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**PERCEIVED SUCCESS FACTORS AFFECTING HYBRID
CLOUD ADOPTION**



JYVÄSKYLÄN YLIOPISTO
INFORMAATIOTEKNOLOGIAN TIEDEKUNTA
2022

TIIVISTELMÄ

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Hybridipilven käyttöönottoon vaikuttavat menestystekijät

Jyväskylä: Jyväskylän yliopisto, 2022

Tietojärjestelmätiede, pro gradu -tutkielma

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Tässä tutkimuksessa tutkitaan hybridipilviratkaisun käyttöönottoon vaikuttavia menestystekijöitä case-tutkimuksen ja kirjallisuuskatsauksen keinoin. Tutkimuksessa selvitetään myös mihin organisaatiot haluavat päätyä, kun he ottavat käyttöön hybridipilviratkaisun, esimerkiksi, onko tavoitteena siirtyä kokonaan julkipilveen vai jäädä hybridipilveen. Haastattelut tehtiin kirjallisuuskatsauksen jälkeen. Tutkimuksessa haastateltiin case -organisaation pilviarkkitehteja ja pilviasiantuntijoita sekä yhtä case -organisaation asiakasorganisaatiota. Case -organisaatio on auttanut asiakasorganisaatiota hybridipilven käyttöönotossa ja siirtymässä julkipilveen.

Hybridipilven käyttöönottoon ajavat useimmiten koettu hyöty julkipilven tarjoamista ratkaisuista, joiden koetaan tuovan liiketoimintaetua kilpailijoihin nähden. Joillakin organisaatioilla hybridipilvi on välivaihe siirtymässä julkipilveen mutta toisissa organisaatioissa hybridipilvi on tarkoitettu tai jää olosuhteiden pakosta lopulliseksi tilaksi. Hybridipilveen jäämiseen vaikuttavat esimerkiksi datan turvallisuusluokitus, datan sijaintiin liittyvät vaatimukset ja vanhojen palveluiden siirtämisen koettu vaikeus.

Kirjallisuuskatsauksessa havaitut menestystekijät osoittautuivat haastattelujen perusteella edelleen ajankohtaisiksi. Ainoa menestystekijä, jota kirjallisuudesta ei löytynyt mutta joka ilmeni useammassa haastattelussa, oli dokumentaation tärkeys hybridipilven käyttöönotossa.

Tutkimus tuo uutta tietoa hybridipilven käyttöönottoon liittyvään tutkimukseen ja voi toimia pohjana jatkotutkimukselle. Hybridipilven tutkimusta pitäisikin tehdä lisää, sillä se on yhä useammin tila, josta organisaatiot itsensä löytävät kun he ottavat kiihtyvästi julkipilviratkaisuja käyttöön olemassaolevia ratkaisuja korvaamaan tai näiden tueksi.

Asiasanat: hybridipilvi, pilvipalvelu, teknologian käyttöönotto, julkipilvi

ABSTRACT

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Perceived success factors affecting hybrid cloud adoption

Jyväskylä: University of Jyväskylä, 2022

Information Systems, Master's Thesis

Supervisor(s): Laatikainen, Gabriella & Koskelainen, Tiina

In this thesis, a case study has been carried out to identify the perceived success factors of hybrid cloud adoption. To support the case study a literature review was done as well. It is also investigated what the end goal for companies that have adopted a hybrid cloud model is, whether they want to stay in a hybrid cloud or for example move entirely into a public cloud. After reviewing the literature, interviews were carried out. The interviewees were cloud architects and cloud experts from a chosen case company. Additionally, the CIO of a customer organization of the case company was interviewed. The case company has helped the customer organization in adopting hybrid cloud and in their transition towards public cloud.

Based on the results, hybrid cloud adoption is primarily driven by perceived relative advantage, that public cloud offers. The public cloud is believed to bring competitive advantage towards competitors. For some organizations hybrid cloud is a transient state on the way towards public cloud. In other organizations hybrid cloud is meant to be the final state of the IT environment either because of a strategic decision or because of forcing circumstances. Whether or not an organization stays in hybrid cloud is affected by data security rating, requirements regarding data location and difficulty of moving legacy services.

The success factors found in literature were proven to still be relevant. The only success factor that was not found in literature was the importance of good documentation in hybrid cloud adoption projects, which multiple interviewees mentioned.

The thesis contributes to the theory and practice by shedding light on success factors that are related to adopting hybrid cloud computing and can work as a basis for more research into the topic. With public cloud adoption on the rise, hybrid cloud is a state where more and more organizations find themselves. More research into the topic is required as hybrid cloud will likely only be more ubiquitous in the future.

Keywords: hybrid cloud, cloud computing, technology adoption, public cloud

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1 INTRODUCTION

Cloud computing refers to different types of services and applications being delivered on the internet (Khan & Ullah, 2016). The National Institute for Standards and Technology defines cloud computing as being a “model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources that can be readily provisioned and released with minimal management effort or service provider interaction” (Mell & Grance, 2011, page 6). The large improvements in processors, virtualization technology, data storage and networking have combined to make cloud computing a more compelling paradigm (Mithila & Kumar, 2011) to the point where currently most companies use at least some form of cloud computing.

Cloud computing can be used in multiple situations. A very common use case for cloud computing in organizations is e-mail services. For example, an organizations’ Office 365 e-mail service might be running on an Exchange server that is hosted in a data center outside of the organization, in a private cloud environment. This simply means that instead of having a data center on the premises of the organization, they are outsourcing the necessary computing resources to a service provider. The company is usually connected to the service providers data center with a virtual private network and therefore the company only sees the service that they are receiving “in the cloud”, i.e., they do not have access to the physical hardware on which the service is running.

There are three service models of cloud computing: Software as a Service (SaaS), Platform as a Service (PaaS) and Infrastructure as a Service (IaaS) (Mell & Grance, 2011). These service models express the level of abstraction of a service and differences in responsibilities between the cloud service provider and the customer organization. Infrastructure as a Service means, that a cloud service provider (e.g. Google Cloud, Amazon Web Services or Microsoft Azure) is taking care of the management of the infrastructure in a data center. A customer can for example deploy a virtual machine in Microsoft Azure and then use it for whatever computing needs they may have. Platform as a Service raises the abstraction level further and lessens the responsibilities of the customer. A common PaaS

service is databases as a service. Here the customer can for example choose to use a database for its needs, but they do not have to worry about deploying the virtual machine on top of which the database is running. Software as a Service raises the abstraction level even further and here the customer can only do minor configuration to an otherwise completely functioning application. One well-known SaaS service is the Dropbox storage service.

Cloud computing has changed the way companies think and do business. Organizations expect that their business needs are met with an on-demand software solution (SaaS), a platform for developing scalable solutions without infrastructure costs (PaaS) or a virtual data center for building solutions at lower costs (IaaS) (Kavis, 2014). If done right cloud computing offers companies with innovation possibilities, more scalable applications, quicker time to market and cost savings.

There are five deployment models of cloud computing services: public cloud, private cloud, community cloud, hybrid cloud and multi cloud. In this thesis the focus will be on the hybrid cloud model due to its' perceived advantages (Baskaran, 2018; Mazhelis & Tyrväinen, 2012; Sturru & Kulikova, 2014) over the other models and due to it being the most used cloud model with 82% of organizations having a hybrid cloud environment (Flexera state-of-the-cloud report, 2021). Public cloud will be investigated as well since often times a hybrid cloud model comes to be when parts of on-premises computing resources are moved to the public cloud. The cloud computing deployment models are used to express who controls what resources in a computing environment. More on the cloud computing deployment models in chapter 3.2.

Cloud computing has been growing rapidly. A part of this growth can be attributed to the overall trend of servitization, where IT-resources are increasingly bought as a service. Growth in the future is very likely too, which can be seen in the investments that companies like Microsoft, Google and others are making in their cloud computing environments. Moreover, Gartner predicts that by 2021, over 75% of midsize and large organizations will have adopted a multicloud or hybrid IT strategy (Gartner, 2019). In addition, the pace of growth does not seem to be significantly fazed by the Covid 19 outbreak. According to a recent market study (Telia Inmics-Nebula blog, 2020) 68% of technology and business executives said that cloud projects are continued at the planned pace. 8% said that the projects had been sped up whilst 24% answered that the projects had been delayed. VNT, a software research company, reported that multi and hybrid cloud environments continue to grow as businesses recognize, that specific jobs require tailored cloud solutions (VNT software, 2020). In another study, one executive states, that hybrid cloud will be the primary architecture for many future computing deployments (Leavitt, 2013).

As Kavis (2014) writes, exponential growth seen in the likes of Instagram and others, would not have been possible without cloud computing offering immense scalability for the business. On the Cloudcast, a podcast run by cloud computing experts, Aaron Delp and Brian Gracely echo this message by saying that, for startups, much of the first 50 million dollars received from a venture capital

round would have been spent on server space and building the infrastructure for the application. With cloud computing, the upfront capital expenditures needed for computing resources are smaller than in a traditional on-premises environment (Cloudcast, Season 2, show 1, 2021). A fast start and the possibility to also fail fast, provide businesses with opportunities not seen before. It has created a space where innovating new technologies and ways of doing business is possible like never before. Cloud computing will stay very relevant for years to come and it is vital for it to be researched scientifically.

There has been prior research about factors that affect hybrid cloud adoption. Critical success factors have also been researched thoroughly in the information technology field. There is however a research gap when it comes to the organizations that are deploying a hybrid cloud model with the help of a consulting firm. It is extremely common that an organization does not have the necessary personnel or skills to perform a cloud migration from an on-premises environment to a hybrid or public cloud one. These kinds of transformations in the IT infrastructure require many skills. Often services running in an on-premises environment need to be expanded, moved or re-structured because of various business needs. These kinds of demands often require the skills from information technology consulting firms who can help with or even perform the whole operation gracefully.

To answer the research gap presented above, there have been four interviews with cloud experts from the case company. The case company is originally a telecommunications enterprise but it nowadays also provides services in cloud computing and other IT areas. Additionally, in an effort to understand both sides, a representative of a customer organization that has recently undergone a transition into a hybrid cloud environment has been interviewed. The goal of this thesis is to find factors that affect hybrid cloud adoption. The research question is the following:

- What are the perceived success factors for a hybrid cloud adoption?

