University of Economics, Prague

Faculty of Informatics and Statistics

Cloud Migration Decision Support Model for SMEs

MASTER'S THESIS

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Declaration

Herewith I declare that I wrote master's thesis called Cloud Migration Decision Support Model for SMEs on my own and I have cited all used sources.

In Prague on April 25, 2018

Bc. Jan Knettig

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Abstract

Thesis *Cloud Migration Decision Support Model for SMEs* is focused on the topic of Cloud Computing, specifically on the cloud adoption potential in Czech SMEs (Small and Middle-sized Enterprises).

To simplify the process for SMEs of adopting cloud the aim of this Thesis is to design a Cloud Migration Decision Support Model to help them make the right decision on whether cloud or on-premises solutions are their better fit.

In order to create such a Model, large qualitative market research on cloud adoption potential by Czech SMEs managers was conducted in 39 SMEs. This research, containing 27 open-ended questions and producing 1500 short answers, was analyzed and from this came the decision criteria which are further used as inputs to the Model. This was done to assure the correspondence of the Model with the real needs and approaches of SMEs. Apart from that, it also serves as market research bringing a view on the current market situation regarding cloud services and SMEs.

The Research showed that 75% of companies asked use some kind of cloud application. More than 60% keep their backups (also) externally and a little less than 50% of companies claim to have a part of their servers located on third party's premises, suggesting a high cloud adoption rate. On the other hand, many respondents were not able to fully define cloud and often they considered it only a distant data storage. Combined with the facts that 'private cloud' could not be correctly defined by 50% of companies, cloud is a synonym of 'public cloud' for many companies and that cloud is only used for a fraction of activities in most companies, there is still a great potential for further increasing the cloud adoption rate by increasing the awareness of what cloud computing offers.

The created Model contains 7 assessment steps and is elaborated in a form of 7 mind maps, each containing specific assessment criteria which bring its users recommendations on suitable solutions to their needs. The steps are in this order: *Need*, *Quality*, *Security*, *Simplicity*, *Agility*, *References* and *Price*. This Model was fully validated by conducting studies with 5 companies. This validation proved the Model's usability and at the same time it showed its limitations and suggested some future work directions.

Prior to creating the Model and conducting the Research, ICT and cloud related theory was studied and described, as well as the theory of qualitative research. An important part of this Thesis is also a detailed description of the design and conducting of the Research, which shall serve as a useful guideline for future researchers in this field.

Keywords

Cloud, Cloud Computing, Cloud Migration, Cloud Adoption, SMEs, Decision Support Model, ICT, ICT Services, Qualitative Market Research, Decision Criteria.

Abstrakt

Diplomová práce s názvem *Model pro podporu rozhodování o migraci do cloudu pro MSP* je zaměřená na téma Cloud computingu, přesněji na potenciál přijetí cloudu v českých MSP (malých a středních podnicích).

Pro zjednodušení procesu přijetí cloudu malými a středními podniky je hlavním cílem práce navrhnout Model pro podporu rozhodování o migraci do cloudu, který jim pomůže udělat správné rozhodnutí, zda je pro ně vhodnější cloudové nebo on-premise řešení.

Aby mohl být takový model vytvořen, byl proveden rozsáhlý kvalitativní průzkum trhu z hlediska potenciálu přijetí cloudu v 39 MSP. Tento průzkum obsahující 27 otevřených otázek a produkující 1500 krátkých odpovědí byl zanalyzován a vzešla z něj rozhodovací kritéria, která jsou dále použita jako vstupy modelu. Tento postup byl zvolen, aby byl zajištěn soulad modelu se skutečnými potřebami a přístupy MSP. Krom toho také slouží jako průzkum trhu přinášející aktuální pohled na trh kolem cloudových služeb a MSP.

Průzkum ukázal, že 75 % dotazovaných firem používá nějakou formu cloudové aplikace. Více než 60 % ukládá své zálohy (také) externě a něco méně než 50 % firem tvrdí, že mají své servery umístěny mimo své budovy, což vše naznačuje vysokou míru přijetí cloudu. Na druhou stranu, mnoho respondentů nebylo schopno plně definovat cloud a často jej považovali pouze za vzdálené úložiště. Když se vezme v úvahu, že termín „privátní cloud“ bylo schopno relativně korektně definovat jen 50 % podniků, cloud je pro mnohé pouze synonymem „veřejného cloudu“ a že cloud je používán jen pro zlomek činností ve většině firem, stále je zde velký prostor pro další zvyšování míry přijetí cloudu zvyšováním povědomí o tom, co cloud computing nabízí.

Vytvořený model obsahuje 7 hodnotících kroků a je vypracován ve formě 7 myšlenkových map. Každá z nich obsahuje specifická hodnotící kritéria a svým uživatelům přináší doporučení z hlediska vhodných řešení jejich potřeb. Kroky jsou v tomto pořadí: *Potřeba, Kvalita, Bezpečnost, Jednoduchost, Agilita, Reference* a *Cena*. Model byl plně ověřen provedením studií v 5 společnostech. Toto ověření prokázalo použitelnost modelu, zároveň však upozornilo na jeho omezení a vzešly z něj návrhy na možné směry budoucí práce na modelu.

Před vytvořením modelu a provedením průzkumu byla studována a zpracována teorie ICT a cloudu, stejně jako teorie kvalitativního výzkumu. Důležitou součástí této práce je rovněž detailní popis návrhu a provedení průzkumu, který může posloužit jako užitečný průvodce pro budoucí výzkumníky v této oblasti.

Klíčová slova

cloud, cloud computing, migrace do cloudu, přijetí cloudu, MSP, model pro podporu rozhodnutí, ICT, ICT služby, kvalitativní průzkum trhu, rozhodovací kritéria.

Content

List of tables

1 Introduction

Topic of master's thesis Cloud Migration Decision Support Model for SMEs is cloud, or cloud computing. More precisely it is cloud computing in Czech SMEs.

1.1 Cloud is a current topic

Cloud is a very current topic in the world nowadays, as well as in the Czech Republic.

What is a cloud? As defined in greater detail in chapter 2 *ICT and cloud*, cloud or cloud computing is the delivery of on-demand computing resources, where computing becomes a utility.

Gartner Hype Cycle positioned Cloud Computing in Climbing the slope stage (Smith & Anderson, 2017) of its cycle which means the technology got over its initial hype, it's been through several versions and now is starting to prove its worth. (Gartner, 2017)

According to Google Keywords Planner (Google, 2018) on March 5, 2018 the average monthly search rate of search term "Cloud" was globally 100k-1M times and 1k-10k times in the Czech Republic. Interestingly, one would not find statistics for "Cloud" if searched in Czech language. However, these settings produce other relevant results. More complex information on this topic is captured in *Appendix B:, Appendix C: and Appendix D:*.

Google Trends (Google, 2018) showed on March 3, 2018 constantly high interest for search term "Cloud" with the low point of 81% during last year on global scale. In the Czech Republic numbers were more volatile with the lowest point of 59% of relative interest compared to the highest search rate during last year. A good explanation of what Google Trends shows can be found on Ahrefs.com website (Ahrefs, 2018) and numbers are in *Appendix E:* and *Appendix F:*.

These statistics prove significance of topic "Cloud" on a global scale. At the same time, it shows cloud is not yet so well established in the Czech Republic at the time of writing this Thesis. Both of these facts were part of motivation to conduct research on cloud in the Czech Republic.

1.3 SMEs are important contributor to Czech economy

SMEs, Small and Medium-sized Enterprises, are defined by European Commission as follows:

Table 1 Definition of SMEs (European Commission, 2003)

Company category	Staff headcount	Turnover	or	Balance sheet total
Medium-sized	< 250	≤ € 50 m		≤ € 43 m
Small	< 50	≤ € 10 m		≤ € 10 m
Micro	< 10	≤ € 2 m		≤ € 2 m

Data of Czech Statistical Office (Český statistický úřad, 2013) from 2003-2010 shows that on average 99,9% of company sector in the Czech Republic consists of SMEs which is in norm with the EU where SMEs represent 99% of all businesses (European Commission, 2003). Further it employs roughly 7/10 of all employed persons in company sector. In 2016 the ratio of SMEs performance on overall performance was 49,2% according to data provided by Czech Ministry of Industry and Commerce (Ministerstvo průmyslu a obchodu, 2016). According to (Bureš, 2017) contribution of SMEs on GDP in the Czech Republic was roughly 40%.

This data shows the significance of SMEs for Czech economy and justifies focus of this thesis on Czech SMEs.

1.4 Cloud and SMEs

Since cloud technologies are enabling businesses all around the world to simplify their ICT, lower their costs and put more focus on their business, an assumption was made that these benefits should be interesting also to Czech SMEs. At the same time, author of this thesis is interested in cloud computing business for several years now and from his work experience for an ICT services provider sees that the cloud adoption rate might not be as high or as fast as was predicted years ago when this technology first came. Author's affection for modern technologies and for increasing business efficiency were drivers to engage with this topic. Cloud is a very broad topic, so is the SMEs segment. Author's goal is not to limit these areas in any ways, contrary to that it is to obtain and then provide a complex view on cloud computing in Czech SMEs in general.

1.5 Motivation to conduct research on cloud and SMEs

The motivation to conduct research in this area was to find out about perceived relevance of cloud computing to Czech SMEs and gain a solid knowledge of what state the market is in. By state is meant how much these companies know about cloud, what the cloud adoption rate is and whether they plan to move to cloud. First and foremost, the research was meant to uncover the motivations to either stay on their own premises or move their ICT (or part of it) to cloud. These motivations would then be transformed into factors for and against cloud, delivering criteria important for making a decision on whether to migrate to cloud.

These decision criteria together with acquired general knowledge of the market and its real needs should then serve as elementary inputs of Cloud Migration Decision Support Model (CMDSM). This model shall be designed to help identify suitable scenarios for companies of all sizes when their ICT needs are likely to be better satisfied using cloud solutions and when using traditional ICT.

1.6 Aim and objectives

The Aim of this Thesis is to design a Cloud Migration Decision Support Model for SMEs, helping them make the right decision on whether cloud or on-premises solutions are their better fit.

The main inputs to this Model shall be gathered from a qualitative market research on cloud adoption potential by Czech SMEs managers.

Objectives are as follows:

1. Describe briefly **theory of ICT and cloud related terms**
2. Summarize **theory of conducting a qualitative market research**
3. Conduct a qualitative market **research on cloud adoption potential by Czech SMEs** managers in 39 SMEs and **identify the most important criteria** on whether to migrate to cloud
4. Describe in detail **methods used to conduct this research**
5. Design **Cloud Migration Decision Support Model for SMEs** based on qualitative market research results
6. **Validate the Model** usability in real SMEs

1.7 Preconditions and limitations of the Thesis

Since the topic processed in the Thesis is very broad, it is expected that some areas might not be described in such detail and some findings not as rigorous as in case of dedicated works to a specific area. The result shall be a model applicable to all cases of SMEs which can influence the overall complexity of the Model, which in turn can be too simple to evaluate very specific cases or on the other hand too complex to evaluate simple cases.

The Thesis and the Research does not anticipate any level of knowledge on given topic from its respondents and readers. Therefore, all needed terms are explained in chapter 2 *ICT and cloud* and the Research itself does not acquaint respondents with the terms. Actually, it aims to discover respondents' own level of knowledge, their definitions and perception of researched area. This in turn can lead to certain amount of 'wrong' answers which may disrupt the overall Research results. On the other hand, this shall not be faulty from the point of view of the Research. In case of large amount of wrong answers, this would project itself in the Model, whose usability might be then lowered.

1.8 Expected outputs of this Thesis

The most important expected output of this Thesis is the Cloud Migration Decision Support Model itself, which shall help SMEs self-assess their current or future situation based on their identified business and or ICT needs and obtain a valid recommendation on when cloud computing is suitable for their needs.

Second most important output of the Thesis shall be the detailed analysis of the qualitative market research results. This analysis itself provides a useful overview of what state the market is in and based on what criteria SMEs managers adopt cloud, innovate their ICT and choose their ICT contractors.

Third great output of this Thesis shall be a by-product of conducting the extensive market research. A complete know-how on conducting a qualitative market research, acquiring respondents and analyzing data from unstructured interviews will be created and provided.

Fourth output shall be the data from interviews which provided as an Appendix to this Thesis could serve other researchers as both a frame of reference or data for their own research.

As minor output, but perhaps useful to some, descriptions of brief theory related to ICT topics and qualitative market research can be considered.

1.9 Thesis structure and methods overview

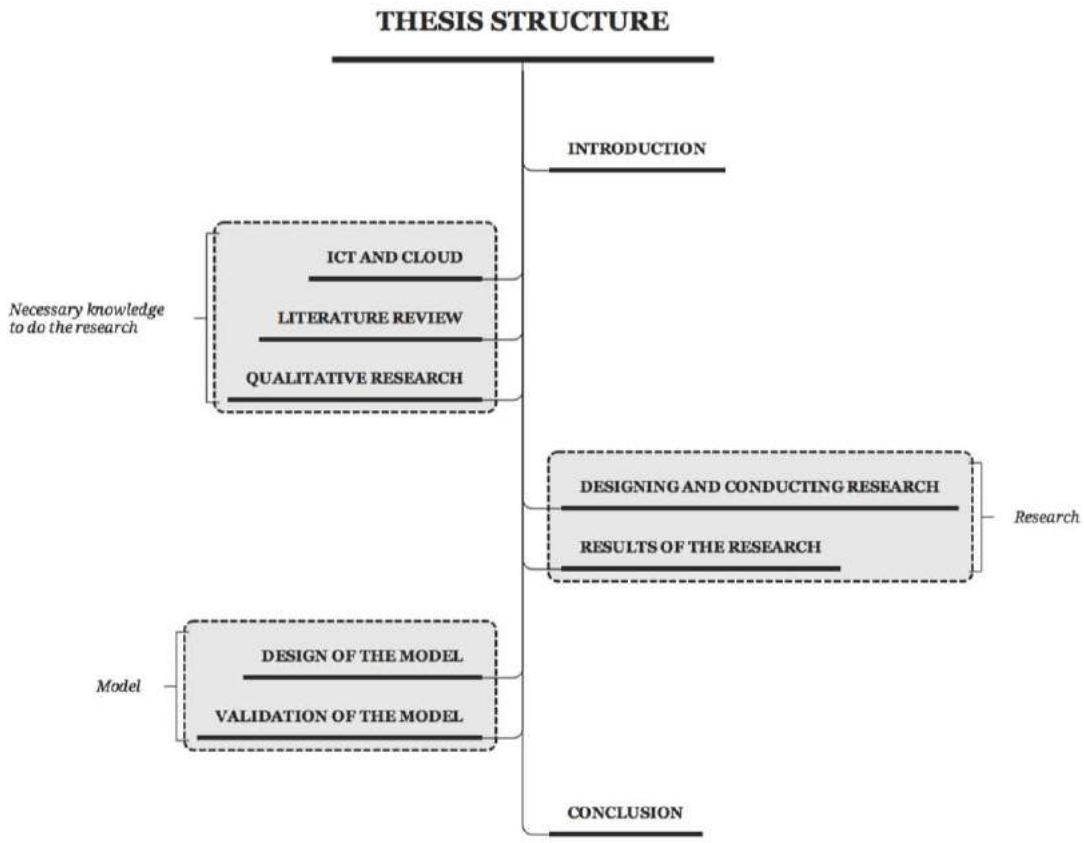

Image 1 Thesis structure

Chapter 2 *ICT and cloud* provides a useful overview and short definitions of terms used throughout this Thesis including the relations between some of them. These definitions are paraphrases of information found on reliable websites engaging themselves with technology.

