influence cloud adoption, firm size, network and collaboration, competitive pressure, trading partner support, digital strategy, and standardization.

5.1 Technological context

In this study the technological context is combined with innovation characteristics, including four factors: relative advantage, how difficult cloud computing is to integrate in existing IT infrastructure, digital strategy and standardization of cloud computing. Two of these factors show to influence cloud adoption, standardization and digital strategy. Furthermore, loss of control shows to influence the relative advantage of cloud computing, and vendor lock-in shows to influence the compatibility of cloud computing.

Firms with a clear and coherent digital strategy including how tech drives business goals and how it could be implemented indicate to influence cloud adoption. This applies to companies migrating office automation to the cloud, but also companies migrating CRM, office automation, IT-service support, and human resource systems to the cloud. A majority of the participants work for companies that already use office automation software in the cloud, an integrated digital strategy could be an explanation to this.

Individuals that perceive the standardization of cloud computing as sufficient for deployment within the firm negatively influence cloud office automation adoption. In other words, companies that migrate office automation systems to the cloud and where the users perceive the standardization is sufficient would less likely adopt cloud. Different cloud providers offer different levels of standardization and flexibility. For companies migrating office automation systems to the cloud, more flexibility to customize the solution might therefore influence companies' cloud adoption. Aspects like flexibility and customization is not included in this study but can be examined in future studies.

Similar to two previous studies (Gutierrez et al., 2015; Hsu et al., 2014), the results show that relative advantage of cloud computing do not influence cloud adoption. But according to a majority of previous studies on cloud adoption, relative advantage is an aspect driving adoption of cloud computing (Gangwar et al., 2015; Low et al., 2011; Oliveira et al., 2014, 2014; Sabi et al., 2016; Senyo et al., 2016). In this study, cost reduction and business opportunities are considered as benefits of cloud computing. The result is inconsistent with, Hsu et al. (2014) who found that cost reduction influence cloud adoption in the ICT industry in Taiwan and Oliveira et al. (2014) that confirmed cloud computing as relatively advantageous if it provides cost savings in the manufacturing industry. One possible explanation for the insignificance of the benefits might be the awareness of the benefits by both non-adopter and adopter firms. A majority of the participated professionals perceive that the use of cloud computing offers new business opportunities and reduces IT expenses. Non-adopters might therefore recognize these benefits but due to other limitations a migration might not be possible.

The result also shows that the degree of how difficult cloud computing is to implement does not influence cloud adoption. This is somewhat consistent with Borgman et al. (2013) who evaluated cloud adoption across various industries, Low et al. (2011) in the high tech industry in Taiwan, and Sabi et al. (2016) in educational establishments in developing countries. One explanation could be that users might perceive the implementation as easy. Support from the cloud provider or other secondary suppliers, helping companies migrating to the cloud could be another explanation.

Individuals' concerns regarding security, loss of control, availability and quality of service (QoS) were assumed to negatively influence the perception of the relative advantage of cloud computing. The results show that loss of control influence the perception of the advantages of cloud computing relative the technology it replaces. While availability, QoS and security concerns do not influence the relative advantage of cloud computing. This is consistent with previous studies, Oliveira et al. (2014), and Sabi et al. (2016) also evaluated the security risks when adopting cloud computing and showed that security risks do not influence cloud adoption. Today, cloud computing is reliable and secure. The data is replicated, meaning the data is copied and stored three times, resulting in high availability. There is also a built-in fault tolerance and disaster recovery in a cloud-based environment. If one component fails, another takes over ensuring that the user is not impacted when disaster occurs.

Vendor lock-in was expected to influence the perception of how difficult cloud computing is to integrate with existing IT infrastructure. The results show that individuals with concerns regarding interoperability will more likely perceive cloud computing as difficult to integrate with existing IT infrastructure. Thus, companies that already have an IT system from a supplier different from their cloud provider might perceive cloud computing as difficult to integrate. For example, if one company has Microsoft Office installed within the organization and then decide to use AWS, would more likely perceive the cloud solution as difficult to integrate within the firm.