More specifically, hybrid cloud adoption in this thesis means transforming from a strictly on-premises or a private cloud model to a hybrid cloud model. A hybrid cloud adoption could also be called a hybrid cloud or public cloud transformation project as that is what it often is in practice. In the interviews of this thesis the cloud expert interviewees and the customer organization representative view the transformation from an on-premises-to-hybrid -viewpoint. In practice, hybrid cloud adoption usually means migrating a part of existing information technology workloads from one environment to another.

The thesis will have theoretical contributions as well. Cloud computing has been researched but it is often from a public cloud, private cloud or on-premises point-of-view as later explained. Hybrid cloud has been researched but not much recent literature on hybrid cloud computing adoption was found. As the IT field in general and the cloud computing field especially is a fast changing one, this thesis will provide current results on hybrid cloud computing adoption that can be utilized by information technology and technology adoption researchers.

This thesis also has managerial contributions. Implicitly, as the thesis considers both sides of a consultative hybrid cloud adoption, the thesis supports organizations that are considering hiring external help for a cloud adoption. On the other hand, it should also help cloud experts understand their customers' viewpoints in any consultative work related to hybrid cloud adoption or other projects related to cloud computing.

In the second chapter different service- and deployment models of cloud computing are explained. In addition, the prior research is presented and brought together visually in a technology-, organization-, environment framework. The third main chapter the methodology is more thoroughly explained. In the fourth chapter the results are presented. In the results section the same framework is used as in the literature section so as to tie the thesis to existing literature. The fifth chapter will present a discussion of the results and present other important matters that need to be considered, such as the limitations and theoretical and practical contributions of the study. In the sixth and final chapter of the thesis a conclusion from all previous chapters is drawn and the reader is invited to join the discussion around hybrid cloud adoption and related themes. At the very last, the references used in this thesis are presented as are the interview questions used in the empirical part of this study.

2 THE CURRENT STATE OF CLOUD COMPUTING

Cloud computing is currently a widely used way of providing services over the internet to consumers and businesses alike. In this chapter cloud computing is explained more thoroughly to provide context for the analysis of hybrid cloud environments. There are three different service models of cloud computing, infrastructure as a service, platform as a service and software as a service. There are five cloud computing deployment models : the private cloud, public cloud, community cloud, multi cloud and hybrid cloud. In this study, cloud computing adoption success factors are analyzed, which is why the different service- and deployment models need to be understood. The success factors need to be analyzed to better understand the benefits and challenges of hybrid cloud adoption.

2.1 Cloud computing service models

Cloud computing is deeply tied to three different service models regarding delivery of information technology. The three service models are Software as a Service (SaaS), Platform as a Service (PaaS) and Infrastructure as a Service (IaaS) (Mell & Grance, 2011). These three distinct service models can be utilized through deployment models of which there are five: private cloud, public cloud, community cloud, hybrid cloud and multi cloud (Mell & Grance, 2011; Vasiljeva, Shaikhulina & Kreslins, 2017).

In the following section it will be explained what the different service models mean and what services are tied to which service model. With each service model, the responsibilities of the user lessen in the sense of what has to be done by the organization and what is handled by a cloud service provider. To put it briefly, in a on premises model the administrators have the most control over the entire system on which their service or program is running. One can think that with each service model going from infrastructure-as-a-service towards software-as-a-service responsibility for administrators is abstracted away. The service models affect the amount of responsibility an organization has for a service.

For example, in a SaaS e-mail service the organizations IT department might only have to configure some part of an otherwise finished product. If the e-mail service is hosted in an IaaS environment, all the computing, networking and storage configuration has to be done by the IT department.

The service- and deployment models are tied to each other, but the reader also needs to understand that they do not have to be. One can use a public cloud service to host IaaS components or PaaS components. On the other hand, an organization could host a PaaS service in their very own, on premises data center, if they had the skill for it.

2.1.1 The on-premises model

Before going any further into the service models, it is important to understand that many of the services that are nowadays offered in the cloud were originally available within an on-premises computing infrastructure. This means that a company would have a server room on company ground in which all the services that a company might need were hosted. The computers, network devices such as switches or firewalls, operating systems, applications, and data needs to be controlled by the company and none of it is handled externally, outside of the data center. This is the traditional way of way of hosting computing workloads (Diaby & Rad, 2017). In an on-premises model the company using the services has to do all of the infrastructure themselves or hire outside IT experts that might need to be physically present in the data center. This means handling processing power, storage solutions, networking infrastructure and other essential services by yourself. Processing power means for example an allocated CPU with a certain performance. Storage solutions can mean some sort of disk or other drive where data can be stored. Networking is the virtual equivalent of setting up a private network and setting up switches and cabling. The user must manually install the operating system & applications and also keep them updated manually. The on-premises model might require the most technical knowledge to set up as one is starting from nothing. The physical safety, IT infrastructure and hardware needs to be set up and only after that can one start configuring services that will run on the installed hardware.

2.1.2 Infrastructure as a Service

The three service models differ from each other by offering varying amounts of services. In the Infrastructure as a Service -model, the bare bones of computing are handled by the cloud service provider, but the company has to manage the other parts themselves (Manvi & Shyam, 2014). This means that processing power, storage services, physical networking services and physical hardware are handled by the cloud service provider but everything else must be done at the company using the computing resources (Kobilinskiy, 2019). One could say that in the infrastructure as a service -model the physical side of computing services such as server racks and physical security is the only thing one does not have to worry about directly. Infrastructure as a service is sometimes first used in so

called lift-and-shift migrations, where existing computing infrastructure is moved from an on-premises data center to a public cloud as is. The virtual machines running on physical servers are moved as such and no modernization of services is done. This might be the quickest way for a migration from on-premises to hybrid or public cloud, but it also usually takes the least advantage of the services a public cloud has to offer.

2.1.3 Platform as a Service

The next level in the service models is Platform as a Service. Platform as a service provide a platform on which applications can be developed and run. PaaS can scale the application and offers other functions to ease development (Wolke & Meixner, 2010). With PaaS, on top of the computing, storage and networking services, also the operating system and middleware is handled by the organization using the computing services. Applications that are deployed by using this model need to be deployed by the administrators. Also, the data in the system is the responsibility of the administrators. An example of platform as a service is the Microsoft Azure App Service, which offers users the possibility to deploy web applications on a platform that is hosted by Microsoft Azure. It differs from infrastructure-as-a-service in that for example the operating system is abstracted away (Kobilinskiy, 2019). An administrator deploying a web application in a PaaS service cannot log in to an operating system running on some virtual machine. They would only need to use a readily provided service to deploy a web application. The code and other infrastructure required to deploy the web application will still need to be created.

2.1.4 Software as a Service

Software as a Service means that everything mentioned above is managed by the service provider and that the administrators only see and use the provided application. In this model, an administrator might need to configure the application to work in a specific environment. An example of a software as a service offering is Microsoft OneNote. It is a program which allows users to take notes and share those notes between devices over the internet. To use it, a company does not have to deploy any code or necessarily worry about firewalls or other networking infrastructure. An organization can simply buy the licenses for it and can start using it (Dubey & Wagle, 2007). Using a software-as-a-service -application grants the organization the least control over the application (Kobilinskiy, 2019). The reasoning behind using software-as-a-service can be that a company considers it not to be worth it to code and maintain an application on their own. Rather, they might prefer to focus on their own core business and simply use a ready-made application.

2.1.5 Responsibility & control in cloud services

In Table 1: Cloud Services Control Comparison, (Kobilinskiy, A., 2019) it is visually explained how the responsibility and control of the organization using cloud computing services lessens when moving from on-premises towards a software as a service -environment.

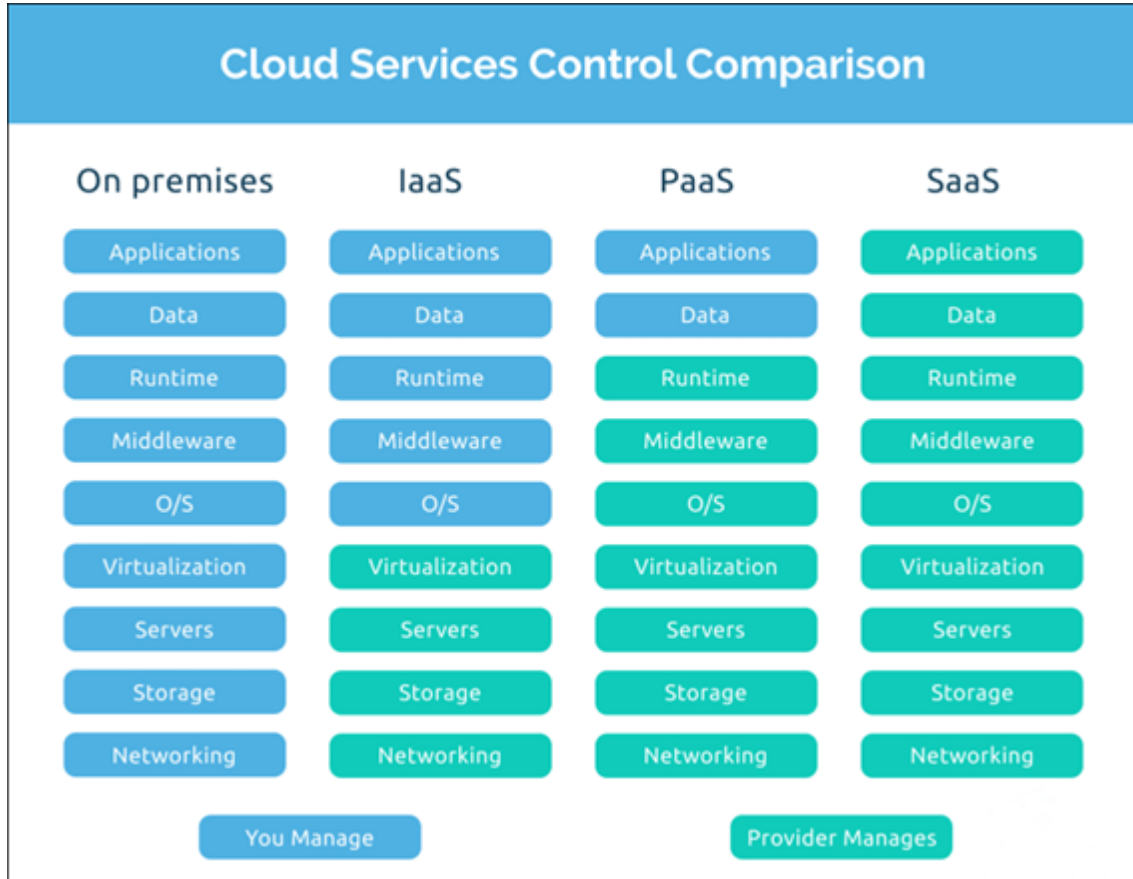


Table 1: Cloud Services Control Comparison, (Kobilinskiy, A., 2019)

In an on-premises environment, the organization has to buy servers, build or rent a space for them, install them, configure networking and finally install operating systems and programs running on the servers. Thereby the organization has control to every aspect of the environment in which they are running their services. However, with each step, the cloud service provider manages more and more of the system. In other words, parts of the system are abstracted away. This means the administrators have less control over the environment. With less control also comes less responsibility over certain areas which may be considered an advantage from some viewpoints and a disadvantage from others - as explained later on in the thesis.