Chapter 3 *Literature review* presents works on similar topic to this Thesis elaborated at the University of Economics, Prague. It is intentionally positioned after Chapter 2 explaining the basic theory as this literature review already uses some of the terms which might not be known to some readers. Each work referenced in this section is briefly described in terms of its goals and results. Based on this information each work is compared to this Thesis, so a clear distinction could be made.

Chapter 4 *Qualitative research* provides a summary of reviewed literature on this topic which serves as a useful frame of reference for readers or future researchers unacquainted with the nature of this research type. Various recognized international and Czech sources are referenced, and information is gathered in a form that it guides a reader from a qualitative market research inception through its processing till its analysis.

Chapter 5 *Designing and conducting a qualitative market research in ICT* describes a complete procedure of conducting a qualitative market research in terms of this thesis. The description is detailed, providing its readers a complete know-how useful for conducting a similar research of their own. Described are respondents acquiring techniques, interviewing procedures, qualitative data processing and analysis as well as all the questions asked during the research including their justification.

Chapter 6 *Results of research on cloud adoption potential by Czech SMEs managers* presents summarized results of originally unstructured data available to each of 27 questions asked 39 company representatives. Most of questions' analyses feature a table presenting all identified (sub)categories of answers within given question ordered by their significance given by the number of companies whose answers are associated with such (sub)category and by total number of associations to each (sub)category. Results presented in tables are then described in detail, providing insights and even quotes of respondent's which uncover many unexpected realities. At the end of the chapter is a summary of research results which provides an aggregated view on acquired findings.

Chapter 7 *Design of the Cloud Migration Decision Support Model for SMEs* fulfils the aim of this thesis to design a model helping SMEs make the right decision on whether cloud or on-premises solutions are their better fit. A part of this chapter is a short description of the Model creation, then the Model itself is presented and explained in section *Introducing the Model*, followed by section about recommended usage.

Chapter 8 *Validation of the Model* presents perceived usability of the Model by introducing 5 complete studies conducted with 5 different SMEs proving Model's usability as well as pointing out its limitations and suggesting future work directions.

Last chapter is the *Conclusion*

which summarizes this Thesis, its results and proves the fulfilment of Thesis objectives by referencing it.

2 ICT and cloud

Chapter *ICT and cloud* provides an overview of terms used throughout the Thesis and their short definitions with relations to each other. They are ordered in a way that basic terms, approaches and technologies are presented first and the others later, so latter terms use for their definitions terms explained earlier. It is recommended therefore for an unacquainted reader to start from the very first term and advance all the way to the last. This will also serve as sort of a short genesis of this field as technologies are basically ordered as they emerged. Understanding these terms Is crucial for understanding questions asked in the Research, its results and also the Model, which is the ultimate goal of this Thesis.

2.1 IT and ICT

IT is an abbreviation of Information Technology and ICT stands for Information and Communication Technology. These two terms are closely related and often used interchangeably. Definitions of these terms vary across the Internet sources, so it is not clear where exactly is the line between them and which is superior.

In this thesis IT is defined as "*anything related to computing technology, such as networking, hardware, software, the Internet, or the people that work with these technologies.*" (TechTerms, 2018)

ICT is in this sense considered a broader concept which enhances IT of the "communication" capabilities. As such ICT refers to "*all the technology used to handle telecommunications, broadcast media, intelligent building management systems, audio-visual processing and transmission systems, and network-based control and monitoring functions.*" (Techopedia, 2018)

Since modern technologies are all about sharing data, collaboration and communication, ICT is in this sense considered an umbrella term to IT and therefore it is used throughout this thesis.

2.1.1 Hardware (HW)

In ICT, Hardware (abbreviated as HW) describes the physical – e.g. computers and their components and peripherals (such as screen, keyboard, mouse or a printer), servers, network cables. Simply put it is everything what one can 'touch', therefore it is 'hard'. (TechTarget, 2017)

2.1.2 Software (SW)

Software, on the other hand, is the intangible of ICT. It refers to "*programs used to operate computers and related devices.*" (TechTarget, 2017). A basic division is into application software (programs users perform specific tasks with, such as spreadsheets creation in Microsoft Excel) and system software (operating systems, such as Microsoft Windows, which allow users to run applications).

2.1.3 Network

Network, as referred to in ICT, is a connection between multiple devices communicating with each other. These devices can be computers, but also tablets, smartphones, printers and nowadays also a TV or even a refrigerator. The connection itself is realized by cables or through the air using wireless devices. There are two types of network: local and wide. Local area networks (LAN) are limited to a specific location, such as a home, office or campus. In contrary, wide area networks (WAN) span across multiple locations, connecting for instance all offices of a company. The largest WAN is Internet. (TechTerms, 2017)

2.1.4 Server

Server is a physical device (a type of HW) similar to computers but more importantly it is also a software used to manage other devices on a network. There are different types of servers, such as file server (used for storage and sharing of files), print servers (for managing printers), database servers (for processing database queries), web servers (for delivering web pages) or application server (for handling operations of business applications). (Webopedia, 2018)

2.1.5 Infrastructure

IT Infrastructure is a term describing basically all the supporting IT a business uses, that is IT resources used to store, process, analyze and deliver data and applications to users. It encompasses HW, SW, networks, facilities and people managing these resources. By facilities is meant the physical premises where the main HW and SW, such as servers, is located and everything needed for its operation, such as power, cooling systems, cyber security appliances (such as firewalls) and physical security measures, such as surveillance system, electronic key entry or controlled physical and virtual access to these resources. (TechTarget, 2017) (Techopedia, 2017)

2.1.6 On-premises

On-premises (also referred to as 'on-prem' and 'on-premise') refers to ICT infrastructure and software located on company's own premises which allows for physical access of IT staff to these resources. As such it is considered a traditional form of ICT. (Webopedia, 2018)

2.1.7 Virtualization

Virtualization is a core concept of modern ICT as it allows for a more efficient use of physical resources, such as servers, data storages and networks. It is mostly associated with server virtualization, though also networks, storage, data, desktops and applications can be virtualized.

Concept of virtualization means that something physical can be virtually divided into more pieces. For instance, traditionally on a server can be installed only one operating system (software operating the server and providing user interface). By virtualizing it is possible to have 2 and more operating systems running on 1 server. These operating systems then share physical resources of that server. Virtualization itself is done by a special software and creates a layer between the HW and SW of the virtualized asset. (TechTarget, 2018)

An analogy to virtualization is this: there is a big cake (server) and several people to eat the cake (operating systems). If we do not have a knife (virtualization), there is no way to slice the cake and only one person can eat it. Knife (virtualization) allows slicing the cake so all the people (operating systems) can share the cake as long as there is enough cake (computing power) for everyone.

2.2 Cloud

Cloud, or more precisely a Cloud computing, is the delivery of on-demand computing resources. Computing in this scenario becomes a utility, just as an electricity or a water supplied by a cloud provider. Delivered can be anything traditionally running on-premises, that is everything from applications to servers. It is delivered over the internet on a pay-for-use basis. (IBM, 2017)

The main advantage of cloud is that companies using cloud service do not need to build and maintain IT infrastructure, they simply consume what they need as a service and pay only for what they really use. This significantly simplifies IT for companies, in many cases brings significant cost-savings and allows them to concentrate on their business.

Other basic traits of cloud service are self-service (eliminating the need of IT administrators) and elasticity, which allows for easy scaling up and down the resources used based on current demand. (TechTarget, 2017)

One of the elementary concepts which made birth of cloud computing possible is virtualization. Virtualization allows for the multi-tenant environment and high efficiency of cloud solutions by maximal usage of physical resources. Cloud resources are therefore virtualized.

2.2.1 Distribution models of cloud services

IaaS

IaaS, Infrastructure as a Service, as the name suggests, is a service providing infrastructure over the internet. By infrastructure in this regard are usually meant servers, storage and networking HW, as well as the virtualization layer. Thanks to this service do not need to build their own data centers and they can simply rent what they need to run their applications. (TechTarget, 2017)

PaaS

PaaS, or Platform as a Service, is one level above IaaS. It is a service providing platform over the internet. By platform is meant the infrastructure, HW and SW, needed to develop and run certain applications. (Webopedia, 2017) Therefore, this can be used for easy deployment of business applications, such as an ERP software, or for a development of new applications while not having to install anything besides the application itself, all other needed software is ready.

SaaS

SaaS, Software as a Service, is the highest level of cloud computing, providing software over the internet as a service. This is the most convenient option, as in this case no infrastructure at all is needed, that is no HW or SW to run the application from customer's side, applications are ready-made and directly delivered to users. SaaS applications are typically accessed through a web browser using a username and password. Some of these applications are so natural for our daily use that many people might not even realize they are using a cloud application. Typical user examples of SaaS are a Gmail or a Facebook. Often used business applications are from human resources, customer relationship management and content management areas which embrace the collaborative nature of cloud where more people can easily access the same data if needed. (Investopedia, 2017)

2.2.2 Types of cloud deployment and consumption models

Public cloud

Public cloud is the most commonly used type of cloud and it refers to computing delivered over the internet provided by a third party (a public cloud provider). It is highly scalable (easy to adjust the amount of service consumed). Thanks to public cloud there is no need to invest into on-premises infrastructure which significantly reduces many costs as no HW, often SW is needed and often also less ICT staff is needed. (Gartner, 2017) Since data and applications in public cloud environments are located off a customer's premises, there are many security concerns regarding public cloud, though, as (Microsoft, 2017) puts it, if the public cloud provider implements correctly security methods, it can be just as secure as the most effectively managed on-premises infrastructures.

Private cloud

Generally, private cloud can have two meanings. (Microsoft, 2018) defines it as computing services provided either over the internet or internal network which provide many benefits of public cloud while being more secure and private because of using internal resources and not being exposed to third parties, on the other hand they require skilled staff. (Techopedia, 2018) distinguishes between a *private cloud* and a *virtual private cloud (VPC)*. The latter is a private cloud using a third-party cloud provider's infrastructure. Most of the time private clouds are located on-premises, thus bringing higher security, though some of the benefits of cloud diminish, such as no need to invest into and manage internal infrastructure. Private clouds can be established by using technologies, for instance, from VMware or Citrix.

Hybrid cloud

Hybrid cloud, as the name suggests, is the hybrid between private and public clouds. It allows for optimal usage of the both solutions by "allowing data and applications to be shared between them". (Microsoft, 2017) Companies then use a private cloud to keep the essential business applications and sensitive data on-premises, while using public cloud for their non-sensitive data and computing-tasks. Thanks to that they can keep their ICT infrastructure highly secure behind company's firewalls while not having to invest into excess capacity, as short-term spikes or unexpected growth can be offset in public cloud.

Community cloud

Community cloud is a newer and not as often mentioned type of cloud computing, though certainly very interesting to some organizations. In a way it is again a hybrid form of public and private clouds. Community clouds create a sharable environment specifically designed for performance, security and regulatory compliance needs of certain group of individuals and companies or an industry. As such they bring the security of private clouds and cost savings realized from economies of scale by sharing the same infrastructure with other related companies, which are commonly found only in public clouds. (DataCenter Knowledge, 2014)

2.2.3 Cloud migration

Cloud migration, which is central topic of this thesis, generally refers to the process of moving applications, data or other business elements from company's on-premises data centers and computers to the cloud, that is to a cloud provider. (TechTarget, 2017) Though, as private clouds exist, migration to cloud can also mean moving data and applications inside one organization from traditional data center infrastructure to private cloud infrastructure, which is mostly a thing of software.

2.2.4 Other cloud related terms

SLA

SLA, a Service Level Agreement, is an essential part of any outsourcing in technology business. In terms of cloud, it is a contract between a company and the cloud provider stating the quality of service required, the metrics to measure that quality and also remedies or penalties if that quality is not achieved. (CIO, 2017) Some common metrics used in SLAs include availability, performance, application response time, schedule for notification of planned changes, help desk response time and provided usage statistics. (TechTarget, 2016)

2.3 ICT security related terms

Terms introduced in this section are especially useful for understanding some of the questions in the Model presented in chapter 7.

2.3.1 Business continuity (BC)

Business continuity are processes and procedures used to ensure no disruptions occur to critical business processes or they are quickly reinstated in case of a disaster. The aim is to omit financial and other losses incurred to the business being out of order. (Business Continuity Institute, 2018) (TechTarget, 2018)

2.3.2 Disaster recovery (DR)

Disaster recovery is a term closely related to Business continuity and commonly these 2 terms are used together or interchangeably in an abbreviation as BCDR. Business continuity is more proactive and refers to business processes of a company as a whole. Disaster recovery is also about reinstating the normal function of a business following a disaster as soon as possible but focuses more on technology infrastructure and in its nature, it is more reactive to emerged incidents. (TechTarget, 2018)

2.3.3 Antivirus

Antivirus is a software installed on computers or servers whose purpose is to protect the system from viruses. Viruses are programs which are designed to negatively affect computer's health in a way that they manipulate with files, consume computer's resources and cause it to not function properly. (TechTerms, 2011) Antiviruses are prevention of these malicious programs. They can recognize them and block them before viruses can do any harm. (TechTerms, 2010) Some viruses are designed to steal data from computers and therefore it is important to use updated antiviruses.