5.2 Organizational context

The organizational context includes aspects related to characteristics of the company. Here, firm size, network and collaboration, support from top management and technical competence were expected to influence cloud adoption. Two of these factors, firm size, and network & collaboration show to influence adoption of cloud adoption.

Small and mid-size companies were anticipated to use cloud computing more than large firms, but the results show a positive relationship between larger firms and cloud adoption. This applies to overall cloud adoption which is consistent with previous studies (Alshamaila et al., 2013; Low et al., 2011; Oliveira et al., 2014). Larger firms-have more resources and financial support and would more likely survive failures than smaller firms (Zhu et al., 2003) and would therefore more likely invest in cloud services. It is consequently possible to question whether the costs are beneficial for small companies, start-ups or companies in developing countries. The costs are initially advantageous as the companies do not need to buy the hardware but possibly not in the long run. Many cloud service providers use a pricing model where the users get discounted prices by paying in advance, between one to three years. This forces users to sign up for a long-time subscription.

Network & collaboration is measured by the degree of cross-functional teams used by the company. The results indicate that high level of cross-functional teams positively influence cloud adoption. This is also specifically applied to cloud ERP adoption. An ERP system includes several integrated applications used to collect, store, manage, and interpret data from many business activities. Collaboration between teams with members from different functional areas in the organization such as business and technology are therefore essential for migrating an ERP system to the cloud.

Top management with leaders who understand the values of digital technologies to the organization's future were expected to influence cloud adoption. Similar to two other studies (Gutierrez et al., 2015; Oliveira et al., 2014), the results show no correlation between this aspects and cloud adoption. A majority of the respondents perceive that the company's top management understand the values of digital technologies to the organization's future. Today, leaders may be more aware of the benefits of technologies, that IT can create value beyond cost benefits to include faster speed to market and create new business opportunities.

Similarly, digital capabilities such as skills, education and experience within cloud computing were also expected to influence cloud adoption. Even if a majority of the participated companies use hybrid cloud environments, the digital capabilities is not a requirement for cloud adoption. A hybrid deployment model includes more complex implementation and could require more technical skills and expertise than a public cloud. The digital capabilities would therefore have an impact on enterprises likelihood to use cloud. But these digital capabilities to implement, maintain and use cloud computing might not be as important for cloud adoption since companies can utilize cloud providers' or consultancy firms' knowledge and support. Trading partner support make the technical competence within the firm less critical for a successful cloud adoption. Furthermore, there are companies today that offer products and services such as ERP systems where their tools are based on a cloud environment. Their customers, in turn, receive a ready-made platform where they need less knowledge of the underlying technology, but they are still utilizing cloud. This is related to the benefits of cloud computing, since users of cloud computing are outsourcing the technology, companies are freeing technical and human resources and instead focus on its real business core (Trigueros-Preciado et al., 2013).

5.3 Environmental context

The environmental context consists of aspects of the environment in which the company operates. Here, competitive pressure, regulatory support and provider support were expected to influence cloud adoption. In this study, the results show that two of these aspects influence companies' likelihood to adopt cloud computing, competitive pressure and trading partner support.

Firms operating in an environment with competitive pressure will more likely adopt cloud computing, indicating that migration to the cloud could be a way of gaining competitive advantage. This is similar with previous studies (Gangwar et al., 2015; Gutierrez et al., 2015; Hsu et al., 2014; Low et al., 2011; Senyo et al., 2016; Zhu and Kraemer, 2005). Different from other studies, this study shows that competitive pressure is particularly a driver for firms migrating ERP, CRM and governance, risk and compliance systems to the cloud. Competitive pressure forces firms to move these systems to the cloud to retain the competitive advantages as other similar firms already adopted. A majority of the participants work for companies that plan to migrate ERP and governance, risk & compliance systems to the cloud in the near future, an increased competitive pressure could be an explanation to this.