2.2 Cloud computing deployment models

There are five deployment models: private cloud, public cloud, community cloud, hybrid cloud and multi cloud (Mell & Grance, 2011; Vasiljeva, Shaikhulina & Kreslins, 2017). Hybrid cloud and multi cloud are terms that are sometimes used interchangeably (Ko, 2017) but in this thesis a line will be drawn between them. In the following section it is explained how each deployment model works and how they are connected.

2.2.1 Private cloud

Private cloud means that the cloud is hosted and operated for one organization only (Mell & Grance, 2011). A third party, like the case company of this study, might be hosting the physical hardware in their own data center. The private cloud is very customizable, secure and it is possible for it to be accessed without internet availability if they are run internally or with a direct access tunnel (Leavitt, 2013).

2.2.2 Public cloud

Public cloud means that the cloud infrastructure can be accessed by anyone for a price, and it is owned and serviced by an organization selling cloud services (Mell & Grance, 2011). Well-known public cloud vendors and their respective public cloud services are Google Cloud, Amazon Web Services or Microsoft Azure. Public clouds offer various computing instances from which customers can choose. Public clouds are accessible over the internet, their advantages include cost-efficiency and ease of adoption & use (Leavitt, 2013).

2.2.3 Community cloud

In a community cloud multiple organizations share computing resources with a common goal. The organizations might have similar security-, policy- or compliance needs. By sharing the computing resources, the organizations share the associated costs. A community cloud can be managed by the organizations, or a third party and it can exist on or off-premises (Mell & Grance, 2011).

2.2.4 Multi cloud

In the multi cloud deployment model services from multiple public cloud providers are used for different functions. An organization might for example use some services from Microsoft Azure and use other services from Google Cloud. In case a multi cloud environment uses a private cloud component the environment is both multi cloud and hybrid cloud. The key is that the different cloud environments are typically not managed as one entity (VMware, 2021). Multi

cloud can also be used strategically as Sustar et. al., (2022) explain, to run different types of computing workloads in whatever cloud that is best suited for each workload.

2.2.5 Hybrid cloud

Finally, hybrid cloud is a model where some services are running in a private cloud or on-premises and others in a public cloud. The key is that typically these cloud environments are managed as one identity (VMware, 2021). For example, an organization might have an on-premises server room in which they store confidential data but a public cloud platform for web application hosting. Whenever the web application needs certain confidential data, it might retrieve that data from a disk in an on-premises server room. Sturru & Kulikova (2014) write that hybrid cloud computing is less about technology and more about rethinking the management and deployment of IT environments. The concept of hybrid cloud is particularly important to understand because of its ubiquity. A hybrid cloud environment is also a natural state for any organizations that either have their own data center or computing resources in a private cloud but are looking to move their computing resources into a public cloud environment. As soon as an organization has started to change their computing environment so that a part of their services are being run in a public cloud, a private cloud environment becomes a hybrid cloud environment. The computing environment might stay hybrid for a short while only or it might be the final state of computing resources for an organization. Organizations have found ways to economically integrate and operate both private and public cloud environments as one system by merging the two, thereby creating a hybrid cloud (Leavitt, 2013). Whatever way organizations choose to operate, it is an IT strategy decision that the organizations have to make.

2.3 Cloud computing adoption

When it comes to factors that affect cloud adoption in general, Senarathna et al. (2018) propose in their paper that there are three primary factors that influence cloud adoption: relative advantage (increasing profits, reducing costs, creating business opportunities), quality of service (creating a flexible business environment with dynamic scaling and accessibility) and awareness of cloud (understanding the opportunities of various cloud-options). These factors are important as they might be cause for a hybrid cloud adoption to either succeed or fail. When an organization with no cloud computing resources, starts adopting e.g., computing resources in a public cloud, it becomes a hybrid cloud environment. Therefore, factors that affect cloud adoption in general are also factors that affect hybrid cloud adoption.

Industry type can also affect the adoption of cloud services. Vasiljeva, Shaikhulina & Kreslins (2017) write that there is a difference between the ICT

sector and other sectors - with the ICT sector using storage & backup and tools for developing and testing software, while other sectors are mostly concentrated on web-based e-mail services and online office software. These findings seem to be partly backed by other research like Oliviera et al., (2014) who write that the manufacturing and services sectors have different drivers of cloud computing adoption. Interestingly this is contradicted by Senarathna et al., (2018) according to whom, industry type was not found to be very influential. As there is evidence pointing both ways - regarding the importance of the industry sector in cloud computing adoption - the possibility of the caveats of each industry affecting a hybrid cloud adoption are to be considered whenever a hybrid cloud adoption is planned.

Another factor that must be considered is that within the SME (Small & Medium sized Enterprises) construct, micro-organizations (less than 4 employees) are less likely to adopt cloud computing technologies (Senarathna et al., 2018). Organizational size in general can be important, since a larger organizational size seems to bring both advantages and disadvantages to the difficulty regarding cloud adoption. For example, larger organizations usually have more resources and more knowledgeable personnel to spare (Senarathna et al., 2018) whereas smaller ones might benefit from faster decision making. Also, the size of the organization can influence the type of cloud computing that is needed. For example, smaller ones might focus on e-mail services while medium-sized organizations actively use storage, backup solutions and online office software (Vasiljeva et al., 2017) In the Australian market, despite the growth of the cloud computing market, and 94% of Australian SMEs having internet access, only 44% use cloud computing compared to 86% of large organizations (Senarathna et al. 2018). In their study on Latvian SMEs Vasiljeva, Shaikhulina & Kreslins (2017) found that the most popular types of cloud computing services are storage and backup solutions, web-based e-mail services and online office software. These amounted to 63% of cloud services used by Latvian SMEs. In their study, the most popular deployment model was public cloud (43%) whereas hybrid cloud only amounted to 24%. SaaS was clearly the most popular delivery model at 49% with IaaS and PaaS being at 38% and 13% respectively.

In other words, it is backed by multiple sources, that organizational size in one way or another affects cloud adoption and implicitly plays a role in hybrid cloud adoption, too. Organizational size can affect the speed of hybrid cloud adoption, the expertise and personnel required for it and the services that are moved to or from public cloud to another environment.

Sturru & Kulikova (2014) write that a hybrid cloud environment requires additional efforts to gain the full potential of it. With multiple clouds being used, coordination of the environment needs to be methodological. Success of cloud adoption is tied to the challenges of cloud computing in general. To the challenges, mitigating factors need to be found to succeed. A hybrid cloud adoption is often tied to adopting different cloud computing resources which require skill in areas that the company might not yet have.

2.4 Hybrid cloud adoption success factors in the TOE framework

In this thesis, success factors are viewed as Grunert & Ellegaard (1992) explain them in their study: they are a description of the major skills and resources required to be successful in any given market. In the case and scope of this study, the market is the cloud computing field, which is one operating field of the case company. The case company's customer organizations adopt and develop their cloud computing environments with the help of the case company and this thesis is looking for the success factors that need to be met for a hybrid cloud computing adoption and development project to be successful. More specifically, in this thesis, the cloud adoption theme is viewed and analyzed from a hybrid cloud point-of-view.

The Technology-Organization-Environment (TOE) framework by Tornatzky & Fleischer (1990) was used to contextualize the findings in the literature review and later in the results. The table below is constructed from multiple literature sources by using the (TOE) framework by Tornatzky & Fleischer (1990). The TOE framework can be used to identify and group factors that affect the adoption process of a technology innovation, like hybrid cloud computing. The framework is considered to be free from restrictions related to the size or industry of an organization (Wen & Chen, 2010). This was one important factor in choosing the TOE framework as hybrid cloud adoption is a technology adoption process where factors like industry or organizational size can affect the process. In addition, the interviewed companies were not chosen by the size or industry of them, further making the TOE framework very fitting for this thesis. Additionally, Oliveira et al., 2014 report in their study on cloud computing adoption, that the TOE framework is consistent in delivering empirical support in research. As this thesis is both empirical and related to cloud computing, the TOE framework further solidified its place in this study to help contextualize and analyze the findings. Finally, multiple literature sources e.g., Borgman et al. (2010), Gangwar et al. (2015) and Al-Hujran et al. (2018) respectively were found to have used the TOE framework to successfully study technology adoption processes. Therefore, the usage of the TOE framework in this thesis is considered both theoretically backed but also a very practical way to frame the study and bring posture to it.

Cloud computing adoption and hybrid cloud computing adoption are tightly knit. Hybrid cloud computing is, as earlier stated by Sturru & Kulikova, (2014) less about technology and more about rethinking the management and deployment of IT environments. Hybrid cloud computing adoption shares many of the traditional cloud computing adoption success factors. This is because hybrid cloud computing adoption – in practice – means adopting cloud computing resources that have not yet been adopted. Therefore, any hybrid cloud adoption project needs to consider the traditional cloud adoption success factors in addition to other factors that are specific to hybrid cloud environments. Many of the success factors are shared between both cloud adoption and hybrid cloud adoption.

As with any technology, adopting a hybrid cloud computing model is not always straightforward. There can be compliance, security, privacy, or other concerns in addition to possible monetary challenges or challenges related to the skill of the experts implementing the changes. Based on the reviewed literature, a list of success factors for hybrid cloud computing adoption were identified and labeled in technological, organizational, and environmental contexts. The factors found in the literature are categorized according to the TOE framework and listed in Table 2: Hybrid cloud computing adoption success factors. The table was constructed by systematically reading and analyzing literature on cloud adoption and hybrid cloud adoption. Next, the success factors will be presented in technological, organizational and environmental context.