2.3.4 Encryption

Encryption is a process of transforming an information using a special algorithm to a form unreadable to unauthorized users. Authorized users have a key allowing them to decipher

the information. It is used for protecting sensitive data and is an important concept also in cloud environment. This is especially true in public clouds, where data is managed by a third party and so it is often needed to encrypt this data to protect it from an unauthorized use. (Techopedia, 2018)

2.3.5 Firewall

Firewalls are security devices or software used to protect private networks, such as a company network. They do so by monitoring outgoing and incoming traffic (transmitted data) and access attempts and based on defined security rules automatically decide on which traffic to allow and which to block. Firewalls are the first line of defense in network security for almost 3 decades now and they, of course, are still very important in today's cloud infrastructure. (Cisco, 2018) (Webopedia, 2018)

2.3.6 Data Loss Prevention (DLP)

Data loss prevention, sometimes also referred to as data loss protection, is a system designed to prevent any confidential information getting into unauthorized hands. As such it has predefined policies and allows for custom definitions of policies which allow to protect sensitive information and to company with specific regulations, such as GDPR. DLP scans all the documents and files, identifies the sensitive or critical information and, for instance, does not allows anyone to send this information in an e-mail outside the organization or to upload it onto a consumer cloud service, such as Dropbox. In case of GDPR, it identifies documents containing personal data and protects them from unauthorized use. Today, DLP as a Service is gaining popularity. (TechTarget, 2014) (Digital Guardian, 2015)

2.3.7 Monitoring

Monitoring, in this regard an infrastructure monitoring, is a continuous data collection and analysis of information about company's infrastructure. Monitored are specific metrics defined in the monitoring software, such as network traffic, processors usage or free space on storage devices. This allows management of these resources and also prediction of possible problems due to insufficient capacity. It is also very useful in troubleshooting infrastructure as it contains all the information on its usage history. By correctly setting up the alert criteria, ICT administrators get automatic notifications on when there are problems in the infrastructure. Monitoring can be also assured by using Monitoring as a Service (MaaS). (BMC, 2017) (K-net, 2016)

2.4 Chapter summary

Chapter *ICT and cloud* provides knowledge needed to understand the content of this Thesis. Terms from very basic, such as ICT, through cloud and its forms and types to ICT security technologies were explained. These terms are a useful knowledge base for anyone who wants to use the Cloud Migration Decision Support Model, which is a main outcome of this Thesis.

3 Literature review

Chapter *Literature review* presents works on similar topic to this Thesis elaborated at the University of Economics, Prague. It is intentionally positioned after Chapter 2 explaining the basic theory as this literature review already uses some of the terms which might not be known to readers. Each work referenced in this section is briefly described in terms of its goals and results. Based on this information each work is compared to this Thesis, so a clear distinction could be made.

3.1 Works on a similar topic at the University of Economics, Prague

Cloud and SMEs is not a new topic at University of Economics, Prague. Regarding cloud, in total 218 bachelor, master and doctoral theses associated with cloud exist in University's library catalogue, from all 6 faculties. Though, only 12 works associated with cloud are written in English, out of which 6 are from the Faculty of Informatics and Statistics.

Already in 2009, a master thesis called "Analýza potenciálu SaaS v malých a středních podnicích"[1] by Pavlů was seriously engaged with cloud, specifically with software as a service. It described SaaS, its advantages and disadvantages and even methods of investments evaluation – TCO and BSC. It introduced the SME segment of companies and defined the most useful categories of SaaS software for this segment and also the 3 most useful applications in each category. Pavlů also did a quantitative research regarding SaaS adoption by Czech companies answered by 32 companies. This produced results that 75% respondents knew the term SaaS. The most common reason for not using SaaS solutions was fear of data security in the cloud, second reason was lack of customizability. E-shops, Content Management Systems and Document Management Systems were the most commonly used. While the goals of referenced work were related to goals of this Thesis, the difference is in the use of qualitative questionnaires in this Thesis, limiting the scope of Cloud Computing to SaaS and especially in the main goal, which is not to analyze the potential but to give SMEs a tool to self-analyze the potential of cloud solutions for themselves.

In 2011 a bachelor thesis by Horenský called "Analýza využitia softwaru cez internet v malých a stredných organizáciách formou SaaS"[2] is again analyzed SaaS in SMEs. This works provides also a brief theory on how to implement SaaS applications in a business. In the results there were 2 examples of companies who newly implemented a SaaS solution, and their experience with it based on which SaaS is a recommended solution. Apart from that there are 4 cases studies of anonymized or fictitious companies considering a chosen economic SaaS software. The result is, this software is suitable for small business where it is cost-saving, whereas it increases costs for the middle-sized businesses. In contrary to this Thesis, referenced work is

[1] In English: "Analysis of SaaS potential in Small and Medium-sized enterprises"
[2] In English: "Analysis of SaaS usage in SMEs"

only engaged with SaaS solutions, further limiting to economic software, and in fact to just 2 representatives in this field.

In 2012 a master thesis called "Adopce Cloud computingu ve firemní sektoru"[3] by Malík had a goal of describing the cloud, analyzing its current market, divide business sector into industry fields and then for these different fields determine the status of cloud adoption. This would be a very similar goal to a market research conducted as part of this Thesis but there are two main differences. First, the data used for analysis in the referenced work was only gathered from available sources, no original qualitative or quantitative research with real respondents was done. Second, the referenced work was written in Czech language, though the data used for analysis was global, not focused on the Czech Republic as in the case of this Thesis.

Another master thesis from 2012 by Brýl called "Analýza podoby IS v MSP v době Cloud Computingu" which studies the development potential of cloud computing as an information system solution for SMEs. The work discovered that Cloud Computing is suitable for all needs regarding information systems of SMEs.

A bachelor thesis from 2012 called "Aktuální stav využití Cloud Computing služeb v českých firmách"[4] by Janů had a goal of discovering a current state of Cloud Computing services usage in Czech companies. As such besides describing everything associated with cloud computing this work also contained an original quantitative research conducted on the sample of 92 companies (addressed were 1381) from automotive, electro-technical, ICT and engineering industries of all sizes. The research showed that cloud computing was used by 26% of companies and it is mostly used in large enterprises with more than 250 employees. The difference between referenced work and this Thesis is that the research was quantitative, thus influencing respondents' answers and the main goal of this Thesis is not the Research, but the Model.

In 2014 Petrík wrote a master thesis on topic "Analýza nabídky ERP systémů pro malé a střední podniky formou SaaS v ČR"[5]. This work analyzed cloud ERP systems available in the Czech Republic. It found that ERP systems on-premises do not differ much from ERP systems provisioned in form of SaaS. SaaS had some other benefits such as faster implementation by a third to half, online access to system from anywhere, low entry investment and easy extensibility. Author recommended SaaS as a suitable model for ERP for SMEs.

Another bachelor thesis from 2015 called "Analýza trhu Cloud Computing"[6] by Kondáčová had a goal of Cloud Computing market analysis in the Czech Republic and Slovakia. This analysis was done for a Czech company DataSpring. A quantitative research was conducted on a sample of 202 companies from the Czech Republic and Slovakia. The research scheme was taken over from the previously referenced bachelor thesis by Janů and is therefore directly comparable. The research showed that 30% of companies in the Czech Republic and

[3] In English: "Adoption of Cloud computing in business sector"
[4] In English: "Current state of Cloud Computing services usage in Czech companies"
[5] In English: "Analysis of ERP systems offering for SMEs in the Czech Republic in form of SaaS"
[6] In English: "Cloud Computing market analysis"

21% of companies in Slovakia use some kind of cloud computing service. That shows that there was a 4% increase during the 3 years passed between the 2 referenced works.

In 2016 Nguyen Sy wrote a bachelor thesis called "Analýzy nabídky ERP služeb nabízených formou SaaS pro malé a střední firmy"[7] has a goal of comparing available ERP cloud solutions suitable for SMEs on Czech market. This is done using original assessment criteria. 5 ERP solutions are compared using a multi-criteria decision-making method resulting in information system Netsuite as the most suitable solution.

A recent master thesis from 2017 by Slavětínský called "Analýza cloudových řešení Business Intelligence pro SME"[8] has a goal of finding suitable BI applications for SMEs available in form of SaaS. It defines metrics to consider when choosing a suitable solution and uses a Fuller's method to estimate weights of all criteria. This thesis so also provides sort of a model to fill in one's own weights into Fuller's triangle and so to obtain a recommendation on the most suitable solutions to one's particular needs. The main difference of referenced work is the very narrow scope in compare with this Thesis, focused only on Business Intelligence solutions.

3.2 Summary of the review of works on similar topic

At University of Economics, Prague there have been already quite a few theses written on topic cloud and also on topic cloud in SMEs. There were theses which did a market research on current cloud adoption by SMEs, there were also theses analyzing a certain part of Cloud segment and most of them were engaged with SaaS only. Only the most recent reviewed works provided some decision model, basically as a by-product of their analysis.

This Master's Thesis is the only from the reviewed works which is written in English and therefore it has much broader potential of use. It is also the only thesis using a qualitative research conducted in 39 companies, which is far more difficult to process but brings much more unbiased results as respondents are not given any answers as choices. A special advantage is, it can bring new, unexpected answers and criteria, which was the primary reason of conducting a qualitative form of questioning. And finally, it is the only work bringing a model for SMEs suitable to assess Cloud Computing potential in general for their company. As such it shall serve as an elementary source on making a decision whether cloud is an option at all and some of the other works concentrated on specific applications, such as ERP or BI, might be useful for further, more detailed assessment of given area.

[7] In English: "Analysis of ERP services offerings in form of SaaS for SMEs"
[8] In English: "Analysis of Business Intelligence cloud solutions for SMEs"

4 Qualitative research

Chapter *Qualitative research* provides a summary of reviewed literature on this topic which serves as a useful frame of reference for readers or future researchers unacquainted with the nature of this research area. Various recognized international and Czech sources are referenced, and information is gathered in a form that it guides readers from a qualitative market research inception through its processing till its analysis.

4.1 Basics of qualitative research

"*There is no single generally accepted way to specify and do qualitative research.*" (Hendl, 2008) This statement gives a sense of what a qualitative research is – a very broad and undefined field of human endeavor.

A negative definition of a qualitative research is any research in which results are reached in a different way than by using statistical methods and or other means of quantification. (Strauss & Corbin, 1990)

The main instrument of qualitative research is the researcher himself/herself, rather than standardized methods of data collection. The data collected includes transcripts of notes from observations and interviews, photos, audio and video recordings, diaries, personal comments, notes – basically anything what can help clarify the researched topic. (Hendl, 2008)

4.1.1 Basic types of qualitative research

There are different types of qualitative research. Some of them as described by Hendl (2008) are these:

1. Case study – detailed description and analysis of one or small number of cases
2. Ethnographic research – description of culture of certain group of people
3. Grounded theory – creating theory based on data
4. Phenomenologist research – understanding different experiences with certain phenomena

4.1.2 Research plan

When designing a research, Hendl (2008) states 6 elements or steps a researcher should follow:

1. *Purpose and objectives* – the why and what – what are we trying to find out and why
2. *Conceptual frame* – the theory we build on
3. *Research question(s)* – what questions we need answers for to achieve our objectives (the central element)
4. *Methods* – choosing methods for data collection and analysis based on questions
5. *Strategy of choosing respondents* – based on what criteria we choose respondents

6. *Validity* – how do we ensure quality of our study, e.g. by triangulation

4.1.3 Sample creation

For creating a sample, according to Hendl (2008) researcher has basically 2 options:

1. Pre-defined sample structure
2. Gradual estimation of sample structure

An example of the latter called *theoretical sampling* was defined by Glaser & Strauss (1967) as a method of doing qualitative research during which data is simultaneously being collected, coded, analyzed and at the same time it is being decided what next data is needed and where to obtain it.

The first, on the other hand, is a case when criteria for determining the sample are known in forth. Then goal is to equally distribute respondents among given criteria. (Hendl, 2008)

4.2 Qualitative market research

A qualitative market research can be defined as "*a form of a market research that seeks to explore and understand people's attitudes, motivations and behaviours – the 'why' and 'how' behind the 'what' – using methods that seek to reach understanding through dialogue and evocation (rather than measurement)*" (Chrzanowska, 2002).

It is a "*Research designed to help organisational decision-making, focusing on understanding the nature of phenomena and their meaning, rather than their incidence. It tends to have the following characteristics: direct face-to-face contact between the primary researchers and those being researched; in-depth examination of small-scale samples or small numbers of observations; unstructured interviewing guides which are responsive to context and may be amended throughout the project; the researcher and his/her interpretative input is key to the process.*" (AQR, 2018)

It is important to say that this discipline is commercial and evolved separately from an academic qualitative research and that relatively little has been written about it as commercial research agencies tend to keep their know-how private. Knowledge has been largely tacit, and the field showed little interest in theory as clients are mostly concerned with findings rather than with procedures of reaching them. (Chrzanowska, 2002)

4.2.1 Qualitative market research objectives

Qualitative market research has many forms and methods and it is useful to classify them by research objectives. Relevant to research conducted in this thesis the typical objectives are: exploration, strategic development and evaluation.

An 'exploration' as an objective aims to discover the current state of a market by observing it and categorizing it. It asks questions like: What is the situation? What is people's general attitude to our product or service?

When an objective is a 'strategic development', the goal is to generate ideas for future strategic decisions by asking 'what if' questions in interviewing.

An 'evaluation' is a case when a researcher is trying to find out reasons for a past behavior and or define the potential of a product or a service on a market. (Chrzanowska, 2002)

4.2.2 Qualitative market researcher skills

Qualitative market researchers need to know more than just asking open-ended questions. First, they need to obtain information without asking too direct questions which could suggest ideas to the respondent. Second, they need to listen very carefully to unlock full a potential of a respondent's answer. Third, they need to create a safe environment in which respondents would not be afraid to express their private opinions and feelings. Fourth, they need to keep people attentive and focused on specific goals and explore them in various ways.

One research trainee described a qualitative research this way: "*Moderators are like ducks – everything looks smooth on the surface, but they are paddling furiously underneath*." (Chrzanowska, 2002)

4.3 Interview as a qualitative research method

Since the research conducted in this thesis uses an Interview as a data collection technique, it is the qualitative research technique which will be further described in terms of this text.

There are different types or formats of interviews, basically they can be either individual or group. Individual depth interviews are used in cases when it is impractical to do group interviews, such as when respondents are too busy, the information provided is too sensitive, there is a risk of influencing one another by each other's responses or when the knowledge of respondents is specialized, and it is important for the research to record individual knowledge. Although, depth interviews can be more stressful as there is no group to hide behind, they are widely used especially in Germany and the Netherlands.