Sufficient support from trading partners is a driver that is shared among all systems. This is similar to previous studies, Alshamaila et al. (2013), Gangwar et al. (2015), and Low et al. (2011) who found that trading partner support drives cloud adoption. This is somewhat related to the digital competences; technical competence is not an aspect driving cloud adoption which could be explained by the support from trading partners. Companies take advantage of knowledge and support from the new vendors without putting new workloads to the teams. External support has several advantages over internal support, first, enterprises do not need to maintain expensive internal staff when the implementation is completed, and maintenance is infrequent. Second, they do need to provide ongoing training for the IT staff to keep up with the emerging technology. Third, companies do not need to hire new specialist required for the implementation (Simon, 1985).

In addition, the results show that support from regulatory environment like laws and regulation including the use cloud computing do not influence cloud adoption. This is similar to Hsu et al. (2014), Oliveira et al. (2014), and Senyo et al. (2016). One possible explanation could be that early adopters and companies that already adopted cloud computing share the same perspectives on support from regulatory environment. Around 40 percent of the respondents perceive that the laws and regulations that exist nowadays are not sufficient to protect privacy, access, and confidentiality in a cloud-based environment while 47 percent consider it sufficient. In other words, there is a great variation in the professionals' perspectives. As a majority of the participants work for a company that already have adopted cloud computing, firms might move to the cloud even if they believe that the laws are insufficient. It could also be an issue they did not realize before they migrated. The results reflect the inconsistency of requirements. For example, GDPR ensures to protect privacy and personal data in EU while the US law, Cloud Act implies that US authorities should be given access to data, regardless of where the data is located. US-based service providers for that reason cannot refuse to disclose such data. These providers and cloud users face difficulties in meeting this obligation (Abraha, 2019). Some cloud providers are keeping up with the regulatory environment making it easier for firms to meet the compliance and security requirements.

5.4 Research and practical implications

This study contributes to the existing literature about cloud adoption. The environmental factors have greatest impact on companies' intention to migrate to the cloud. Trading partner support and competitive pressure are currently the most important drivers for cloud adoption. This could be explained by the nature of cloud computing and the development of the technology. Cloud computing is a business model where users pay for what they use and has developed to be a service or product that companies rent on a monthly basis from mainly two big cloud providers. These players have created platforms that companies can utilize without the need to spend time or money developing or installing cloud computing from scratch. The cloud providers have utilized economies of scale to boost their market shares. This makes the exchange of knowledge between the users and the cloud providers essential and the users might depend on these providers support. The service providers need to train and certify people quickly to satisfy the needs for skilled cloud professionals. But can these service providers keep pace with the market trends and the increased pressure to adopt cloud computing?

This is related to the risks of vendor lock-in, which shows to be the most important aspect influencing practitioners' negative perception of cloud. Concerns regarding vendor lock-in and loss of control are factors that have an impact on the perception of cloud computing and the ease of use of cloud computing. When relying on one provider, companies might lose the control over the underlying infrastructure. The hardware is not owned by the users in a cloud-based environment which could decrease the visibility on what is happening at the hardware level. The risks of vendor lock-in could be related to hybrid clouds. A majority of the participants are using hybrid clouds and according to Dillon et al. (2010) hybrid clouds have raised the issues with interoperability. But around 15 percent of the participant are using multicloud strategies, in other words, they are working with several cloud providers. These strategies could probably reduce vendor dependency, making it easier to move applications and take advantage of multiple clouds.

This study also provides a new approach within studies about cloud adoption. The study evaluates whether some aspects are more important for specific IT systems the companies intend to move to the cloud. For example, digital strategy is an aspect that have not been widely evaluated before and which shows to have an impact on cloud adoption in this study. In particularly for companies migrating office automation systems to the cloud, which a majority of the companies are using in the cloud. The degree of cross-functional teams was also tested and shows to have an impact for the overall cloud adoption but especially for companies moving ERP systems to the cloud. This is a new aspect in the existing literature on cloud adoption. Although further research is needed to achieve a more comprehensive understanding regarding cloud system adoption, this study shows that cloud adoption requires specific requirements that are dependent on the system companies are moving to the cloud.