Context	Success factor	References
Technological	relative advantage	Abdollahzadegan et al., 2013; Armbrust et al., 2010; Battleson et al., 2016; Borgman et al. 2013; Brinda & Heric, 2017; Senarathna et al., 2018; Morgan & Conboy, 2013; Li et al., 2014; Leavitt, 2013; Wang et al., 2013; Vasiljeva et al., 2017
	data privacy & security	Balasumbramanian & Aramudhan, 2012; Huang & Du, 2014; Ko, 2017; Leavitt, 2013
	complexity of innovation	Borgman et al. 2013; Ko, 2017
Organizational	size of organization	Abdollahzadegan et al., 2013; Senarathna et al., 2018; Vasiljeva et al., 2017;
	top management support	Abdollahzadegan et al. 2013; Borgman et al. 2013; Khan & Ullah (2016)
	availability & skill of human resources	Abdollahzadegan et al. 2013; Ko, 2017;
	geographical location	Morgan & Conboy, 2013
Environmental	regulatory issues	Heiser & Nicolett 2008; Novkovic & Korkut 2017
	competitors	Borgman et al. 2013
	Security & legal issues	Brinda & Heric, 2017; Morgan & Conboy, 2013; Khan & Ullah (2016); Ko, 2017

Table 2: Hybrid cloud computing adoption success factors

2.4.1 Technological context

The TOE framework's technology context means the technologies that are relevant for the organization (Borgman et al. (2013). Both internal and external technologies are meant by this. Internal technologies might mean an in-house system that was made only for the organization for some specific tasks. An external system on the other hand might mean a system that was bought from elsewhere and other organizations can use them as well. An example of this can be an internal sales system that is integrated into an external CRM (customer relationship management) system.

Relative advantage means that by adopting a new technology, the company gains an advantage relative to its competitors. It means by how much people think an innovation is better than the previous way of doing things (Rogers, 2003). Relative advantage in its' many forms is a very common reason for choosing to adopt hybrid cloud computing and cloud computing in general. This is

supported for example by Borgman et. al. (2017) who write that relative advantage of cloud computing is seen in part in the cost advantages that cloud computing brings. Often it is hoped that cloud computing will lessen hardware costs and thereby shift the organizational IT spending more towards operational expenditures rather than capital expenditures. In the public cloud, it is possible to pay for computing resources on the go and by demand as opposed to more traditional on-premises data center costs which need to be bought in advance and where an organization might have computational overhead for the while that it takes to actually start using all of the bought hardware resources. Relative advantage is also mentioned by Senaratha et al. (2018) who find that relative advantage is one of the three most important factors that significantly affect cloud adoption. In addition, Morgan & Conboy (2013) state in their study that when a company moves toward cloud computing they start to see increased profits, reduced costs, and a potential for more created business opportunities. Morgan & Conboy (2013) provide a more specific explanation for this too. They elaborate on the relative advantage factor by writing that the pay-as-you-go -payment model and move away from capital expenditures towards operational expenditures offered by many public cloud vendors, is viewed as extremely beneficial because of reduced hardware costs. Senarathna et. al. (2018) add that cloud computing offers flexible and affordable access to IT infrastructure, platforms and software. Moreover, in the SME sector, it provides SMEs with opportunities to become as technologically advanced as their larger counterparts, without financial outlays. The opportunities provided by cloud computing to SMEs are also underlined by Abdollahzadehgan et al. (2013) even if they also face challenges that their larger counterparts do not.

Armbrust et al. (2010) write that the challenges related to scalability of services or maintenance of hardware and software can be mitigated with cloud computing - thereby creating an advantage compared to competitors. Wang et al. (2013) continue to write that hybrid cloud helps reduce hardware costs and improve dynamic resource provisioning. An advantage towards others can be observed from multiple different angles when viewing hybrid cloud adoption. Battleson et al. (2016) found in their study that transforming an organization's business can be advanced with cloud computing, improving for example efficiency of used resources. Vasiljeva et al. (2017) state that advantages of cloud deployment include access to applications/data from anywhere, cost savings, implementation speed, data backup & disaster recovery, flexible payment, automatic software updates and reducing on-site infrastructure. A relative advantage can be created from multiple angles.

In their study on the changes in cloud computing, Brinda & Heric (2017) explain how a company deployed a hybrid version of Microsoft Azure with some computing in Azure and some happening elsewhere, like on-premises. By using public cloud resources selectively, they were able to create innovative, new offerings in a hybrid cloud environment. This is something that can set one company apart from others and thereby create a relative advantage to others. Leavitt (2013) elaborates on relative advantage and mention increased adaptability and ability

to handle spiky workloads as a method to stand out from competitors and improve services that the company is offering either externally to customers or internally for their own employees.

Data privacy is discussed by Huang & Du (2014) who state that the hybrid cloud model could be a solution to the privacy of big data. Public cloud, according to Huang & Du (2014) remains a privacy concern but with specific schemes, greater data privacy can be achieved in a hybrid cloud environment with only a part of the computing effort required. Balasubramanian & Aramudhan (2012) comment on the security issue by saying that in a hybrid cloud environment, the security of multiple platforms must be taken into consideration. This creates a unique challenge specific to the hybrid cloud and its complexity. On the other hand, they write, the hybrid cloud is also an opportunity for greater data security than what can be achieved in a solely public cloud environment. This is, in part, because a hybrid cloud model allows for more flexibility in regard to where the data is stored or how an application is run. From this point of view, a hybrid cloud environment can be a final state, not just a transitory state on the way towards for example an entirely public cloud environment. Ko (2017) views security from a managerial and human resources angle. According to them, with top security talent present, hybrid cloud can achieve better security than other options such as solely public cloud. Ko's (2017) point can be extended to the complexity factor too, as hybrid cloud can provide better security but because of its inherently more complex nature (than solely public or on-premises) it requires top security talent to run it. Whether or not an organization has this top security talent remains for them to decide. In their 2013 study Leavitt (2013) write about a cloud executive that stated that workload-specific issues need to be taken into consideration too. Not all workloads are suited for the public cloud and therefore need to remain in a private environment. There might be latency or other concerns related to public clouds therefore encouraging a hybrid cloud solution.

Continuing from Ko's (2017) point, another theme in the technology context is the complexity of the technologies that an organization is considering adopting. Borgman et al., (2013) write that with more complexity, it becomes less likely for an organization to successfully adopt a new technology. In hybrid cloud adoption projects this can be an important factor as higher complexity is built-in to hybrid cloud environments. When a company starts to adopt for example public cloud computing resources and shifts computational workloads from an on-premises environment partly to the public cloud - it necessarily complicates the environment. This is because before the shift of computational workloads to the public cloud, all the computation was handled in one place whereas in a hybrid cloud environment it is two or more places.

Applications have varying requirements that need to be met for the application to run and these requirements might only be met in a certain environment. When there are different cloud environments used for applications that have a need to communicate with each other, there is added complexity in the system, creating a need for corresponding skill sets. (Ko, 2017) The complexity of a system is further demonstrated by the fact that each public cloud provider is constantly

innovating and adding new features to their cloud ecosystem. This creates a challenge for organizations trying to keep up with the newly provided technologies. Ko (2017) cites a cloud expert saying partnering with a managed-cloud provider could ease this challenge.

2.4.2 Organizational context

The TOE framework's organizational context is related to an organizations' internal issues, that may affect technology and innovation adoption processes. These may include employees and their skills, the size of the organization or the number of resources it has available (Borgman et al., 2013).

The size of the organization is one factor to consider in the organizational context as stated by Abdollahzadegan et al., (2013). Large companies have more resources both monetarily and in employee numbers, creating a more secure environment to try out new innovative technologies. On the other hand, small and medium sized organizations can be more flexible as there is likely less bureaucracy involved in decision-making which might slow down technology adoption and transformation projects. Senaratha et al., (2018) add to this by writing that small and medium sized organizations are more likely to adopt cloud computing than very small organizations with less than 4 people working in them. They write that a possible reason for this is that larger organizations have more resources to go through with cloud adoption projects, thereby adding to the findings of Abdollahzadegan et al., (2013). These factors should only be more important when taking into consideration the added complexity of a project that will see an organization end up in a hybrid cloud environment. Organizational size is also linked to whether an organization uses cloud computing at all or not. Vasiljeva et al., (2017) found that the companies with less than 9 employees are less likely to use cloud computing services than larger ones - adding to the findings of Abdollahzadegan et al., (2013) and Senaratha et al., (2018) regarding organizational size affecting cloud adoption. Vasiljeva et al., (2017) also found that the size of organization affects the type of cloud computing services companies are using. They found that companies with less than 9 employees are not using storage, backup solutions or online office software as actively as larger organizations.

A high level of top management support is linked very closely to the decision to adopt cloud computing according to Borgman et al. (2013). They write that top management support contributes to technology adoption by making the environment friendly for innovative thinking and providing resources that might be needed. In other words, things such as verbal endorsements and a certain tolerance towards risks should be there for hybrid cloud adoption to be successful. Too much fear of failure can indeed also be a cause for failure if the people at grassroot level do not have the confidence to pull through a difficult project like hybrid cloud adoption. Abdollahzadegan et al., (2013) continue, that top management can significantly affect the perceived success of cloud adoption. There needs to be encouragement from the top down to other employees of the organization that are carrying out the change process. In hybrid cloud adoption

projects top management is therefore also very important as it contains regular cloud adoption. Khan & Ullah (2016) noticed that the second most cited challenge of cloud computing adoption to be “effective management issues”, cementing the need for a cohesive top management strategy for hybrid cloud adoption projects.

To successfully adopt a hybrid cloud environment, Ko (2017) states that the IT workers need to be able to handle new technology in addition to the existing cloud environment. In that sense, the availability and skill of human resources are important in a successful hybrid cloud adoption. Abdollahzadegan et al., (2013) add to this that there is a better availability of human resources in larger organizations which is why they are more prone to experiment with new ideas. In larger organizations with more people there are also likely more skilled resources available, making a hybrid cloud adoption process easier. Ko (2017) also looks at cloud computing adoption from an organizational point-of-view by stating that the three internal IT skills required to support a multi-cloud environment are planning and commercial skills, top security talent and a multi-disciplinary approach. IT is closely linked to the business success of an organization and therefore good planning and commercial skills are needed. From this point of view, it is clear that availability of human resources with the aforementioned skills is important for any hybrid cloud adoption project to succeed.