Among strengths of qualitative interviewing one can count the space given to respondents to express their own views on some things, their own descriptions and stories in their own words. What they say, how and in which order provides an insight into their priorities, knowledge and experience. Based on this data it is possible to explore their needs and desires and find out about ways they define and categorize things.

A limitation of qualitative interviewing lies in a fact that what the respondent says does not need to be the same as what actually is respondent's reality. Their real behavior might differ from their own description. Respondent may also be influenced by the interviewer if the interviewer isn't aware of his own biases and opinions and doesn't hide them properly. (Chrzanowska, 2002)

4.3.1 Structured interview with open questions

A structured interview with open questions is a type of an interview which consists of exactly formulated questions and it is also basically the type used during the Research conducted in the means of this Thesis. It is a useful approach when it is needed to ensure that data collected across different interviews would not vary significantly. It allows for minimizing an effect of an interviewer on quality of an interview. As topics are divided into questions, it is easier to analyze data. That provides for replicability of the research by a different researcher. It is also useful when there is a limited time to devote to each respondent with no chance of repeating the interview. (Hendl, 2008)

4.3.2 Interview with a topic guide

Another approach to interviewing is interviewing with a topic guide. Topic guide is basically a list of questions or topics which are important to be discussed during an interview. First, a researcher sets a general topic and subsequently all the side topics. (Hendl, 2008)

It is good to start with easy topics and get as early as possible information which will help to understand later provided answers. Important is to pay a close attention to the order of questions as these not only define how a respondent will feel during the interview but some questions may influence answers to later questions. Usually questions are ordered from the general to the specific. The most critical or sensitive questions are recommended to be placed at the end of the interview. (Chrzanowska, 2002)

It is a freer type of an interview than a structured interview which allows an interviewer to freely form questions as the discussion flows and at the same time to get answers to all important questions. (Hendl, 2008)

Even though, the Research conducted in this Thesis was based on structured interviews, the respondents themselves sometimes tended to mix the order a bit by having a monologue which answered several questions at the time. Therefore, it is good for a researcher to be prepared for this situation and so to be able to react in a form similar to just having a topic guide.

4.3.3 Types of questions

Krueger (1998) identifies opening, introductory, transition, key and ending questions. Inexperienced moderators usually write out the questions in full and follow them closely, whereas experienced moderators are more likely to differ from the questions listed and adapt them as needed during the interview.

It is advisable for novice interviewers to practice the questions and learn them by heart as looking into a paper with questions creates a barrier between a respondent and an interviewer. (Chrzanowska, 2002)

Questions can be modified and added during a research, data collection as well as data analysis. Therefore, a qualitative research is very flexible. New hypothesis and decisions emerge during the period of conducting a research. (Hendl, 2008)

It is basically impossible to predict all the questions and the skill of a fluid creation of supplementary questions is important. Every researcher has developed ways of prompting a respondent to uncover more information, keep or start talking. Interrogatory questions starting with 'why' need to be used very carefully and it is better to soften them like 'I am interested about what you do with/what you said/…". It is useful to paraphrase, summarize, reflect and challenge respondents in order to get the fullest answer possible. (Chrzanowska, 2002)

Hendl (2008) defines these types of questions relevant to this research:

1. Questions regarding experience and behavior – aim to discover the way a respondent normally acts
2. Questions regarding opinions – aim to discover goals, values and attitudes of a respondent
3. Questions regarding feelings – trying to uncover a respondent's emotions associated with certain events
4. Questions regarding knowledge – aim to discover what a respondent truly knows
5. Questions regarding perception – aim to discover what a respondent saw or heard
6. Demographic and contextual questions – identification characteristics of a respondent

4.3.4 Roles of interviewer

There are different roles an interviewer can play to elicit useful information. Among others they are *The deliberately naïve, The experienced veteran, The independent 'reporter'* and *The devil's advocate*.

The deliberately naïve is used when an interviewer truly has little or knowledge on the subject or wants to hide his/her biased view.

The experienced veteran is a role played when confronted with people with specialized knowledge who might feel held off by answering questions to an unknowledgeable person.

The independent 'reporter' is a practiced role in situations when clear pros and cons need to be established and there is a chance of being a target of respondent's anger aimed at a researched subject.

The devil's advocate might temporarily support a subject of a research (e.g. a product) in order to challenge a respondent and induce his/her reaction. (Chrzanowska, 2002)

4.3.5 Respondent – researcher relationship

A researcher is responsible for protecting the anonymity of respondents, properly informing them of a purpose and nature of a research and for obtaining their consents in case of an

audio or a video recording. Respondents need to be assured there is nothing wrong with not answering all the questions and they are free to walk away at any time.

Apart from this official agreement between a researcher and a respondent there is also an unsaid agreement in place. When respondents agree to take part in an interview they usually feel obligated to actively help a researcher with getting as valuable data as possible. (Chrzanowska, 2002)

A researcher needs to keep a neutral attitude towards content of collected data. "We collect data, but we don't judge the person" (Hendl, 2008)

4.4 Data processing, categorizing and presentation

After collecting data in form of an interview or other, the data needs to be processed, categorized and presented.

4.4.1 Transcription techniques

Transcription techniques are part of data preparation for further processing and as such are the first step of data processing. According to Hendl (2008) following techniques can be distinguished:

1. Literal transcription – a word by word transcription of an interview (time-consuming)
2. Commented transcription – commenting on important data acquired from a literal transcription
3. Summarizing protocol – summarizing acquired information based on an assumption that not all information is important or can be obtained from other information
4. Selective protocol – only information following pre-defined criteria is selected

4.4.2 Categorization systems

Creating categories serves purpose of sorting data and its reduction. Categories can be defined upfront but more commonly during a qualitative research as they emerge from the ongoing research. Categorization is used in data processing but is close to data analysis as well. It is usual that creation of categories is an iterative process and so often they need to be reworked several times during data processing phase. (Hendl, 2008)

4.4.3 Data presentation

By data presentation is not meant presenting the final research results, contrary to that it is a process needed for a following analysis. The main presentation technique in a qualitative research is a text which can be coded. Though, there are other means of a qualitative data presentation, such as tables, process models and structure models. Structuring data into tables is a useful way. One of possible usages is to setup table in a way that it shows relations between cases of a study. It is important to state whether the table has a descriptive or exploratory role, thus uncovering configurations of data or development of certain things. (Hendl, 2008)

4.5 Methods of qualitative data analysis

After the data was processed, it needs to be analyzed to obtain useful findings. Three commonly used analysis methods are introduced. They all have a similar course – in all of them the vast amount of qualitative data is simplified and categorized in order discover useful findings. The method most closely describing the process conducted in terms of the Research in this Thesis is a below described 'Case study analysis'.

4.5.1 Framework analysis

Framework analysis was developed by Ritchie & Spencer (1994). Its purpose is to ease systematic exploration of qualitative data. First, materials need to be organized – sorted and reduced, next they need to be interpreted, that is described or explained.

First step is to identify initial topics and concepts which are based on thorough read-through of all materials. These topics are organized into structured lists. Second step is indexing data, or individual parts of texts, with the lists created in the first step. Third step is creating topic tables in order to sort and organize data. Each topic has its own table. In fourth step all the data is summarized and synthesized in tables.

4.5.2 Case study analysis

A widely accepted method of analyzing case study data was developed by Miles & Huberman (1994). This analysis is iterative and continues until all questions are answered. First step is to store and organize data by transcribing it, usually by inputting into a computer software. Next step is a segmentation where data is divided into logical units. A natural segment is an answer to a question. Third step is coding. Codes are associated with certain parts of text and help organize and classify them. It is a crucial part of data analysis. There are two levels of coding, where first associates codes with pieces of text, whereas second aggregates codes into meaningful groups based on topics. Last step is commenting, where a comment or note is something what comes to researcher's mind during research or contains information about codes and their relations to each other. These relations between codes and categories can be described in great detail. Then data is displayed using graphs and tables.

Among methods and tactics recommended by the authors to analyze data can be noted:

1) Counting frequencies – e.g. frequency of usage of a certain word or phrase or mentioning a certain problem.
2) Clustering – putting together related events, people or topics.
3) Categories refinement – for a more detailed and precise categorization of data
4) Combining categories – for categories with too little amount of cases
5) Searching for main factors – replacing several similar categories by one with a clearer and more robust meaning
6) Capturing relations – for related factors whose values change in parallel

4.5.3 Grounded theory

Grounded theory is a famous methodology of conducting a qualitative research developed originally by Glaser & Strauss (1967). Three main elements are concepts, categories and propositions. Concepts are core elements of data analysis from which theory is derived. Categories serve to aggregate concepts and so are the substantial determinants of emerging theory. Meaning of propositions is to describe relations between categories themselves and between categories.

The selection of material is done using theoretical sampling. That means that selection is governed by the needs of ongoing research and accordingly modified. Categorization of material is an iterative process during a research and is called theoretical coding. Behind empirical indicators (means of behavior, events) are latent categories (conceptual codes and constructs). Several similar categories indicate a central category.

Because during the whole research emerged concepts and categories are being compared between each other the whole method is sometimes called a Constant comparative method. (Hendl, 2008)

4.6 Chapter summary

Chapter *Qualitative research* provided an overview of theory applicable on conducting a qualitative research, or more specifically a qualitative market research with respect to the Research conducted in terms of this Thesis. Core steps and concepts were introduced including information on designing a research plan, creating the respondents sample or types of skills needed to conduct a research. Interview was presented as a data collection technique together with types of questions asked and interviewer roles played in order to obtain desired information. Data processing and analysis methods were described. The theory presented is further used in praxis as described in following chapter *Designing and conducting a qualitative market research in ICT*.

5 Designing and conducting a qualitative market research in ICT

Chapter *Designing and conducting a qualitative market research in ICT* describes a complete procedure of conducting a qualitative market research in terms of this Thesis. Methods used follow the theory presented in previous chapter where applicable and enhance the theory where it was not specific enough. The description is detailed, providing its readers a complete know-how useful for conducting a similar research of their own. Described are sampling and respondents acquiring techniques, interviewing procedures, qualitative data processing and analysis as well as all the questions asked during the research including their justification.

5.1 Research plan

Section *Research plan* describes the steps set upfront to conduct a qualitative research on cloud adoption potential by Czech SMEs managers.

1. Define purpose and research questions
2. Create sample design
3. Design interview
4. Acquire respondents, dates and locations
5. Conduct interviews
6. Process, code and present data
7. Analyze data
8. Write a report of key findings with indicated factors

5.2 Purpose and research questions

Purpose and main research questions were outlined already in the *Introduction* of this thesis. Main purpose of conducting this research was to find out about factors for and against cloud. In order to fulfil this purpose, following topics were identified:

1) State of market with regard to cloud
    a. How much executives of SMEs know about cloud
    b. How many companies adopted cloud or plan to
2) Motivations for or against adopting cloud
3) Explanations to the motivations based on deeper understanding of situation of each of the respondents

In order to find answers to these topics, specific questions were designed which are described in latter section of this chapter - *Interview design*.

5.3 Sample design

Section *Sample design* discusses the process of sample creation, i.e. who is the respondent of this market research. Sample defines the language used for formulation of questions and is highly connected to process of acquiring respondents as initially defined sample had to be changed several times during the Research period as strategies for acquiring respondents changed and research needs changed.

As defined earlier in introduction of this Thesis, SMEs in Europe are considered companies with up to 250 employees and turnover not exceeding 50 million Euros or not having a balance sheet total over 43 million Euros. (European Commission, 2003) Therefore, an effective way to find only relevant companies was needed.

The purpose of this thesis is to build a universal model for all SMEs, not just for SMEs in certain sector. For that reason, a wide range of business areas needed to be established.

5.3.1 Introducing database of companies Albertina

For identifying suitable companies was chosen Czech software Albertina by Bisnode. This software is available to all students and teachers of University of Economics, Prague which was the primary reason for using this software.

Albertina is a database of companies in form of a desktop software connected to an online database which gets updated regularly. It provides basic contact, profile and economic data on companies operating in the Czech Republic. In order to find certain companies, they can be identified using their name or identification number, which is useful when information on specific company is needed. For the purpose of this thesis, though, much more important were filtering options of this software.

Companies can be filtered using criteria listed in *Appendix G: Filtering criteria in database of companies Albertina*.

5.3.2 Basic filtering scheme

In order to filter out relevant companies in a reasonable amount, following criteria were used:

- *Region* = Prague
- *Legal form* = Public commercial company, Limited liability company, Societe comandite, Joint stock company
- *Area of business activity* – using CZ-NACE as described further
- *Annual turnover* = categories of turnover lower than 1 499 million CZK
- *Number of employees* = number of employees lower than 250

Prague as a region was used because of high density of companies there as it is capital of the Czech Republic and also because of convenience to the author of this thesis who is based in Prague.

Chosen were such legal forms which suggest private ownership.

For area of business activity was used filtering by CZ-NACE. CZ-NACE (**N**omenclature statistique des **a**ctivités économiques dans la **C**ommunauté **e**uropéenne) is a classification of economic activities which is in accordance with the Regulation of the European Parliament and of the Council. (Fischer, 2007)

In order to ensure a wide range of economic activities and at the same time to limit number of potential companies, initially, diverse activity groups were selected as listed in *Appendix H: Initial business activity categories for sample definition*.

SMEs have defined annual turnover lower than 50 million EUR (CzechInvest, 2014) which is approx. 1 270 million CZK (source: Google on March 10, 2018). The closest available category in Albertina is 1 000 to 1 499 million CZK and therefore all categories lower than this category and including it were selected.

Number of employees in SMEs is 1 to 250 (CzechInvest, 2014), therefore all categories complying with this criterion were chosen.

5.3.3 Changes to filtering scheme

Even though software Albertina was used already in the stage of defining basic filtering scheme, during acquiring respondents stage, as described further, was found out that many companies in the selection were not fitting the research needs and at the same time the needs of the research evolved during its conduction and so different strategies were evolved.

Following criteria were added to the selection process:

1. *Position in a company* = IT director, IT Sector Director, Head of the Information Systems Department (as these people were supposedly the most competent to answer research questions)
2. *Related persons*
    a. *Country of owner* = Czech Republic (to limit preferably Czech owned companies)
    b. *Number of workplaces* = 3 and more (based on author's assumption that cloud can be more interesting to companies with more branches)
3. *Region* → *District* = Prague 5 (as a place of residence of a researcher in pursue of optimizing the time spent on travel)
4. *Economic growth* = chosen were companies with positive economic growth (based on author's assumption that economically striving companies are more likely to consider advancements in their ICT strategy like migration to cloud). As this is not a settable criterion in Albertina, it needed to be done manually as described further.