The result will also contribute to the development of a research model used to evaluate cloud computing adoption. It will also contribute to the existing literature on cloud computing by empirical evidence from several perspectives in several countries and industries. This provide a valuable background for potential adopters of cloud computing in their journey towards the cloud. It could potentially help them in their decision-making process to successfully migrate to the cloud. The findings also provide valuable information for cloud service providers and other professionals in their cloud computing projects.

6. Conclusion

This study aims to determine the factors that influence the adoption of cloud computing in several countries and industries. Aspects within the pillars of the TOE and DOI framework was investigated to understand which factors that influence cloud adoption. These aspects were derived from previous literature about cloud adoption and cloud computing. Based on available data, trading partner support is the most significant factor. Cloud providers and secondary suppliers play an important role for companies migrating to the cloud. In addition, the findings show that the aspects differ between the system companies intend to move the cloud. Competitive pressure shows to drive companies moving ERP, CRM and risk, compliance and governance systems to the cloud. The findings also show that a digital strategy could be a prerequisite for companies moving office automation systems and CRM systems to the cloud.

6.1 Limitations and future research

This study is not conducted without limitations. An insufficient sample size may not reveal a significant effect that exist in the underlying population. Here, 91 respondents were received and according to previous literature, the sample size should be between 100 and 200 (Hoyle, 1995). There could consequently be significant aspects in the population that are not revealed here. Furthermore, reliability and validity were not initially established, a pilot testing of the questionnaire would have provided initial support for the model’s constructs and items. For example, the survey could initially be sent out to 20 people to test whether any of survey questions had to be removed or changed. Moreover, data was collected from members in LinkedIn and Facebook groups and as their companies where not included in the survey, the participants could be working for the same company. But as the study investigates individuals' perception and conception of cloud computing this would not have any effect on the findings. From another perspective, the professionals in these groups might not be representative for cloud adopters in general. The result is based on a sample where a majority of the individuals are working for companies that operate in Sweden and United States. Furthermore, around 50 percent use a hybrid cloud. The sample could therefore possibly not be representative for the world-wide cloud users and for all deployment models. However, this might not be the case, some service providers claim that a public cloud is the most common deployment model (Microsoft, n.d.) but maybe the development has changed towards more hybrid cloud environments.

For future research about cloud adoption it would be interesting to investigate specific service model adoptions, for example if there is a difference between cloud SaaS adoption or PaaS. There is one previous study about SaaS adoption (Safari et al., 2015) but future studies could investigate specific service model adoptions and test other more specific characteristics of these different models. For example, in a PaaS or SaaS solution the provider manages the virtualization, servers, storage and networking while the users have fully control over these layers in an IaaS solution. The concerns regarding loss of control could therefore be more widely spread among enterprises using PaaS and SaaS solutions.

In this study the sub-sample size for each deployment model were too small but future studies could investigate these further. As the factors that influence cloud adoption probably varies between these different deployment and service models, they could be analyzed separately. We were also hoping to investigate the difference between the cloud providers. Whether the aspects influencing cloud adoption differ between companies using AWS, Azure, or Google. A company can also choose different cloud providers. According to Armbrust et al. (2009) the providers' different offerings could be distinguished between the level of abstraction presented to the programmer and the level of management of the resources. Amazon is at one end of the spectrum. Users can control the entire software, from kernel upwards that allows developers to code whatever they want. On the other hand, management issues are highly application dependent. On the other end of the spectrum is Google. They target exclusively traditional web applications and enforce a structure of the application which makes it less convenient for the programmer. Microsoft's Azure is in-between this spectrum of flexibility and programmer convenience. The system supports general-purpose computing, rather than a single category of application.

The environmental context in the TOE framework showed to be the most important aspects, further research could investigate this dimension by including more factors influencing cloud adoption. Similarly, digital strategy was a new factor for this research field, future studies could investigate this aspect further. For example, could different cloud strategies mitigate the risks of vendor dependency or loss of control. Furthermore, companies are migrating back from the cloud. According to Rogers (1983) organizations in the final stage, *confirmation* of the innovation-decision process could decide to reverse the decision to adopt. The confirmation stage continues after the decision to adopt for an indefinite period of time. It would therefore be interesting to study factors that influence companies' decisions to move back from the cloud.

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