2.4.3 Environmental context

The TOE framework’s environmental context namely refers to the environment in which an organization conducts its business. This can mean the industry or sector in which the organization is mostly operating, the competitors an organization has or the legal boundaries which the country of operation has set for the organization (Tornatzyky & Fleischer, 1990).

Sometimes geographical issues might appear indirectly, as Morgan & Conboy (2013) write in their study. They quote a product manager who explains that since datacenters might be scattered around the world, data may – in a disaster recovery situation – end up in a jurisdiction where it should not be. This is one way how environmental issues tie together to each other and create complex scenarios that can be difficult to control for IT managers, especially in a hybrid cloud environment. The geographical location of each datacenter that might be used in any situation must be exactly known by the management in charge of the hybrid cloud. These geographical issues are often also tied very closely to regulatory issues and might even go together. An organization might be following certain regulatory rules that are expected, for example, the data of an organization be held in a certain geographical area. The data residency and data flows need to be well known and documented if these types of issues are to be mitigated by the IT managers.

Heiser & Nicolett (2008) write that with cloud computing a regulatory compliance risk arises, which must be mitigated. It is possible that a cloud environment does not meet the regulatory obligations that an organization has agreed to respect, as written by (Novkovic & Korkut, 2017). This can lead to organizations

being cautious towards hybrid cloud computing solutions in general, especially as in a hybrid environment these issues might be exacerbated.

According to Borgman et al. (2013), a high competition intensity positively affects cloud adoption decisions in organizations. A high competition intensity can make decision makers of an organization feel like they have to come up with more means to stay ahead in the industry, which in turn can lead to more willingness to adopt new technologies. They write that a moderating effect of cloud adoption is caused by IT governance structures and processes. These governance structures and processes such as having to have certain data in a certain location can grow increasingly difficult to manage with a hybrid cloud solution, thereby causing the moderating effect.

Morgan & Conboy (2013) explain that security and legal issues were the most important environmental factor. Various issues like security risks of cloud adoption are mentioned to cause distress in the people who oversee a cloud transition of an organization. Security is a growing concern so investing in the prevention of cyber threats is essential. Ko (2017) explains that there are security concerns but looks at them from an organizational perspective rather than a technological one. When an organization transforms their environment from one that is running on-premises or in a private cloud into a hybrid cloud environment there might be a larger attack surface into their system, that needs to be realized on an organizational level. Communication from management towards employees needs to be well thought out to keep the organization safe from attackers - in addition to the technological means like firewalls.

Khan & Ullah (2016) identified challenges that an organization is faced with when looking to adopt a hybrid cloud model. In their literature review they find that the highest cited challenge is "public cloud security concern". The concern here is that some data might be exposed on the public cloud and more vulnerable to attacks than when compared to it staying in a private cloud or the organizations' own datacenter. Brinda & Heric (2017) however suggest security might be less of an issue in their review, stating that security concerns have moderated with concerns related to compliance, vendor lock-in and data portability being on the rise. Still, security is considered an issue too - just not quite as important as the other ones.

3 RESEARCH METHOD

This thesis is investigating the critical success factors related to adopting a hybrid cloud environment. At the same time, it is natural to investigate the end-goals organizations have when going for this transition. A qualitative approach by conducting semi-structured interviews was chosen because the thesis is trying to uncover new issues related to the phenomena. Sekaran & Bougie (2010) support the use of qualitative methods in these kinds of research situations. The interviews together with the literature review are meant to provide a novel view into the research revolving around hybrid cloud adoption factors and the goals that companies have when they start adopting a hybrid cloud environment.

To support the literature review and the customer interview, interviewees were chosen from a case company. The case company is an enterprise -size telecommunications operator for whom cloud computing consulting is one line of business, alongside other IT and telecom services. A part of the cloud computing and IT services of the case company are operated by subsidiaries, that the case company has acquired over the years. The case company operates both in Finland and internationally. The main reason for this telecom operator to offer cloud consulting and other IT services is a strategy decision and the goal is to be a holistic IT partner for companies.

In this study a customer of a telecommunications organization which also does cloud computing consulting has been interviewed to recognize success factors from the customers point of view. In parallel, cloud architects from the case company of the respective projects have been interviewed to find success factors from both sides of the project. Additionally, cloud computing experts in management roles from the case company are interviewed in a more general manner to understand their view on hybrid cloud computing and the end-goal companies have when they adopt a hybrid cloud environment.

In total, five interviews were conducted. One with an IT decision maker from the customer organization for whom the case company implemented a hybrid cloud solution. The person was responsible for overseeing the hybrid cloud project from the customers' perspective. Regarding this project, two cloud architects from the case company were interviewed. The cloud architects were

responsible for the hybrid cloud implementation of the customer organization. Additionally, two cloud experts from the case organization were interviewed to get a more thorough basis for the results. The questions were open ended so as for the questions not to be leading towards certain answers. Therefore, the interviewees had the possibility to express what is important from their point of view and what they considered meaningful in the hybrid cloud adoption project and in hybrid cloud adoption in general.

The cloud architects interviewed had been in the IT -industry for an average of 15 years. They had been working with cloud computing for most of the time that they had been in the industry. For example, one cloud architect [I-2] had been working with Microsoft cloud products since the times of Microsoft Business Productivity Suite (BPOS) in 2010.

The transcribed data was analyzed with a thematic analysis since it is very flexible and not tied to any specific theoretical perspective. (Maguire & Delahunt, 2017) The six-phase framework for thematic analysis by Braun & Clarke (2006) was used to search for themes, define them and present them in the results section. The six steps for the analysis according to Braun & Clarke (2006) are the following:

1. becoming familiar with the data
2. generating initial codes
3. searching for themes
4. reviewing the themes
5. defining the themes
6. a write-up phase to bring the results together.

The method explained by Braun & Clarke (2006) will provide comprehensive and thorough results.

The interviews were conducted during March, April and May 2021. The interviews lasted between 50 to 60 minutes. Every interview was recorded with the consent of the interviewees and transcribed afterwards. The interviewees are anonymized.

All of the interviewees were based in Finland and they had mostly worked with companies based in Finland. The customer organization is operating in the infrastructure and mobility. The experts were from different backgrounds, but all had more than 10 years of work experience in the field of modern cloud computing. The case companies' customers are mostly large organizations.

ID	Interviewee role & amount of cloud experience in years	Interview date	Duration
I-1	Chief Information Officer, 10 years	26.3.2021	50 minutes
I-2	Senior Cloud Architect, 15 years	1.4.2021	55 minutes
I-3	Senior Cloud Architect, 15 years	23.4.2021	50 minutes
I-4	Senior Cloud strategy manager, 15 years	28.4.2021	50 minutes
I-5	Head of digitalization, 20 years	31.5.2021	55 minutes

Table 3: Interviewees, their roles, interview dates & duration of interviews

4 RESULTS

The results were gathered from semi-structured interviews, and they are presented in the chapters below. When asked what is perceived to be critical for a successful hybrid cloud adoption, answers were varied.

In line with the six steps of analysis by Braun & Clarke (2006) an overview needed to be gained by reading through the transcribed interviews. Following that, initial codes were generated to link together similar answers or themes. Then themes were searched for, reviewed, and finally defined. The defined themes are the sub-headers of this chapter. Interview answers were thematically grouped to create a coherent results section.

4.1 Perceived success factors of hybrid cloud adoption

The themes are related to the factors that organizations consider when they want to move some of their computing resources into a hybrid cloud environment. The themes that were identified in the interviews are data location & security, compliance, legacy systems, costs, latency, scalability, project leadership, and documentation. The risks of hybrid cloud and the future of hybrid cloud were also discussed. The answers of the interviewees are identified by marking [I-number of interviewee]. The numbers correspond to the interviewees presented in Table 3.

4.1.1 Data location & security

Data location in the hybrid cloud context meant the physical location of servers. The public cloud -side of a hybrid cloud environment might be hosted in a data center that is in another country than where the company is operating. This is a reason for some of the interviewees to feel wary of a hybrid cloud environment. However, it seems that some organizations that use a hybrid cloud model are not shying away from storing sensitive data in the public cloud. For example, the interviewee from the customer organization said

[I-1] Business critical data is being stored in a public cloud, meaning we are not like the Finnish Defence Force. Even with these unfortunate (public) situations where information security was compromised, we have not decided that the public cloud would not be a possible storage place for some of our data.

This was interesting because in some of the literature, data security is one of the top concerns about cloud adoption and a reason for not storing some data in the public cloud. However, from the cloud architects' point of view the data location was important and it had also been a topic that had to be discussed with clients. This was a reason for some of the data or applications having to stay in a private cloud environment or on-premises environment.

[I-3] A client might give us requirements that the data can at no point be handled by an actor outside of Europe. Some other clients might have a high data security rating which mandates that they cannot store data in datacenters that are owned by an American company.

4.1.2 Compliance

The organizations' representatives' answers regarding the location of data were very much in line with the literature. The organizations need to comply with regulations from the outside, or they might have responsibilities towards their customers. As one interviewee said

[I-1] The basis for the location of our data is that our cloud environment has to be in the EU-region. Some of our clients require that their data is not moved outside of the EU. In that sense the cloud capacity has to be located within the EU.

GDPR and its effects on data storage and location of certain data seems to be taken seriously by both organizations and architects designing cloud environments. Compliance in regard to GDPR is important too as it clearly steers decision making, as one cloud expert said:

[I-4] GDPR and the location of personally identifiable information is important to us.

4.1.3 Legacy systems

The reasons for hybrid cloud adoption in the first place were less strategic and more guided by the natural state of things before going hybrid. Old but critical legacy systems and applications are difficult to move to the cloud. Moreover, moving applications to the cloud is perceived to be a gradual, long process. In these situations, organizations kind of "end up" in a hybrid cloud environment whether they want it or not.

[I-1] We can't modernize every old application at once, so we are stuck [in hybrid].

[I-5] If an organization has some history and some legacy infrastructure, a public cloud migration can't be done in a week.

At the beginning, an architect stated, the cloud business started with companies adopting cloud computing e-mail services first. They said that other cloud computing was introduced later. The interviewees want to move away from legacy systems but found it to be difficult to make the transition – thereby forcing a hybrid cloud environment where a fully public cloud environment would have been more desirable.