Annual turnover, number of employees and legal form were the only criteria which were always present in filter, though narrower defined categories were sometimes chosen, like companies with 10-50 employees and turnover of up to 100 million CZK or on the other hand 200-250 employees and turnover of 500 to 1 499 million CZK.

The configurations of filter changed constantly as research needs evolved and not all of the criteria mentioned above were always used.

Initially lined out scheme of economic activities was soon abandoned as an important criterion of inclusion of a company in the research became its willingness to participate in it. A principle which stayed though was to cover as wide area of economic activities as possible in order to get a sense of the whole market.

5.3.4 Companies screening and second level filtering

Upon the basic filtering done by Albertina based on given criteria second level filtering was done by manual screening of filtered companies.

Following procedure was used for screening:

1) Check correlation of economic *activity* with company's own description
2) Check *economic (business) data* with respect to growth
3) Check company's *website* profile regarding activity, relations to other organizations, bio and contacts

First step, checking economic activity, was often a fast determinant of exclusion of a company from the Research because it turned out that statements about CZ-NACE in commercial register are often far from what companies actually do. If the company did not fall into category of search but still was compliant with another defined category of economic activity, it stayed included for further screening and possible research.

Second step, checking economic data, was sometimes more complicated as not all the data is present in Albertina. Albertina gathers its economic data primarily from server justice.cz, which is a portal administered by Czech Ministry of Justice and it presents publicly available data from the Commercial Register. Companies which are required to do so by Commercial Code enter data about their activity into Commercial Register. Among them are profit and loss accounts and balance sheets. (Chamr & Partners, 2017) The problem is that not all companies enter the most current data to the Commercial Register and perhaps also Albertina does not have a fully automated system of data integration and so it is common that only data older than 2 years are available. Therefore, for newer companies it is usual that no economic data is present.

Third and last step of screening is checking company's website. This step is very useful and cannot be omitted. First, it is the final confirmation of what the company actually does. Second, from company profile can be obtained very worthy information. Quite often it happens that the company follows all defined criteria but when screened it turns out it is a part of a global corporate or a part of another larger body which mostly makes it non-compliant with the SME rule. Third, company's biography explains a lot about company's development and is useful in the phase of acquiring respondents, as well as in a following interview and can be important as a contextual information during analysis. Fourth, it is advisable to check available contacts, as contacts available in Albertina are not always accurate and sometimes contacts for specific persons are available on websites which

significantly eases the process of acquiring respondents as described further. A detailed description of negatives and positives of using Albertina is available in *Appendix I: Negatives and positives of using Albertina*.

5.4 Interview design

Section Interview design explains the process of designing an interview, that is the questions asked including introduction of an interview, hints to ease respondent answering in case of not understanding a question and connecting sentences to create connections between questions and make an interview seem more as a fluid and natural conversation.

A complete interview design including all questions is available in *Research interview template (a Word file in Czech)* in *Appendix A: Digital additions to this Thesis*.

5.4.1 Language

Intentionally, the language used in all questions was as trivial as possible. Since not all the interviewees were educated in ICT, it was important to phrase questions in such a way that everyone could understand. Therefore, for instance when talking about "hosting" it was referred to as "rental of servers in cloud" after prior definition of the term "cloud" by the respondent. If the person couldn't define word "cloud", then "hosting" would be described as "rental of servers operated by another company in a different location". The exact wording of the questions could therefore be changed as needed to acquire answers to research questions.

5.4.2 Using hints

Each question was accompanied by a series of hints. These hints were usually not used. Their primary usage was to remind researcher of what kind of data is intended to be gathered. Another important usage was to help interviewee understand the question. Most of the time hints would not be used as using them is likely to influence respondent's response, which is undesirable. Though, in cases when the person would directly ask for hints, required further explanation of a question, or the answer was not relevant to the question asked, these hints would provide a useful frame of reference to a researcher to quickly help respondent find corresponding answers.

5.4.3 Connecting sentences

In order to explain upcoming question or to make a connection between two seemingly unrelated topics, explaining or connecting sentences were made part of interview design. An example of such a sentence is introducing an interviewee to first question about ICT: *"The first question is going to be introductory, so we could align our ideas of ICT."* These sentences were not always used using the exact same wording, but they served as a useful guideline to the interviewer.

5.4.4 Questions' purposes and their wordings

Question 1: Defining ICT

Purpose of the first question was to start a dialogue and foremost to give the researcher a general context of an interviewee's perspective of ICT. It was intended to be a broad topic, so it would not be very personal and so the interviewed person would feel comfortable answering it.

Wording was as follows: "*What is ICT (or information and communication technology) for you?*"

Often later during research the question was refined as: "*What is ICT (or information and communication technology) for you in context of your company?*"

Hints: "*Is it a computer, a network, E-mail or an internal information system?*"

Question 2: Number of ICT users

Second question was another context question. Number of ICT users isn't always the same as number of employees (it can be both smaller or larger as confirmed in research further) but it gives a sense of importance of ICT to business and its scale.

This question was as follows: "*How many users of ICT do you have?*"

Hints: *no hints used*

Question 3: Size of ICT department

Another question important to specify position of ICT in company's structure. Zero staff in ICT department would usually mean low significance of ICT for the business. The higher the number of ICT staff, the more likely ICT is an important part of the company.

Question: "*How big is your ICT department?*"

Hints: *no hints used*

Question 4: Areas of ICT usability

Purpose of fourth question was to find out in what ways ICT supports the business, what services does it provide to business. This would provide again a useful context in determining importance of ICT in a company, deeper insights into company's processes and structure as well as first hints on where cloud services could be useful for a particular company.

Question: "*How ICT supports your business? What services does it provide to your business?"*

Hints: "*Should it ease communication with your customers or an internal communication? Should it help with production? How? In what quality?"*

Question 5: Problems with ICT

Definitely a first sensitive topic which would not always yield the most honest answers as would sometimes be found out later during an interview. The purpose of this questions was to uncover pain points of the interviewee in context of ICT. Often it provided useful insights into company's problems, current or recent changes and nearby plans. Sometimes it even helped respondent realize a certain issue which would then decide to find a solution for.

Question: "*Are there differences between your idea of your ICT functioning and its reality?*"

Hints: "*Does ICT fulfil your ideas of how it should support your business? How satisfied are you with its functioning in terms of reliability, availability and security?*"

Comments to questions 4 and 5

Original wording of these questions was slightly different, though the general purpose was the same. At first question 4 was as follows: "*How should ICT support your business?*" and question 5 was: "*How and in what quality ICT supports your business at this moment? In which areas do you use it?*"

The difference is that question 4 was asking for an ideal state of ICT support whereas later it was changed to how actually ICT is supporting business. The reason for this was that the question was partly duplicating with question 27 as described further and also at this stage it was not easy for the respondents to understand what they should answer and often they were describing what their ICT actually does. Therefore, the question was changed.

Question 5's original wording was intended to compare ideal state described in question 4 with the reality and so to uncover problems. This purpose was kept but the wording was changed in accordance with the change in wording of question 4.

Question 6: ICT costs tracking

Since one of the main decision criteria of whether to migrate to cloud or stay on one's own premises are presumably costs of either solution, it seemed necessary to research whether and how SMEs keep track of their ICT costs. Question 6 was the first on this topic.

Question: "*Are you calculating your ICT costs?*"

Question 7: Method of calculating ICT costs

Second question from topic *ICT costs* was meant to find out what methods companies use to calculate their ICT associated costs. Presumably it should be some methods which would allow for comparison of different ICT projects.

Question: "*Do you use any method for calculating your ICT costs? Which?*"

Hints: "ABC, *TCO, Payback Period, company's own method*"

Question 8: Inclusion in ICT costs

Based on author's education obtained through course *IT Financial Management* lectured by doc. Ing. Miloš Maryška, Ph.D. at University of Economics, Prague there are many things and areas considered ICT costs and in order to calculate a cost of certain project they should be taken into account. Since calculating costs would be an important part of decision making when migrating to cloud, it is important to define *what is an ICT cost*. An assumption was made that this knowledge might not be universally present in all companies and so a research question was framed.

Question: *"What do you calculate in ICT cost?"*

Hints: *"Purchases of computer equipment, software licenses, ICT staff, space for your servers"*

Question 9: ICT disaster costs

Question about ICT disaster costs was aimed to discover what it costs a company when ICT is not functioning. This question had two goals:

1) Find out, whether company knows an exact financial sum as that makes every investment decision easier to asses
2) Find out, what time frame of non-functioning ICT is critical for a company

Question: *"Do you know what it costs you when your ICT is non-functioning for a day?"*

Question 10: ICT security risks

Since cloud is a highly controversial topic regarding ICT security, before talking about cloud it was necessary to discover companies' fears regarding ICT security in general.

Question: *"What risks do you perceive in ICT security?"*

Question 11: GDPR

GDPR, or General Data Protection Regulation, is at time of writing this thesis a very current topic as talks about it are ubiquitous and the regulation is not yet effective. As a regulation protecting user data it has a strong relation to ICT security and the author has met many people from industry who believe it might accelerate migration to cloud as some cloud tools are very suitable for meeting GDPR requirements.

Question: *"What does GDPR mean to you? How do you prepare for it?"*

Hints: *"EU regulation about personal data protection, which is to be effective since May 25 2018"*

Question 12: Definition of Cloud

First question regarding cloud directly. Since many following questions are associated with cloud, it was important to first find out how an interviewee defines *cloud*.

Question: *"What is a 'cloud' to you? What does it mean?"*

Hints: *"Is it E-mail? Office 365? Amazon?"*

Question 13: Data backup

Data backup is a typical cloud use case. Therefore, this was placed as a first cloud associated topic with intention to find out whether companies backup their data on their own premises, in cloud or using both options. Second reason to ask this question was to discover how important it is for companies to back up data. Third reason was to uncover how well (or badly) companies back up their data.

Question: *"How do you back up your data?"*

Hints: *"How often do you back up? Where? Do you keep versions?*

Question 14: Backup security

An assumption was made that mostly every company backs up its data some way. The question is, how well? How secure are their data backups and can they be sure they will recover their data from backups? From author's work experience, companies usually back up their data but not so often keep track of how well they back it up.

Question: *"How you can be sure that you restore your backup?"*

Hints: *"Have you ever had to recover data? Have you tried to?"*

Question 15: Internal backup vs. cloud backup comparison

No matter whether they back up using their own resources or back up to cloud, companies do so usually as they see some advantages and disadvantages of the respective options. Discovering these pros and cons provides a useful base for defining criteria for the final decision support model which is a primary goal of this thesis.

Question: *"What advantages and disadvantages do you perceive regarding internal backup vs. cloud backup?"*

Question 16: Usage of servers

Purpose of this question was to find out whether a company operates any servers for its business. If it does, housing and hosting services can be relevant to them.

Question: *"Do you operate any servers?"*

Hints: *"For e-mail, web, application distribution, accounting"*

Question 17: Servers operators

This question aims to discover whether the company operates their servers or has another company operate them for them. This can unveil a lot about company's trust in services of third parties. If a company has a third party running their servers, they might be more likely to make use of housing or hosting services in the future.

Question: *"Who is operating your servers? Is it your ICT department or an external company?"*

Question 18: Server quality requirements

As in cloud world there are common SLAs (Service Level Agreements), for cloud providers it is a usual practice to guarantee certain level of quality. The goal of this question was to find out what the actual requirements of server quality for SMEs are. Answers to these questions could potentially yield interesting results. Theoretically, one possible outcome could be that their requirements are not as high as what cloud providers provide and therefore perhaps they could be satisfied with a lower quality and a cheaper service. Other possible outcome is that their requirements are high, but they are not able to satisfy them using their own resources and so there would be a great opportunity for cloud.

Question: "*What are your requirements regarding quality of your servers' operation?"*

Hints: *"Availability, speed, reliability, security"*

Question 19: Infrastructure monitoring

After asking what their requirements are it seems as a logical step to ask them, how do they ensure the quality is as expected. Presumably, almost everyone wants a fast, reliable, always available and secure environment. How do they know their systems are working the way they are supposed to? By monitoring them.

Question: *"Do you monitor your infrastructure by any means? How?"*

Hints: *"Do you have any way to monitor state of your servers, routers, networks and are you able so to prevent problems before they actually happen?*

Comment to question 19

This question was originally listed behind question no. 5. Later on, it made more sense to the researcher to locate this question after questions regarding servers as it is both related to infrastructure.

Question 20: On-premises servers vs. hosting

Another comparison question, this time trying to reveal the reasons to either operate one's own servers or to use hosting services. By comparing advantages and disadvantages of both approaches, decision criteria shall crystallize.

Question: *"What advantages and disadvantages do you perceive regarding internal operation of servers vs. their rental through cloud?"*

Question 21: Housing

Purpose of this question was to present an idea of keeping one's own servers while moving it to a specialized company.

Question: *"What is your opinion on an option to not operate your own server room, but instead to move your servers into a server room of a specialized company and let them take care of them?"*

Question 22: Cloud applications

Even though, a company could have answered negatively to all questions regarding cloud so far, there is a good chance they are using some cloud application. And a good chance they are not aware of the fact it is a cloud application. Purpose of this question therefore is to find out whether there are any cloud applications the company uses.

Question: *"Do you use any applications in cloud?"*

Hints: *"E-mail, accounting, e-mailing solution, CRM"*

Question 23: Private cloud

Cloud can have many pejorative meanings or associations to some companies, especially due to security concerns. Though, they might want to use the modern technologies like working from mobile devices or from anywhere on the planet. For some of them a private cloud can be a solution. Therefore, this question aims to discover whether companies know about this option and its name.

Question: *"Could you describe what you imagine under a term 'private cloud'?"*

Hints: *"On-premises cloud technologies or dedicated resources at a third party"*

Question 24: ICT improvement decision factors

First of the final questions which shall help in determining decision criteria for the final decision model. This question is general and aims to discover broad factors taken into account when considering an improvement regarding ICT.

Question: *"Which factors do you take into account when making a decision regarding improvement of your current ICT?"*

Hints: *"How it helps business operation, costs, savings, time frame of the project, how big part of company will be influenced, ease of adaptation of the innovation, scalability of the solution"*

Question 25: On-premises vs. cloud decision factors

One of the last question was aimed to find out general decision factors of whether on-premises or cloud is better.

Question: *"Which factors do you consider when deciding whether to operate something on-premises or in an external cloud?"*

Hints: "*Availability, security, form of payment, internal ICT staff resources, trust in a service"*

Question 26: ICT contractor qualities

A question aimed to discover all the important factors when choosing (or staying with) a certain ICT contractor. Analysis of the answers should help reveal what kind of qualities cloud operators should have in order to succeed with SMEs.

Question: *"What is important to you when choosing an ICT contractor?"*

Hints: *"Time on market, price, recommendations, availability of personal consultation, origin, language of business, certifications, expertise, credibility"*

Question 27: ICT visions

Last question was meant to induce respondent's imagination on what could be done using ICT or where the company's next move should be directed and how ICT could help with that. Analysis of these answers could provide a useful insight on where cloud is standing in the near future of Czech SMEs.

Question: *"How could you improve your company using ICT? In which areas do you see a potential of using ICT for improving your business operation? Where ICT could drive your business?"*

5.5 Acquiring respondents, setting dates and locations

Section *Acquiring respondents, setting dates and locations* describes the process of cold calling and other methods used to arrange interviews and the way this process evolved over time. During this process potential respondents always got acquainted with the interview design and the thesis aims. Sometimes the respondents required to see questions ahead of agreeing to giving the interview. If the respondent agreed to an interview, date and a location were established.

Most of respondents were acquired through so called "cold calling". As defined by (Business Dictionary, 2018), cold calling is "*Calling a prospect (who does not know the caller) for a sales appointment.*" This cold calling was, of course, not done with an intention to sell anything but the author thought of it as a good method to obtain meetings for interviews. The assumption was that success rate would be higher than with contacting via e-mail.

After the screening contact information is found. Using contact information available in Albertina was soon abandoned as it proved to be unreliable. Few times it happened that number called belonged to a completely different company. When filtering by position in a company, the person would be listed but available numbers would have no assigned person in Albertina which resulted in uselessness of this information. Therefore, soon the only method of obtaining phone numbers became screening of companies' websites.

5.5.1 Defining a respondent

Respondent was supposed to be someone who is competent in deciding on ICT strategy of given company and investment decisions. Therefore, depending on each specific company this would be mostly a CEO, managing director, ICT director, or economic director.

5.5.2 Designing a call script

As author had no experience with cold calling prior to conducting this research, calling without preparation would likely result in high rejection rate. Therefore, a call script was elaborated.

Based on various information found on the internet and consultation with colleagues from author's employment a scenario available in *Appendix J: Call script scenario* was developed.

Of course, this call script was not completely universal. For instance, there is no scenario for the situation when a called number was wrong and so a different company was called. When interacting with people, it is virtually impossible to predict all possible reactions and it would make call script very complicated and difficult to navigate. The ability to swiftly react to emerged situations came naturally as more and more calls were made.

Before first real calling, several practice calls were made with family and colleagues. These people imitated different situations which could happen during real calling. This process significantly helped reduce stress before first calls, increased professionalism and mostly reduced possible rejection rate. It is a very advisable step to every researcher.

5.5.3 Calling

Prior to each call, call script was always slightly edited to reflect each specific business. Purpose of this is to show that calling to this particular company is not accidental. It is intentional, caller already knows something about the company. This makes a feeling on the other side of line that they are important to caller and not just "a number on a list" which helps in getting an interview.

Calls were always made using formal language, a high emotion in tone of voice to evoke a good mood and as self-confidently as possible while being decent, again in order to raise chances of not being hung up on.

First few calls were recorded in order to have a feedback. When the process was smooth enough, this was no longer needed and therefore discontinued. Every call, whether successful or unsuccessful was recorded in an Excel table to keep track of called numbers and success rate. Structure of this table is available in *Appendix K: Calls tracking table*.

5.5.4 Other ways of acquiring respondents

Apart from cold calling which was initially the only strategy to acquire respondents, significant part (about 50%) of respondents were obtained through recommendation of acquaintances and family. The criteria were only a Czech company with 10 to 250 employees. Therefore, it happened, that some of the companies were outside of Prague, where the most distant one was from South Moravia (a region of the Czech Republic to the southeast).

Of course, this strategy was much more effective than cold calling which was very time consuming. Though, combination of these two approaches proved to be very good for the research as each approach and each recommending person brought different kinds of companies to the research which assured a variety of respondents.

5.5.5 Setting dates and locations of interviews

Dates and locations were always set in a way that it would be convenient for the respondent.

Most of the time the location was an interviewed person's office or a meeting room at their facilities as this was very convenient for them and researcher himself didn't have any special facilities for this purpose. For companies who were outside of Prague a meeting place differed. Two interviews were conducted in a cafe in Prague, one in a cafe in Brno and with three of them the meeting was in their office, but it was necessary to travel there by a borrowed car.

Time of meeting was usually during working hours. In one case meeting took place in early morning hours (7:15 a.m.) and in 2 cases in the evening (6 p.m.)

5.5.6 Stats about acquiring respondents

Table *Acquiring respondents statistics* below provides data on total number of companies called, number of realized interviews out of these calls and so a calculated success rate, next number of companies obtained through recommendation and total number of respondents.

Table 2 Acquiring respondents statistics

Statistics description	Value
Number of companies called:	112
Number of interviews acquired from cold called companies:	19
Cold calling success rate:	17% (19 out of 112)
Number of companies obtained through recommendation:	20
Total number of respondents:	39

5.5.7 Acquired sample of companies

In total 39 companies were interviewed. These companies are not ordered in any particular way in order to increase their anonymity which was their condition of making an interview. However, the order provided in table *Interviewed companies overview* available in *Appendix L: Interviewed companies* is kept throughout the analysis in a form of a number specified in column *Company ID*. This way it is possible to track back what kind of companies have which needs. The information about each company includes field of activity, number of ICT users, number of internal ICT staff and position of an interviewed person. This provides important information on context of the acquired data.

20 companies in the sample are considered a middle-sized enterprise, ranging from 50 to 250 employees. 19 companies are small-sized, out of which 3 are micro, ranging from 1 to 49 employees.

5.6 Data collection: Interviewing

Section *Data collection: Interviewing* deals with the process of interviewing itself – setting, language used, working with questions and respondents. It is also the first form of data processing as the content of an interview was written down during the interview itself.

5.6.1 Structure of interview

Each interview consisted of following parts:

1. Introduction of the researcher, research, interview and its outcomes for the respondent
2. Introduction of the respondent and company
3. Interview
4. Interview unrelated talk
5. Conclusion

5.6.2 Description of interviewing process

Introduction of the researcher included researcher's name, university, reminder of the purpose of the meeting. Introducing the research consisted of presenting the research purpose. Introducing the interview encompassed information about length of the interview and its structure. Outcomes for the respondent were supposed to be a certain basic analysis of company's ICT emerging from the interview and also the diploma thesis itself which is meant to be a tool for companies.

Usually, after this introduction a brief (sometimes longer) introduction of the company had its place. Though, the researcher usually conducted quite detailed research of what the company does, still it was very interesting and useful to hear that directly from an inside person, especially from managing directors and other managers. It also provided a useful frame of reference, context for the whole interview and possibly for the research.

Interview itself was always the longest and, of course, the most important part of the interview. In reality, the questions were not always answered in the same order as prescribed. Very often an interviewee started to talk about their company which also answered the first or fourth question and sometimes also questions 2, 3 or 5. This was not considered a problem, contrary to that it proved that the introductory questions made sense.

Though, this wasn't the only irregularity. Often the researcher had to "jump" from questions placed at the beginning to the questions at the end because the interviewee started to talk on that topic. Again, there was no problem with that, only it was more difficult for the researcher to keep pace and track of what the interviewee is talking about and so where to make notes on that. After each such "turnout" the interviewer always came back to question originally asked or to a question following.

Interviews didn't always take the same time. Time limitations and the willingness to talk varied significantly. Therefore, the shortest interviews took about 30 minutes whereas the longest about 2 hours. Of course, 30 minutes is not enough for 27 questions. Therefore, unfortunately, not all the questions were always answered. This was also true, when interviews were longer. If the interviewee expressed certain opinion on a given topic sooner during an interview than a related question came, sometimes the question was not asked any more. Interview itself probably never took longer than 60 minutes. If the whole meeting was longer, it was because the two parties found a common ground on some topic and continued

unrelated to the research and interview. For instance, in 4 cases the researcher obtained right after finishing the interview direct or indirect job offers so the talk would be about company itself and its culture.

Conclusion included reassuring that the interviewee and company would stay anonymous in the research, question about whether the respondent would like to receive finished research and goodbye.

5.6.3 Interview recording

An original plan of recording an interview was using a combination of recording using a cell phone recorder and taking notes. During the first interview this plan was abolished when the interviewee expressed his disapproval with audio recording and that he would rather repeat what he said, so the interviewer could write everything down.

Since then, the only used method was taking detailed notes of relevant answers. At the beginning of the research a handwriting on papers with printed interview questions was used. Later a tablet was used where the answers could be written down in electronic format right below corresponding questions. Handwriting was since then only used as a backup method which had to be used a couple times.

Switching to a tablet had significant advantages to the researcher as no further transcription was needed. Also, researcher could write faster on a tablet than with hand. At the same time, tablet didn't create a greater barrier between interviewer and interviewee as it is more alike paper than laptop. The only drawback is a great number of typos in the text and missing accents. Typos sometimes were so severe that it was difficult to extract original meaning from a particular sentence. On the other hand, fast hand-writing also didn't produce very neat and easily readable notes to anyone. Each of these methods therefore have their limitations and notes are best interpreted by the researcher himself. A great advantage is a feeling of higher security for the interviewees than when recording.

5.7 Data processing, coding and presentation

Data processing describes the processing of finished interviews on computer, its transcription, basic coding and presentation.

Already during the interviewing stage first data processing started. Initially, a full transcription of notes was to be put into one comprehensive table.

5.7.1 First data processing table

Design of the *First data processing table* was as follows (table on next page):

First column holds question number. Second column keeps questions in full. Third and following columns hold the full answers of individual companies. Second row contains information about dates of interview.

Three dots "…" symbolize data lying in between two ends, for example other companies between Company ID 1 and n.

The purpose of this table was to gather all collected data in one place. In total 13 interviews were fully transcribed into this table and 2 interviews only had summary.

This approach was then abolished as after entering data from these 13 companies, the table was too large and contained too diverse data in order to yield a meaningful comparison or to even provide a way to compare data.

Table 3 First data processing table

Question no.	**Question**	**Company ID 1**	**…**	**Company ID n**
		Date of interview 1	…	Date of interview n
1	Question 1 in full	Full answer of interviewee 1 to question 1	…	Full answer of interviewee n to question 1
…	…	…	…	…
n	Question 27 in full	Full answer of interviewee 1 to question 27	…	Full answer of interviewee n to question 27
	Summary	Summary of key points in interview 1	…	Summary of key points in interview 2

5.7.2 Second data processing table

After first unsuccessful try a second strategy was established. In order to simplify data that is going to be analyzed, a new table and coding scheme was developed.

In this table first row is dedicated for company identifiers so the researcher could refer back to the original data.

Second row keeps information about field of activity of interviewed companies so the data in the table would have an associated context.

Row three and after were determined to hold questions and coded answers to them by all companies. All the codes are kept below relevant question in alphabetic order, so they could be easily scanned.

Area to the right of each code serves as a way to record the fact which company stated this code. This matter of fact is identified using "x" sign for each code which the company stated. As more companies could have had a same coded answer, there can be more "x" signs in one row.

Three dots "…" symbolize data lying in between two ends, for example other codes between codes 1 to w.

Design of the *Second data processing table* was as follows:

Table 4 Second data processing table

	Company ID 1	**…**	**Company ID z**
Field of activity	Activity of Company ID 1	…	Activity of Company ID z
Question 1 in full			
Code 1 to Question 1	"x" if true	…	"x" if true
…	…	…	…
Code w to Question 1	"x" if true	…	"x" if true
…	…	…	…
Question x in full			
Code 1 to Question x	"x" if true	…	"x" if true
…	…	…	…
Code y to Question x	"x" if true	…	"x" if true

The whole *Data processing table including Research data (an Excel file in Czech)* is available in *Appendix A: Digital additions to this Thesis.*

Difference between first and second table – first level coding

It is important to state that a significant difference between this second type of table and the first type of table is in the way the answers are recorded.

In the first table the answers were recorded in full which made them too long and difficult to analyze which was the reason of abandoning this approach. Therefore, in the second approach the data was coded. By coding is meant that from paragraphs of text short bullet point like answers were extracted which would have a chance of reuse as the goal was to identify similarities and dissimilarities in answers of different companies. This partial and short answers are called codes hereafter.

Result of first level coding

Result of first level coding was over 1 500 codes on 27 questions while identifying over 2 800 matches ("x").

This data still was too complex to be directly analyzable, so further coding needed to be done.

Software tools used

For ordering data into tables was used Microsoft Office Excel for Mac, version 16. This software was used as a very flexible and standard tool since the researcher didn't have an opportunity of using a more sophisticated tool specialized on a qualitative research analysis. This solution had also an advantage. Thanks to using Office 365 the data was available anywhere and backed up as it was saved both locally and in the cloud.

5.8 Data analysis

Section Data analysis addresses the ways used to analyze qualitative data obtained from the interviews using coding and categorizing.

First stage of analysis was dividing the large table into smaller, more comprehensible tables.

This was done by simply creating a new sheet for every one of 27 questions in existing Excel file. Then, for each sheet only data relevant to each one of 27 questions would be present.

When having only data relevant to one question in one table, it was easier to think of possible outcomes. First, all the data was read through carefully. Already during this read through, first ideas for categories emerged.

First level categorization

During second read-through categories were created based on the codes. Basically, similar codes or codes on the same topic were put together and given a common category name which seemed to encompass all of the codes. This was a first level categorization.

Second level categorization

In some cases, a category consisted of too many items or logically needed a further division and hierarchizing. Therefore, a second level categorization was made in some questions.

5.8.2 Design of tables for codes categorization

Table design was, quite logically, very similar to the table design of *Second data processing table* used in first level coding. The difference is that it contains only one question and codes relevant to this question. Further, codes are divided into categories and subcategories.

First column of *Categorization table* (table on next page) holds the full question, categories, subcategories and also codes. Second and further column include company IDs and statements of assignment in form of "x". "x" can be assigned to a code, but also to subcategory or category if this was also a code and became a category or if aggregated so for other analysis purposes.