Whether or not a hybrid cloud adoption is successful also depends on what the on-premises environment currently hosts. Some on-premises applications might be cloud native and be very easy to move while others are not. Old applications might become very expensive if they are not re-architected when moved to the public cloud.

[I-1] We need to very carefully analyze and understand how moving an application to the public cloud affects it.

4.1.4 Costs

Cost of compute resources also drives organizations. Often the cost of a certain solution can be lower in a public cloud than if it was done on-premises or in a private cloud environment. As explained by one interviewed cloud expert:

[I-3] [In the case of a SQL database] the cost of building the solution in a public cloud is a fraction of what it would cost to the customer if we were to build the solution in a virtual machine in our own data center.

Once a part of the applications are moved to the public cloud and the company was essentially in a hybrid cloud environment, optimization and cost analysis on the public cloud had to be done. By optimization the interviewee [1] meant things like shutting down test and development environments during nighttime and only keeping the production environment running 24/7.

Without good planning, cost savings are difficult to reach.

[I-2] TCO (Total Cost of Ownership) calculations are difficult to make. There are a lot of variables especially in public cloud. The reason that some people think public cloud is expensive is that TCO calculations are made by people who do not understand public cloud.

[I-5] If governance is not well thought out the costs for hybrid cloud or public cloud will grow exponentially.

When discussing cost also interviewee [3] mentioned, that the primary business case driving hybrid cloud adoption is cost savings. A on-premises datacenter might be cheapest if the usage is calculated over a five-year period but the issue is that it requires large up-front investments.

[I-3] You do not need to do large, up-front capital expenditure investments but rather you can pay for what you need for the public cloud.

Some critical voices regarding transitioning towards a public cloud through a hybrid cloud were also raised. If yearly costs of an IT environment are at a certain level on-premises and they are promised to be much lower in a hybrid cloud environment, this might at first be an interesting proposition. However, if the transition itself costs many times more than the yearly costs of the current IT environment, a company will likely not want to do that transition because the return on investment is so far out in the future.

4.1.5 Latency

Also, certain heavy, computing intensive applications are seen as a hindrance for the movement to a cloud environment.

[I-1] Our employees used heavy design applications that felt too slow in the cloud. They wanted these applications to stay in a local data center so that a desired speed was met.

Another interviewee said

[I-3] For end-users working in Finland, the latency to a public cloud server in west-Europe might be too high. Especially if there are many small queries going back and forth between the client and datacenter these “round trips” that the data is taking might add up - making the user experience bad.

These latency concerns were however also considered something of an old problem. The interviewee [I-3] said they felt that speed is less of an issue today than what it was a few years ago. Understanding the current infrastructure and what is held in on-premises data centers was important. Also, whether applications were cloud-native came up since some applications were perceived to be very work-intensive to move from an on-premises environment to the cloud and therefore were deemed not worth it to move.

Another cloud expert had a partly opposing view.

[I-4] A datacenter in the same country or in the same city will always have a lower latency than a public cloud datacenter in some other country. Now public cloud vendors try to combat this by bringing some services into new countries but still the problem prevails.

4.1.6 Scalability

Scalability is an important factor when choosing to run workloads in a public cloud environment. This is thoroughly explained in the literature and in most marketing materials of public cloud vendors. Instead of, in an on-prem environment, having to buy all the computing hardware according to the expected maximum capacity, an organization can scale their compute instances when the need

arises. This shifts the cost to an organization from capital expenditures (a large upfront investment into hardware) to operational expenditures (spending money on a monthly basis, billed for the actual usage). This is echoed by one interviewed cloud expert:

[I-3] You can scale the workloads [in the public cloud]. For example, in each month you pay 29 days of a month for a small virtual machine and then only 1 day for a very powerful machine, according to your needs. You do not have to buy hardware based on that one day where you need more compute power.

Scalability also offers other business benefits. As two of the experts explained:

[I-2] Scalable public cloud services make room for innovation which in turn provides business benefits.

[I-3] On-premises you need to purchase hardware according to peak load times whereas in the public cloud you can scale it as you need.

4.1.7 Project leadership

One of the interviewees [I-1] said that the biggest challenge in the hybrid cloud adoption process was communicating the changes to the employees. The project itself went very well with the help of the case company since schedules and cost estimations were met.

Project managers should also keep in mind the speed at which change is implemented in a given environment. One architect said:

[I-3] When moving to a cloud environment, it is important to take small steps and gradually move services over to the public cloud to reach good results.

People in the position of a project manager also need to find ways to establish a good trust-relationship with all involved parties. When asked about factors that enabled good results in a public cloud project, one important thing was the good relationship and trust between the service provider and customer organization. This is also in line with previous literature, as stated in the literature section earlier. In regards to this, one interviewee said:

[I-2] The amount of IT-skills on the customers side does not matter for the success of a project. If there is a good trust-relationship, the project is likelier to succeed.

Ways of working and processes should also be looked at by a project manager. Moving servers into a public cloud environment as-is, in a lift-and-shift operation was not considered smart from a cost perspective. Modernizing the environment during the project should be a priority to get the most out of it. Simply moving parts of an environment into a public cloud does not make it necessarily better.

[I-2] Work methods and processes need to be evaluated, adoption of a DevOps and infrastructure as a code can bring agility to an organization and with it, cost savings.

[I-2] Moving IT infrastructure to public cloud should be made using the 6R model. Meaning, do it smart and methodically. Think about how to gain the advantages that public cloud has to offer. Think about how can the environment be modernized, don't just move everything as is – that is not how you get public cloud advantages.

One of the architects [I-2] also mentioned that there were changes in staff during the cloud project on both sides of the project. This was seen as a challenge to the project and is something project leadership should take into account before the start of any project.

From a project leadership point-of-view it was also considered to be an advantage that the case company was able to offer both private cloud capacity in their own datacenter and expertise for transitioning towards the public cloud.

[I-1] When we have one partner, it is easier to develop the architecture of our entire IT solution – where each service should be and how to make it happen. We even get service desk from [the case organization] so there is also a cloud management aspect.

In general, it was thought to be important to understand the nature of the workloads that will be moved. The possible outcomes of moving workloads from one environment to another should be forecasted.

[I-3] The best way to ensure success is to understand the effects [of a public cloud migration] and work so that the possible issues will not happen.

Communication was seen to be key for any successful project. It is especially important in hybrid cloud adoption projects where many things are changing. The project manager coordinates who does what and has knowledge of everything that is going on. Also the project manager needs to make sure communication between all involved parties is working.

[I-3] The vendor offering the solution can't do it all, the customer has to be involved too. The communication within the customer organization needs to work well too.

4.1.8 Documentation

Interviewee [1] spoke about trouble with documentation and the transfer of documentation to the case company implementing changes in the cloud environment. The challenge was that the organization could not deliver thorough documentation of the current cloud environment to the case company because of information security issues that were out of the organizations hands. This was a challenge because the case company cloud architects were not quite sure of the exact previous architecture. Therefore, some architectural decisions had to be made in the dark. The interviewee said that they would make sure the documentation is now very thorough. The documentation is now shared between the case company and customer organization and if at some point the customer

organization decides to part ways with the case company, the documentation will help the new service provider to understand the architecture.

In general, when adopting a hybrid cloud environment, it may be that additional technologies are needed to help with the control of it, thereby creating a more complex and harder to manage environment. A balance is needed so that control is manageable, and the system does not become overly complex. In any case, a well documented environment is a must, as one interviewee put it:

[I-3] It is important to be visible from the documentation that if system A is dependable on system B and C, what needs to be done for it to work if system C is moved to another environment [like the public cloud].

In one case, the IT-environment was moved from one service provider to another. This caused challenges because the former service provider could not share complete documentation nor let the new provider into the old environment because of security reasons.

Documentation was thought to be especially important when offering managed cloud services. In cloud environments there are often many actors with different responsibilities. In problem situations clear documentation is crucial for finding a fix quickly. In a hybrid environment these challenges are amplified because there are multiple places from which the problem might be stemming from and multiple people responsible for different parts of the system.

[I-2] Known incidents should all be documented and for recurring problems a root investigation should be made. New incidents need to be documented too.

Interviewee [2] also mentioned a runbook which they use to document RACI matrixes, escalation guides, known incident and how to fix them. If new incidents appear, they need to be updated in documentation. If one issue reappears a root-cause investigation needs to be made so that it is fixed for good. All this emphasizes the importance of good and clear documentation in continuous services situation.

Another factor for succeeding, that project leadership can influence is the usage of clear frameworks for working and documentation of responsibilities and the environment. A responsibility assignment matrix (RACI) in addition to other frameworks with which to abstract tasks were considered to be important by one interviewed expert:

[I-2] Working in a systematic manner and creating thorough documentation in a unified documentation template helps a lot.

[I-5] A unified way of working needs to be present, without it there will be trouble. A RACI matrix helps with this.

4.2 Risks in hybrid cloud adoption

The interviewees mentioned challenges such as large number of service providers, policy requirements and issues with former service providers. Failure of IT-projects in general was mentioned too, with one interviewee [I-1] saying 50% of IT-projects still fail. For a hybrid cloud adoption, or any IT-project, to be successful, it is vital that the current situation is thoroughly understood, the project is planned well, and the experts are knowledgeable. No IT-transition is easy, they explained.

Schedules also pose risks to projects. Another interviewee [I-3] described that they had to do a lift-and-shift -operation to the customers computing environment. The architect would have wanted to do changes to the architecture to achieve higher efficiency and cost savings but this was not possible because of the time constraints. Only changes that were considered to be very easy and quick to accomplish were completed. These included changes such as moving databases from on-premises SQL servers to a PaaS environment. After the lift-and-shift operation, more projects were started where improvements to the environment were the primary goal. Interviewee 1 said that tight schedules pose challenges and risks but also multiple different IT vendors can cause issues – with access, knowledge and infrastructure being scattered in multiple places. In addition customer security requirements and security policies might cause trouble.

Non-cloud-specific issues such as vendor lock-in might also pose a risk to a cloud adoption project.

[I-3] There is less service provider related vendor-lock in when having services in a public cloud. If the company wants to switch their IT partner, it is easy. In the past, traditional on-premises environments would have to be migrated from one data center to another and then the services needed to be replicated too.