These "x" signs are very important in the analysis described in next chapter, where the number of "x" signs in a given (sub)category is equal to a metric *No. of associations*. Based on the fact in which columns are any "x" signs in given (sub)category is calculated metric *No. of companies*, that is the number of companies answers of which are associated with a given (sub)category. Based on these 2 metrics the significance of (sub)categories was evaluated and they were accordingly ordered which again is important in choosing final criteria reflected in the Model.

Three dots "…" symbolize data lying in between two ends, for example other codes between codes 1 to u.

Table 5 Categorization table

Question in full	**Company ID 1**	**…**	**Company ID z**
Category 1	"x" if true	…	"x" if true
Subcategory 1	"x" if true	…	"x" if true
Code 1	"x" if true	…	"x" if true
…	…	…	…
Code u	"x" if true	…	"x" if true
…	…	…	…
Subcategory y	"x" if true	…	"x" if true
Code 1	"x" if true	…	"x" if true
…	…	…	…
Code v	"x" if true	…	"x" if true
…	…	…	…
Category x	"x" if true	…	"x" if true
Code 1	"x" if true	…	"x" if true
…	…	…	…
Code w	"x" if true	…	"x" if true

Software tools used

Initially also for data analysis only Microsoft Excel was used. Soon, though, was found out that reorganization of codes based on emerging categories was too inconvenient in Excel as it doesn't allow for an easy "drag-n-dropping" rows and cells. For that purpose, a more useful tool turned out to be 'Numbers', a competitive software from Apple. This software allowed for an easy reorganization of codes and therefore made this part of analysis more efficient. Author used also for this option saving the work in a cloud, this time iCloud from Apple.

5.9 Chapter summary

Chapter *Designing and conducting a qualitative market research in ICT* described a complete procedure of conducting a qualitative market research in terms of this Thesis. Since theoretical sources found were not specific enough on how to process certain things, it was necessary to develop original methods and procedures. The description is detailed, providing its readers a complete know-how useful for conducting a similar research of their own. Described are sampling and respondents acquiring techniques, interviewing procedures, qualitative data processing and basic analysis as well as all the questions asked during the research including their justification. The 2-level categorization of data is considered a basic analysis method. The final Research analysis is provided in the next chapter.

6 Results of research on cloud adoption potential by Czech SMEs managers

Chapter 6 *Results of research on cloud adoption potential by Czech SMEs managers* presents analyzed and summarized results of the vast amount of originally unstructured data available to each of 27 questions asked 39 company representatives. Most of questions' analyses feature a table (or more tables) presenting all identified categories and subcategories of answers within given question ordered by their significance given by the number of companies whose answers are associated with such (sub)category and by total number of associations to each (sub)category. Results presented in tables are then described in detail, providing insights and even quotes of respondent's which uncover many unexpected realities. At the end of the chapter is a summary of research results which provides an aggregated view on acquired findings.

6.1 Analysis of qualitative market research on cloud adoption by Czech SMEs managers

Analysis of qualitative market research on cloud adoption by Czech SMEs managers leverages the theory introduced in chapter *Qualitative research* and follows the methods presented in previous chapter *Designing and conducting a qualitative market research in ICT*.

In questions which are analyzed using tables containing metrics *No. of associations* and *No. of companies*, the "x" signs in data categorizing tables introduced in previous chapter are important as described in the subsection *Design of tables for codes categorization*. These metrics are used for (sub)categories ordering by their significance where primary ordering criterion is the *No. of companies* and secondary ordering criterion is *No. of associations* (in case of equal *No. of companies* among several (sub)categories).

6.1.1 Question 1: Defining ICT

Question: "*What is ICT (or information and communication technology) for you in context of your company?*"

As this question's purpose was to start a discussion and gain a general context, it was decided not to analyze this question. All the codes are available in *Data processing table including Research data (an Excel file in Czech)* in *Appendix A: Digital additions to this Thesis*.

6.1.3 Question 2: Number of ICT users

Question: "*How many users of ICT do you have?*"

This question is answered in section *Acquired sample of companies* in chapter *Designing and conducting a qualitative market research in ICT*.

The lowest number of ICT users is 1 in case of a micro company, a sole accountant. The highest number on the other hand is 700 hundred users in case of a company providing software for financial services as they have many users who are not their employees, but they are directly supporting them.

6.1.4 Question 3: Size of ICT department

Question: "*How big is your ICT department?*"

This question is answered in section *Acquired sample of companies* in chapter *Designing and conducting a qualitative market research in ICT*.

Below are numbers of whether a company has an internal ICT, has an external ICT or has no ICT:

- Internal ICT department: 22 companies
- External ICT service: 16 companies
- No ICT service: 1 company (a micro company)

Interesting is an analysis of how number of ICT users reflect in an ICT department size. The lowest number is 1 member of ICT staff for a human resources agency with 15 ICT users (Company 9), but also 1 ICT staff in companies with up to 100 users in pharmaceutical production (Company 31) and in real estate development (Company 35).

The highest number of ICT staff, logically, have ICT companies. However, this does not reflect in number of internal ICT staff they reported as most of them do not provide internal ICT services.

Partly similar situation might be with banking, stock and financial organizations which, on the other hand, reported the highest numbers of internal ICT staff. The highest was stocks related company with 20 members of ICT staff. These organizations provide many ICT related services for which they need skilled ICT staff. It is discussable how many of them provide direct services to the company itself, just as in case of ICT services providers.

6.1.5 Question 4: Areas of ICT usability

Question: "*How ICT supports your business? What services does it provide to your business?*"

It was decided that this question does not need a further analysis for the purpose of finding criteria of cloud migration decision. Therefore, it is only coded, categorized and subcategorized and available in *Appendix A: Digital additions to this Thesis* (in Czech).

6.1.6 Question 5: Problems with ICT

Question: "*Are there differences between your idea of your ICT functioning and its reality?*"

It was decided that this question does not need a further analysis for the purpose of finding criteria of cloud migration decision. Therefore, it is only coded, categorized and subcategorized and available in *Appendix A: Digital additions to this Thesis* (in Czech).

6.1.7 Question 6: ICT costs tracking

Question: "*Are you calculating your ICT costs?*"

Table *Costs calculation* shows numbers of how many companies from the sample calculate, respectively omit calculation or only partly calculate ICT related costs.

38 out of 39 companies answered this question. Company 19 did not answer the question.

Table 6 Costs calculation

	Yes	**No**	**Partly**
Calculating costs?	23	10	5

Based on the answers about 60% of companies calculate their ICT costs, more than one quarter do not calculate them and 13% partly keep track of their ICT related costs. For the ones who do not calculate, in half of the cases they consider ICT costs as *insignificant*. Contrary to this, it could be deduced that for most companies keeping track of their ICT costs is important.

6.1.8 Question 7: Method of calculating ICT costs

Question: "*Do you use any method for calculating your ICT costs? Which?"*

Table *ICT costs calculation methods* lists methods used in SMEs from the sample to calculate their ICT related costs and their significance among others by number of companies using each of them.

33 out of 39 companies answered this question. Companies 9, 13, 18, 26, 32 and 34 did not answer the question.

Table 7 ICT costs calculation methods

	Accounting	**Budgeting**	**None**	**Other**
Calculation method	18	10	7	2

This question produced different results than expected by the author as only one company said that they monitor the return on investment. The purpose of costs related questions in the research was to find out whether companies keep track of the costs, but also whether they evaluate them and are able to compare them to other options, which is something very important when making a decision on migration to cloud.

Most companies (18) use accounting methods to estimate their ICT costs, in most cases by creating an ICT cost center in their accounting system and assigning all ICT related costs there. About 1/3 of companies who responded in this question is using budgeting or division into regular and investment payments. 7 companies admitted they do not use any method for calculating their costs and 2 of them on the other hand had a very precise knowledge of their ICT costs thanks to monitoring of the number of ICT tickets in a year, used man-days and associated costs in one case and in the other case they are monitoring ROI.

Generally, most of companies use basic methods to calculate their costs and they do not do any analysis or evaluation. Therefore, it might be necessary to introduce them to some evaluation method for the purpose of comparing their current ICT with cloud.

6.1.9 Question 8: Inclusion in ICT costs

Question: *"What do you calculate in ICT cost?"*

Table *ICT costs categories* shows areas which companies in the sample mentioned as included in their ICT costs. They are ordered by the number of references where HW was the most mentioned category both by number of companies and number of associations.

36 out of 39 companies answered this question. Companies 8, 20, 37 did not answer this question.

Table 8 ICT costs categories

Order no.	Category	No. of associations	No. of companies	Description
1	HW	65	32	HW from computers and servers through networks to printers, TVs and other devices
2	Services	49	27	Services from internet through hosting services to services of an external ICT services provider
3	SW	26	20	SW and its updates, licenses, support and development
4	ICT department	28	17	Salaries, equipment, energies, space for ICT staff
5	Technologies	18	15	Licenses, investments, running costs
6	Systems	9	6	IS, accounting, CRM, BI, CMS
7	Other	5	4	E-learning, print, web hubs

For most of companies HW, such as computers and networks, is the most associated area of ICT which they almost always calculate in their ICT costs. As most companies use some sort of services of third parties to assure their ICT, services, such as internet, server hosting or external ICT company support, are the second most included category of costs. SW, its updates, licenses, support and development, is the third most mentioned area as many companies realize they are using some applications, usually at least Office apps and some sort

of information system, to do their work. Slightly less than a half of companies count in their expenses related to their ICT department. Mostly they calculate wages of their ICT staff, seldom they think of other costs such as their mobile phones, PCs, consumed energies, transport or office space. Investments into technologies, their operation and usage licenses are the fifth most mentioned area. Systems, such as company's information system, accounting software, CRM, BI or CMS were mentioned just by 6 companies and 6 companies mentioned some areas categorized under "Other" which are debatable whether they should be considered an ICT cost.

6.1.10 Question 9: ICT disaster costs

Question: *"Do you know what it costs you when your ICT is non-functioning for a day?"*

39 out of 39 companies answered this question. From answers to this question emerged 3 types of answers. The last of them, *Perception of the situation: non-functioning ICT*, is available in *Appendix M: Perception of the situation: non-functioning ICT (question 9).*

Ability to calculate costs

The first type is summarized in table *Ability to calculate disaster related costs*, which was the expected type of outcome to this question and is divided into categories *No, Partly* and *Yes* in this respective order based on their representation in the sample.

Table 9 Ability to calculate disaster related costs

Order no.	Category	No. of companies	Description
1	No	30	Don't know how to calculate it or it is impossible
2	Partly	5	Having estimates or knowing the way to calculate but not having the result
3	Yes	4	Precisely calculated loss

As can be seen from the categories above, nearly 80% of companies in the sample do not know how to calculate their ICT disaster costs or they claim it is impossible.

Accepted duration of non-functioning ICT

Part of the answers brought information about the duration, which a company is willing to accept as a resolution time of non-functioning ICT. Answers were divided into categories listed in the table *Accepted duration of non-functioning ICT* and ordered by their frequency (table on next page).

19 companies provided this type of answer. Some companies have answers in more than one category, as for example they distinguished between critical problems and normal problems.

Based on categories in table below, critical scenarios of most companies count with less than 3 days and more accurate calculation based on data in source table *Question 9 Categorization*

table available in *Appendix A: Digital additions to this Thesis* shows that 13 out of 19 companies expect solutions within a day and less.

Table 10 Accepted duration of non-functioning ICT

Order no.	Category	No. of companies	Description
1	< 1 day	9	Problem solution between 5 minutes and 8 hours
2	1 day	8	Problem solution between 8 and 24 hours
3	2-3 days	7	Problem solution between 2 to 3 days
4	1 week	4	Problem solution within up to 1 week
5	2 weeks	1	Problem solution within up to 2 weeks

6.1.11 Question 10: ICT security risks

Question: *"What risks do you perceive in ICT security?"*

Answers to this question were divided into categories ordered by significance as *Human factor*, *Data*, *Business continuity*, *Physical and natural threats*, *Regulation* and *Don't know*. These categories can be considered as areas of fears related to ICT security. Subcategories then represent specific fears related to that area. First 2 categories, Human factor and Data, are given their separate tables and are described in greater detail. Last 4 categories are summarized altogether in one table which is available in *Appendix N: Other factors influencing ICT security (question 10)*. There is also one special category – Feeling. This category only reflects answers of some of the companies, which implied how much they fear of their ICT security and is also available in *Appendix O: Feelings associated with ICT security risks (question 10)*.

38 out of 39 companies answered this question. Company 22 did not answer this question.

Human factor as an ICT security risk

Table *Human factor as an ICT security risk* shows all ICT security risks associated with a Human factor. These risks are ordered by their significance, where the most important factor is number of companies which mentioned this risk. Therefore, *Attack* is more significant than *Misconduct*, even though the later has a higher number of associations. Since each of them is significant in a different, both of them can be considered very important. Their numbers are significantly higher than of any other risks identified in this question.

63% of respondents who answered this question are afraid of attacks and viruses. 42% of the same respondents are, though, afraid of mostly unintentional and partly also of intentional mistakes made by their ICT staff or users. These 2 are interconnected as a mistake of a user can cause that a virus can attack a computer or a whole network. Just a small number of companies mentioned theft as a threat to ICT, mentioning theft of devices or even of corporate identity used, for instance, for spam mass e-mailing. In total, about 80% of all respondents identified human factor as an ICT security threat.

Table 11 Human factor as an ICT security risk

Order no.	Category	Subcategory	No. of associations	No. of companies	Description
1	Human factor		72	31	
	1	Attack	28	24	Attacks and viruses
	2	Misconduct	40	16	(Un)intentional mistakes of ICT staff or users
	3	Theft	4	3	Theft of devices or corporate identity

Data as an ICT security concern

Table *Data as an ICT security concern* presents 4 risks of ICT security regarding data. These risks are ordered by their significance, where *Theft of dat*a is the most significant by both number of companies who mentioned it and number associations.

Table 12 Data as an ICT security concern

Order no.	Category	Subcategory	No. of associations	No. of companies	Description
2	Data		31	20	
	1	Theft	11	11	Theft of data
	2	Loss	9	9	Loss of data
	3	Leak	5	5	Leak of data
	4	Modification	4	4	Modification of data

29% of respondents who answered this question said that data theft is an ICT security risk to them. Just slightly less, 24% of the respondents answered that loss of data is a threat to them. Only about 12% of respondents said they are afraid of data leak and modification of data. The important thing is, 51% of companies expressed some sort of risk associated with data.