One architect [I-2] thought of vendor lock-in as a two-way problem. Firstly, in the traditional way, an organization can be locked into one public cloud provider like Amazon Web Services, Microsoft Azure or Google Cloud Platform or in an on-premise environment to the data center provider. The other way is to get locked-in to the services that are produced in the cloud by the external partner, like the case company. By this is meant that if public cloud is used, the cloud native applications should preferably be used in the environment for security, patching or monitoring. These managed cloud services are often done by the external companies own or other third-party software, creating another kind of vendor lock-in to the services by the external partner. According to the cloud architect, the customer organizations should challenge the service providers to use cloud native applications for managed cloud services instead of third-party ones. This would make it easier to switch the IT partner if needed. However, using public cloud is also a way to lessen risks:

[I-2] If our customer wants to change IT vendors and cancel the contract that they have with us, they can do so easily if their environment is in Azure or AWS. Changing IT vendors is much harder in traditional private cloud environments or on-premises environments.

Vendor lock-in was also a concern for the customer organization and their representative, [I-1] who said, that an organization that is considering shifting from a private cloud or on-premises to public cloud or hybrid cloud needs to be on top of the change and knowledgeable about it. The buying organization needs to have it in the contract that they have access to documentation in case they want to change suppliers.

One interviewee [I-2] mentioned that they were thinking of moving a containerized application running in AWS to Azure but they deemed it too risky from a scheduling point-of-view. Also, that application was done by another vendor meaning it would have required work from them and communication with them.

Interviewee [2] also mentioned under-resourcing of human resources to have been an issue in addition to people switching away from the project during the project. In addition, robust processes are needed.

[I-2] RACI matrixes bring clarity. A certain systematic way of doing things and clear documentation is very helpful [in making projects succeed]. During this project we introduced a documentation template that will always be the same in future projects.

[I-5] All managed services need to be clear, governance too. When problems arise, it needs to be immediately identifiable who is in charge of what part of a certain system. Microsoft Cloud Adoption Framework works well when starting out.

Another thing that was mentioned regarding risks is that sometimes a public cloud vendor might have large issues in their datacenter which then cause unfixable issues in production environment. These were said not to be frequent issues but risks nevertheless.

[I-3] If Azure, after a log-in attempt, does not send a MFA (Multi Factor Authentication) token the user cannot log-in and there is nothing we can do.

In these types of situations, one can only wait that the public cloud vendor fixes whatever underlying problem is causing the token not to be sent. Another risk is integrations and dependencies of systems. Sometimes applications might be very tightly integrated, making moving a part of them to public cloud very difficult. The integrations and possible need to move the applications or change data sources of applications to be taken into account when systems are programmed in the first place. If this is not the case, a migration to hybrid cloud might be deemed impossible. In those cases, an application or service might be deemed to be easier to just re-program entirely instead of moving it.

[I-3] It is the best if systems are loosely integrated. The individual applications don't need to know where the other dependent services are living. Open interfaces are easiest. Just tell the application "hey, the URL of this service will change" and it'll work.

A not very obvious risk for companies that offer consulting regarding migrating to public cloud and who also have a private cloud offering, is that when a customer is either fully or partly migrated to a public cloud that capacity is lost from the private cloud that the company is offering. This might make private cloud vendors hesitant to offer a customer help with their hybrid cloud migration.

[I-4] The services that we offer in public cloud – like managed cloud services – do not compensate for the profit that we lost from moving a customer away from our private cloud into public cloud.

If a competitor however wins a bid to migrate a private cloud hosted environment into the public cloud, the private cloud vendor might want to slow down this migration.

If an organization buys outside help from a company that does public cloud consulting like the case company, the supplier has to have their managed services well thought-out. If a supplier is managing multiple customers who all have their distinct environments, the supplier can't take care of them all without a rigid framework.

[I-5] The biggest challenge in system development and digital services are the humans themselves and how to manage change.

4.3 The future of hybrid cloud in Finland

One interviewee said that, going into the future, reasons for having a hybrid cloud need to be very good. Especially, when more public cloud providers bring data centers to Finland thereby eliminating many of the compliance and data location reasons.

[I-5] I don't see any reason for a company to have anything in an on-premises environment other than if the services the company provides are critical from a governmental point of view. This might be the case with the army or so.

Hybrid cloud was seen by one cloud architect [I-3] as a temporary state, which will be replaced by public cloud. However, especially for larger organizations this state is seen to be lasting for years [I-2] but that the shift will be away from on-premise data centers towards a public cloud environment. Start-ups are thought to use all of their computing resources in a cloud environment. If on-premises is absolutely necessary, it too will be provided by a third party data center.

[I-2] In larger organizations the ratio between on-premises / private cloud to public cloud might have been 80% in on-premises and 20% in public cloud. This will shift to be the other way around. Smaller organizations on the other hand will completely get rid of on-premises / private cloud. Start-ups already want everything in public cloud.

[I-2] A good cloud strategy starts at Software as a Service. First, it needs to be checked if a desired service is already available as a SaaS solution as that will be the cheapest way to handle things.

Traditional ways of handling things like using virtual machines in a public or private cloud to run services is becoming less frequent. Components are used more in the PaaS way.

[I-3] Databases and other services are available as PaaS components. Managing virtual machines will surely lessen in the future.

When asked about factors that need to be considered for a hybrid cloud adoption project to be successful, architects had varying answers many of which were in line with the literature.

[I-2] Everyone wants to go into a public cloud offered by hyperscale (e.g. Microsoft Azure, Google cloud, Amazon Web Services) -providers because they offer artificial intelligence, machine learning and other services which enable innovating and business edge capabilities.

It was also said that hybrid cloud is here to stay [I-4]. There might be smaller companies who work together with one public cloud vendor or only build applications on one public cloud. What is known as hybrid cloud today might change as time goes by and as companies come up with new ways to solve issues like latency.

[I-4] Customers want one of two things from hybrid cloud. Some only see it as a temporary solution on the way to public cloud. Others have noticed some new business case that cannot be achieved in solely public or private clouds or on-premises, then they might try to find a solution in hybrid cloud.

[I-5] Hybrid cloud will likely not disappear. But it will change over time. There will be more edge-computing, local datacenters and regional datacenters. It will just take time, especially for larger organizations who have invested millions in their current environment.

5 DISCUSSION

In this chapter the results are compared to literature and possible takeaways are discussed. The TOE table is copied here, and another column is added for interviewees who mentioned a similar success factor than what was identified in the literature. The success factors that were mentioned by interviewees were in order of most mentions:

1. Relative advantage (Mentioned by all 5 interviewees)
2. Data privacy & security (Mentioned by 3 interviewees)
3. Geographical location (Mentioned by 3 interviewees)
4. Complexity of innovation (Mentioned by 2 interviewees)
5. Availability & skill of human resources (Mentioned by 2 interviewees)
6. Security & legal issue (Mentioned by 2 interviewees)
7. Top management support (Mentioned by 1 interviewee)
8. Regulatory issues (Mentioned by 1 interviewee)
9. Competitors (Mentioned by 1 interviewee)
10. Size of organization (Mentioned by none of the interviewees)

Outside of the success factors mentioned in the literature, one additional factor was found in the interviews only: Documentation (Mentioned by interviewees [1], [2], [3], [5])

Next, the results are discussed and compared to Table 2: Hybrid cloud computing adoption success factors. One additional “interviewees” -column is added to Table 4: TOE table for findings in literature and interviews to visually compare literature review and interview findings.

5.1 Discussion of the results

The TOE table below is for findings that were identified in both the literature and the interviews. This way the results will be comparable and all novel insights from the interviews can be clearly viewed.

Context	Success factor	References	Interviewees
Techno-logical	relative advantage	Abdollahzadegan et al., 2013; Battleson et al., 2016; Borgman et al. 2013; Brinda & Heric, 2017; Senarathna et al., 2018; Morgan & Conboy, 2013; Li et al., 2014; Leavitt, 2013; Armbrust et al., 2010; Wang et al., 2013; Vasiljeva et al., 2017	[I-1], [I-2], [I-3], [I-4], [I-5]
	data privacy & security	Balasumbramanian & Aramudhan, 2012; Huang & Du, 2014; Ko, 2017; Leavitt, 2013	[I-1], [I-2], [I-3],
	complexity of innovation	Borgman et al. 2013; Ko, 2017	[I-2], [I-5]
Organizational	size of organization	Abdollahzadegan et al., 2013; Senarathna et al., 2018; Vasiljeva et. al., 2017;	
	top management support	Abdollahzadegan et al. 2013; Borgman et al. 2013; Khan & Ullah (2016)	[I-5]
	availability & skill of human resources	Abdollahzadegan et al. 2013; Ko, 2017;	[I-4], [I-5]
Environmental	geographical location	Morgan & Conboy, 2013	[I-2], [I-3], [I-4]
	regulatory issues	Heiser & Nicolett 2008; Novkovic & Korkut 2017	[I-2]
	competitors	Borgman et al. 2013	[I-5]
	Security & legal issues	Brinda & Heric, 2017; Morgan & Conboy, 2013; Khan & Ullah (2016); Ko, 2017	[I-2], [I-4]

Table 4: TOE table for findings in literature and interviews

Many of the challenges related to hybrid cloud adoption have already been identified by scientific research and cloud vendors, or organizations like the case

company, that are offering consulting services related to hybrid cloud adoption projects. Cloud vendors and consulting organizations have over time found ways to potentially mitigate these challenges. This has been noted by Khan & Ullah (2016) who state that the challenges of “public cloud security”, “management issues” and “integration complexity” declined in frequency when reviewing literature of a more recent time period.

The success factors that were mentioned by more than 3 interviewees and that were also found in the literature were

1. Relative advantage
2. Data privacy & security
3. Geographical location

These three success factors are therefore considered to be the most important ones to get right when an organization is considering hybrid cloud adoption. Interestingly, the importance of good documentation was mentioned by four of the interviewees, but this was not found in any of the literature. The reason for this might have been the fact that after the two interviewees brought documentation up themselves, in the third and fifth interview the interviewees were outright asked about the importance of documentation, thereby creating a bit of an exaggerated result. Nevertheless, it seemed very important to all of the interviewees who talked about it.

Essentially, with the hybrid cloud model, it is hoped to get the “best of both worlds” by using both private and public cloud in parallel. A very fundamental reason for choosing to buy computing resources in a cloud model instead of doing it strictly on-premises is the hope of reducing costs associated with initial investment into hardware or upkeep and management of systems, thereby shifting investments from capital expenditure towards operational expenditure.

Interestingly, being environmentally friendly was not seen to be a very important aspect of cloud adoption in the reviewed literature. In the interviews this was noted as being environmentally friendly is increasingly more important for companies. Hybrid cloud was seen as one of the ways to shrink the carbon footprint of a company as many of the public cloud resources run in datacenters that are powered with renewable energy.

One interviewee [I-2] mentioned that they were thinking of moving a containerized application running in AWS to Azure but they deemed it too risky from a scheduling point-of-view. More interestingly from a scientific point of view was that the application was done by another vendor meaning it would have required work from them and communication with them. It needs to be realized by customer organizations that if they buy a public cloud project from one vendor regarding a certain part of their infrastructure – they might not get the best advice if there are other vendors in the mix too. Meaning, the vendor might not want to work with another company if it is deemed too difficult or time consuming. In this case they might not give the best advice to the customer organization.

The reasons for staying in a hybrid cloud environment were consistent with factors identified in the literature. Some of the servers that host services need to be physically close to the end users or in a certain geographical region. Therefore, all of the services could not be moved to a public cloud, even if the customer wanted to. In the interviews services such as short-term file storage, printers and desktop management were mentioned as having to be close to the user. This was one reason for the hybrid cloud environment to prevail and for the organization to not being able to move to a fully public cloud.

For companies that have their own datacenter and are offering private cloud services it might be difficult to compete with large public cloud vendors like Microsoft Azure or Google Cloud. They might not have the technical expertise to offer PaaS-like solutions in their own data centers that could compete with the PaaS offerings of public cloud vendors. It will be interesting to see how private cloud vendors can differentiate themselves from the large public ones. So far with many public cloud data centers being outside of a certain country like Finland, the private cloud vendors might have this going for them. However, what will happen when public cloud vendors open smaller datacenters in smaller countries like many have already planned? Private cloud vendors need to find their own niche in services to keep afloat as public cloud vendors bring their services to new regions.

The hybrid cloud and public cloud has already disrupted the computing market. Smaller or newer companies that are completely cloud-native can offer new functionalities quickly whereas for an old company with a lot of legacy hardware a new functionality might be very expensive to create. Following next, are the theoretical and practical contributions that are deducted from the analysis of the results.

5.2 Theoretical & practical contributions

This study contributes to the theoretical field of hybrid cloud computing adoption research. The results provide relevant information to researchers looking to research the field of hybrid cloud adoption. More broadly, this study adds to the existing body of literature that investigates cloud adoption factors in general by identifying a success factor related to hybrid cloud adoption that was not found in the reviewed literature.

This study contributes in a practical way by providing a relevant and up-to-date view of the cloud computing field. This study is especially interesting for companies like the case company, that are offering cloud computing consulting to organizations looking to adopt a hybrid cloud computing model. On the other hand, organizations looking to adopt a hybrid cloud model find useful information and things to consider, too. Following next, the limitations of this study that might have affected the results and contributions are explained.

5.3 Limitations of the study

One limitation is the scope of the study. People from one consulting company and one customer organization were interviewed. To gain a more rigorous view, more people in more organizations would have to be interviewed. The interviews could also be scoped so that the size of the organizations would be taken into closer consideration. Another way to scope a future study would be to gauge the size of a hybrid cloud adoption / transformation project and conduct interviews based on that. The size could for example be determined by the number of servers that were moved from an on-premises environment to a public cloud one – creating a hybrid cloud environment in the process.

Another limitation is the fact that many of the referenced studies can seem outdated since the cloud computing domain is a very fast paced one. For example, public cloud security was seen as a concern related to hybrid cloud adoption in many studies but in the interviews, security was not quite as a pressing concern. Public cloud was even considered to be very secure by some interviewed experts.

A third limitation are the semi-structured interviews, in which discussion is not clearly kept around exact questions. This may have caused a drift in interview topics or exaggerated issues that the interviewees considered important, an example of this being the importance of documentation. In the following chapter 5.4 the suggestions for future research are presented.

5.4 Suggestions for future research

As this study is limited in its scope, it would be interesting to research a larger number of organizations that have adopted a hybrid cloud model and create a framework of critical success factors related to it.

More rigorous research into the reasons behind hybrid cloud adoption would be welcome too. From the interviews it was clear that often times the reason for a company to have a hybrid cloud computing environment is less about wanting to go hybrid *per se* and more about ending up in a hybrid cloud computing environment because of tempting business and other possibilities offered by the *public cloud*. Because of governance, data security, latency and other reasons the move to a solely public cloud environment is not possible for some organizations. Therefore, it would be interesting to see research about what the end-goals are when a company adopts a hybrid cloud environment. Some of the literature has already considered this aspect, for example Balasubramanian & Aramudhan (2012) write that in some ways, hybrid cloud can be considered an intermediate stage for companies that are looking to move most of their workloads into the public cloud.

Additionally, I find the way in which hybrid cloud computing is referred to problematic. An organization does not *move into* a hybrid cloud environment but rather, it *transforms* its computing environment so that the computing

environment becomes a hybrid one. In my opinion, hybrid cloud transformation would be more descriptive of the reality of hybrid cloud adoption. Hybrid cloud adoption failure would be interesting to research as well.

In the present day, environmental concerns are very important to many individuals and organizations alike. The amount of carbon emissions caused by cloud computing should be researched more thoroughly. Many public cloud vendors already claim to use renewable energy sources to power their data centers. As greenwashing is something that many organizations nowadays seem to do, a thorough look into the carbon emissions of public cloud and private cloud vendors should be made. These emissions should also be compared to those of on-premises environments.

6 CONCLUSIONS

This thesis investigated the hybrid cloud adoption success factors that should be recognized when starting a hybrid cloud adoption project. Hybrid cloud adoption is increasingly ubiquitous in the modern world where organizations are updating their computing environment and looking for more efficient ways to handle their computing workloads.

An answer was sought to the research question which is:

- What are the perceived success factors for a hybrid cloud adoption?

To this research question existing literature on hybrid cloud adoption and cloud adoption in general was read and analyzed to form a coherent picture. The success factors were analyzed via the TOE framework (Tornatzky et. a., 1990), short for technology, environment, organization framework.

In addition to the literature review, five interviews were carried out. Four interviewees were chosen from a case company which - among other services - offers consulting and implementation of cloud projects. Interviewees [I-2] & [I-3] were involved in the hybrid cloud adoption process of a customer company. From the customer company, the CIO [I-1] was interviewed. Additionally, two cloud experts [I-4] & [I-5] were interviewed to gain more knowledge on hybrid cloud adoption.

The findings are that for a hybrid cloud adoption project to succeed several factors need to be considered. Interest toward hybrid cloud adoption stems from organizations wanting to gain relative advantage towards competitors, such as reduced costs or bettering of their product or service. Data privacy and security need to be addressed somehow to keep a secure and trustful system, for both internal and external parties. Hybrid cloud can be complex to manage which is why top management must support and be knowledgeable about the project. The availability and skill of human resources available often pose as a hindrance for successful hybrid cloud adoption projects. Geographical location of data and applications, regulatory requirements surrounding the data and applications are also risks that need to be mitigated. Competitors might speed up and pressure

organizations towards hybrid and public cloud. Similarly legal issues that are often related to regulatory requirements need to be considered. Often data location is at the center of this. Good documentation was considered important too, however, this was the only success factor that was not found in the literature but only in the interviews.

The results of this thesis can be used by companies like the case company, who offer consulting and resources for other companies like the customer organization. If an organization wants to provide cloud consulting services, this thesis can point towards factors that need to be considered before, during and after the project. The success factors are likely important for the project to succeed in the first place. Additionally, by proving to a customer organization that these success factors are understood and taken seriously in hybrid cloud and public cloud adoption projects, the customer will likely trust the cloud vendor more.

On the other hand, it is important for all parties involved in hybrid cloud adoption projects to be knowledgeable about what might go wrong and what things to consider when undergoing a project like this. The customer needs to have skilled personnel just as much as the consulting company. If the customer organization does not have the required technical knowledge, good project management skills are certainly advantageous. A customer organization can also require a consulting company to provide answers as to how they will mitigate the risks of hybrid cloud computing adoption projects identified in this thesis.

In general, for any cloud adoption, an existing and proven framework, like the Microsoft Azure Cloud Adoption Framework should be used when starting a project like this. To support it, the findings of this thesis can be used to understand the practical meanings of risks and factors that will affect successful cloud adoption.

In conclusion, this paper provides insight into hybrid cloud computing adoption and can serve as a basis for future research around this topic. Hybrid cloud adoption as a term can be misleading as – in practice – hybrid cloud is not technically what is being adopted. It is more about adopting public cloud technologies which causes the IT environment to be split into two or more, thereby creating a hybrid cloud environment. Hybrid cloud is more a way of thinking than a technological framework. In the future, hybrid cloud environments have to be researched more as they will likely be more frequent. Many organizations are looking to utilize public cloud more which will mean more companies will – at least for a while – be in hybrid cloud environments. Hybrid cloud might also be a final state for many organizations as there are various reasons to keep some services or data on-premises or in private cloud.

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APPENDIX 1: INTERVIEW FRAMEWORK

Below is the interview framework which was used in the interviews. Here, the framework is translated from Finnish to English. These questions were used as the backbone of the interviews, but more specific questions were asked if the need arose.

Base interview questions for the customer organizations representative [I-1]

- How would you describe your job and how long have you worked with cloud services?
- What is your role in the hybrid cloud project?
- Do you have prior experience in adopting a hybrid cloud?
- Why was a hybrid cloud model chosen?
- What were the factors that determined what services to put into which cloud? (e.g. security, privacy, cost, others)
- What do you think is crucial for the successful adoption of a hybrid cloud?
- Has the hybrid cloud adoption affected business functions?
- How could the cloud adoption process have been better?
- How could the current hybrid cloud environment be improved?

Base interview questions for the case organizations' cloud architects and experts [I-2], [I-3], [I-4], [I-5]

- Who are you & what is your role in the hybrid cloud project?
- Why was a hybrid cloud model chosen?
- What do you think is crucial for the successful adoption of a hybrid cloud?
- Has the hybrid cloud adoption affected the customers business functions?
- What were the factors that determined what services to put into which cloud? (e.g. security, privacy, cost, others)
- How could the hybrid cloud adoption process have been better?
- How could the current hybrid cloud environment be improved?