6.1.12 Question 11: GDPR

Question: *"What does GDPR mean to you? How do you prepare for it?"*

Analysis of this question was evaluated as insignificant to the Model creation and because of its time-bounded utility due to GDPR being affective from soon after submission of this Thesis, it was omitted. Its categorization is available in *Question 11 Categorization table – GDPR* in *Appendix A: Digital additions to this Thesis.*

6.1.13 Question 12: Definition of Cloud

Question: *"What is a 'cloud' to you? What does it mean?"*

Definition of cloud was a first question aimed on cloud in general with the purpose of finding out how respondents perceive cloud. Answers are divided into 13 categories which are divided

into 3 tables. First table, *What is a cloud*, lists 5 most significant things by number of mentions, that cloud is according to respondents. Second table, *Other things that cloud is*, presents remaining 6 ways of defining cloud by respondents and is available in *Appendix P: Other things that cloud is (question 12)*. Third table, *Cloud usage*, reflects the numbers of companies who use or do not use cloud based on answers to this question and is available in *Appendix Q: Cloud usage (question 12)*.

35 out 39 companies answered this question. Companies 3, 12, 25, 26 did not answer the question.

What is a cloud

Table *What is a cloud* lists 5 definitions of cloud ordered by their significance, where the first 3, *Quality service*, *Data storage* and *Security risk*, are all very close. More detailed explanation of each is provided below the table.

Table 13 What is a cloud

Order no.	Category	No. of associations	No. of companies	Description
1	Quality service	17	10	Automated, easy, supported, 24/7 available, less downtime, secure, effective
2	Data storage	14	10	External data storage outside of company, it is shared and provides backup
3	Security risk	12	10	Unsuitable for sensitive data, risk of misuse by a third party, regulatory issues
4	Outside the company	6	6	A remote system / place / environment / infrastructure accessible from everywhere
5	Cost-(in)effective	5	5	Cost savings for many vs. expensive for others

Even though *Quality service*, *Data storage* and *Security risk* are all very close by number of companies who had associated answers, it is positive that number one is a *Quality service*. By at least approximately 30% of respondents cloud is perceived as something useful, easy to use, well supported, always available, providing less down time while being also secure.

Slightly less promising is the fact that cloud is mostly seen as a data storage, which omits all other cloud forms and usages and implies that there is still limited knowledge about cloud services.

Even less promising is that for many cloud is seen as a security risk. Companies see it as unsuitable for sensitive data and they fear of their misuse by a third party. Company 5, financial services, has regulatory issues with cloud and said that cloud is a "*forbidden word because of a regulatory body. We are supposed to have everything under control, no matter whether it is an infrastructure or something else. We would also have to control, where the data physically is… Cloud provider would have to comply with all the regulatory rules just as if we*

ourselves would do it. So, it is easier for us to have everything in one place." Even more interesting fact regarding company 5: later on, during the interview it revealed that they are using dedicated hosting services. These they do not consider a cloud, as when talking about cloud they would only thing of a "public" cloud and so of a shared infrastructure. Similar turned out for a few other companies as well.

Some companies defined cloud as something remote, such as a system, an infrastructure, an environment or a place which could be accessed from everywhere.

Three companies stated that they see cloud as a cost-saving solution, one said that public cloud is not cost-effective for them and company 33, lights production, explained that cloud is "*very expensive for them, especially because of database licenses.*"

6.1.14 Question 13: Data backup

Question: *"How do you solve backing up your data?"*

Table *Backup location* brings a basic view on where companies from this sample store their data.

38 out of 39 companies answered this question. Company 21 did not answer the question.

Table 14 Backup location

	Internally		**Externally**		**Combination (Internally + Externally)**
	Only	**Not only**	**Only**	**Not only**	
Backup location	14	27	11	24	13

As can be seen in the table above, the results are very equal. Nevertheless, most companies (14) claim to keep their backups only internally, mostly in the same building as their live data. Just a little bit fewer companies (13) use a combination of internal and external backup, which usually means that they backup internally their on-premises infrastructure and backup in cloud what they are using in cloud or that they use cloud as a "backup backup". 11 companies stated that they only keep their backups externally, either in hosting/housing, at their ICT contractor's premises or at their cloud services provider. Quite logically, 14 of the companies backing up (also) to external locations said that their backup is geographically separated. 6 of them specified the backups are in a hosting center.

The most common answer regarding frequency of backup, was a *daily backup* (11 companies). 10 companies keep their backups on backup servers. According to 6 of them their backups are automated whereas 5 of them still do manual backups on external hard drives.

As of cloud adoption rate, it could be said that more than 60% of asked companies keep at least part of their backups in cloud.

6.1.16 Question 14: Backup security

Question: *"How you can be sure that you restore your backup?"*

Table *Positive and negative aspects of backup security* lists reasons why companies consider their backup security either very firm or rather vulnerable.

34 out of 39 companies answered this question. Companies 16, 20-22 and 30 did not answer the question.

Table 15 Positive and negative aspects of backup security

Positive aspects		**Negative aspects**	
Good experience	20	Missing experience	13
Recovery plan	9		
Confident	6	Not confident	6
Backup checks	4		
Believing in it	3		

Even though there is a same number of companies that claimed that they feel confident as those who claimed the opposite regarding their backup security, from the numbers it seems quite obvious that companies mostly think their backups are quite secure.

For most of them (20) this is because of a good experience with successful renewal of their backups in the past. Though, many of them (13) have some missing experience, such as they have never had a major problem and so, for instance, never had to renew a whole backup, just individual files.

9 of them assure their backup security by having a recovery plan and 4 of them stated that they do regular backup checks. 3 of them said that they simply believe in it.

6.1.17 Question 15: On-premises backup vs. cloud backup comparison

Question: *"What advantages and disadvantages do you perceive regarding internal backup vs. cloud backup?"*

This question was a first comparison question and brought many codes which were divided into 5 categories with 12 additional subcategories. Therefore, data was divided into 3 separate tables ordered by their significance, that is by number of companies who expressed their support for given criteria. The tables are as follows:

1. *Cloud backup advantages*
2. *Cloud backup disadvantages*
3. *On-premises backup advantages and disadvantages and other answers* (available in *Appendix R: On-premises backup advantages and disadvantages and other answers (question 15)*)

It is interesting to note that there is a tight fight between cloud backup advantages and disadvantages. 21 companies associated with advantages of cloud and 18 companies associated with cloud disadvantages which puts advantages on the first place. Though, the total numbers of associations in given categories are the opposite. Only 34 total associations were made regarding advantages whereas there are 41 associations to disadvantages of cloud backup.

33 out of 39 companies answered this question. Companies 5, 6, 12, 22, 30, 37 did not answer the question.

Cloud backup advantages

Table *Cloud backup advantages* presents all decision criteria defined as positive for cloud backup. The table is ordered by significance of each criteria in form of a subcategory. All the reasons are discussed further below the table, the top 3 reasons for cloud backup are discussed in a greater detail.

Table 16 Cloud backup advantages

Order no.	Category	Subcategory	No. of associations	No. of companies	Description
1	Cloud backup advantages		34	21	
	1	Security	10	10	Geographic separation, better technical safety
	2	Simplicity	8	8	Less work, easy setup, management and sharing, no worries
	3	Costs	6	6	No investment and management of HW
	4	Reliability	4	4	High availability, stability and load balancing
	5	Other	3	3	Future, good if everything is in cloud
	6	Flexibility	3	2	Always available and accessible from any device

Security

Security was seen as a main advantage of cloud backup. Four companies considered a geographically separated backup and advantage, 2 of them thought of it as an extra guarantee that data will not get lost. Another 3 companies presumed that data in cloud would be better secured, especially from technical point of view.

Simplicity

Simplicity was another important aspect of cloud backup. Companies perceive cloud backup as less work. It shall be easy to set up, manage and also to share data. Basically, they do not need to worry about it, they do not need their own staff and can concentrate on their business.

Costs

Six companies valued the fact that they do not need to invest in their own technologies, management and maintenance which saves them costs significantly. Price of cloud is therefore seen as an advantage by some.

Reliability, flexibility and other criteria

Cloud backup is considered to be highly available, stable and capable of better load balancing. It is also always accessible from any device which can share the data among themselves. Two companies think of cloud backup as of "*future*" and company 25, providing software for financial services, specified that *"it is favorable, if we have in cloud also all of our systems, as it is large data which needs to be transmitted some way."*

Cloud backup disadvantages

Table *Cloud backup disadvantages* lists features of cloud which are seen as negatives. The table is ordered by significance of each defined category. All the features are discussed below the table, the top 3 reasons against cloud backup are discussed in a greater detail.

Table 17 Cloud backup disadvantages

Order no.	Category	Subcategory	No. of associations	No. of companies	Description
2	Cloud backup disadvantages		41	18	
	1	Security	17	11	Third party access to data, distrust, loss of control
	2	Connectivity	8	7	Internet quality dependability
	3	Costs	8	6	Expensive for large data amounts, extra costs
	4	Lack of knowledge	4	2	No experience, no time to try
	5	Other	2	2	Incompatibility with current IS, no need
	6	Quality	2	2	Availability, uncertain for small providers

Security

A main advantage of cloud backup is even slightly stronger disadvantage. Companies mostly fear of third party access to data which they could misuse as the owner has limited control over them. This makes some companies distrust cloud backup solutions.

Connectivity

Connectivity is currently still a valid argument in the Czech Republic from author's point of view as its quality differs significantly. Some companies are afraid to be fully dependent on the quality of internet connection, for some it would mean building up faster external connectivity. As company 32, delicacies and machines producer, put it *"the question is only the internet connection, which is not good at all the places, where we go for business"*.

Costs

Some companies see cost savings, some think cloud backup would mean extra costs for them. Four companies had an opinion that it would be more expensive than backing up on their premises. Two companies calculated that for large data amounts it is expensive for them. Company 18, computer games sector, had an interesting view that *"we don't need a 99,9% availability of a backup"*, meaning that cloud services are too expensive due to unnecessary high availability.

Lack of knowledge, quality and other criteria

Company 16, interior design and production, literally said *"we don't have time to get acquainted with that. We are overwhelmed."* Not knowing enough about cloud was true also for one another company. Company 23, scenic and interior design and production, said that *"there is no disadvantage, but our IS IBM Lotus Notes cannot be operated in cloud"*. Company 28, metal processing, argued that quality of cloud backup services is *"questionable, if it is not a global provider."*

6.1.18 Question 16: Usage of servers

Question: *"Do you operate any servers?"*

39 out of 39 companies answered this question. 7 companies answered that they do not operate any servers. 32 companies operate some servers (either on premises or in cloud which is not specified in this question).

6.1.19 Question 17: Servers operators

Question: *"Who is operating your servers? Is it your ICT department or an external company?"*

Answers to this question provided 2 kinds of information:

1) Who is responsible for operation of servers in each company?
2) Where are the servers located (on premises vs. cloud)?

39 out of 39 companies answered this question.

Table *Location and management of servers* summarizes all acquired findings while reflecting all possible combinations of servers' location and management.

Table 18 Location and management of servers

		Management		
		Internal	**External**	**Internal + External**
Location	Internal	2	14	3
	External	0	5	4
	Internal + External	6	0	4
	No servers	1		

There were different combinations of servers' location and management identified. Clearly, as seen in the table *Location and management of servers,* the most common combination is internally located servers managed by an external company which is true for 36% of all the companies in the sample. Second most common combination with only 15% is internal management of servers located both on-premises and in the cloud, e.g. in hosting. Just slightly behind with 13% are companies which are completely in cloud using cloud services managed by cloud providers. Quite equally represented are all combinations of internal + external management. Internal location with internal + external management means that servers are on-premises managed by a local team with an aid of a specialist third party. Second option, externally located servers managed both internally and externally belongs to companies who use a combination of housing or dedicated servers and hosting or public cloud. 10% of companies are using all of the possible options having servers both on-premises and in the cloud managing them both internally and externally. Usually, on-premises servers are then managed by an internal team, whereas hosted servers are managed by their provider. One micro company claimed to use no servers at all and there were no companies which would use solely internal management on externally located servers and only external management on servers located both on-premises and in the cloud.

As of defining cloud potential, there are 30 companies who use (also) external services (19 only) to manage their servers contrary to only 8 companies who manage their servers only using internal resources. Much tighter fight is when considering location as there are 19 companies who have their servers (also) located externally, and at the same time there are 19 companies who have their servers only internally, in total 29 companies have them internally non-exclusively.

From this could be derived that most of (77%) companies are willing to migrate the responsibility of managing their servers to a third party whereas only a half of them are willing to move to them also their servers (or have done this so far).

6.1.21 Question 18: Server operation quality criteria

Question: "*What are your requirements regarding quality of your servers' operation?*"

Table *Server operation quality criteria* presents criteria identified for assessing server operation quality. These criteria are further described and discussed including specific requirements of companies for given criteria. Criteria are ordered based on their significance.

31 out of 39 companies answered this question and produced 82 associations. Companies 2, 3, 6, 24-27, 37 did not answer this question.

Table 19 Server operation quality criteria

Order no.	Category	Subcategory	No. of associations	No. of companies	Description
1	Availability		52	25	
	1	Functionality	31	24	24/7, > 99,5% up time, e-mail and web are critical
	2	Unplanned outages	11	11	No or minimum unplanned outages, max accepted length of outage
	3	Planned outages	10	9	Acceptable time for a planned outage, being informed
2	Speed of support		17	12	
	1	Speed of reaction	10	8	Expected reaction time
	2	Speed of resolution	7	7	Expected resolution time
3	Previous experience		5	5	Good and bad experiences with contractors
4	Performance		5	4	Stability under high usage and load and other requirements
5	Security		3	3	Importance of data security

Availability

Availability is by far the largest concern regarding quality of server operation as 80% of asked companies had some requirements regarding availability. Regarding functionality, 18 companies said they expect a 24/7 operation. Some were defining exact SLAs from 99,5% to 99,99% availability in case of company 9, a headhunting agency. Company 36, a software developer and cloud apps provider, explained their high requirements with *"we need to fulfil SLAs on our services with clients"*. Contrary to that company 4 operating in municipal services said that *"we do not run non-stop. If it is [servers] not running outside of working hours, I don't*

get to read e-mails." Assuring E-mail and web are running was identified as the most important by 2 other companies.

Companies also had specific ideas regarding unplanned outages. Some of them said they expect zero or minimal unplanned outages, especially during working hours. Others admitted that outage can happen but had requirements regarding when the situation shall be remedied. The shortest mentioned was 15 minutes, the longest half a day or they said it is acceptable either during night or weekend.

Approaches towards planned outages also differ. Company 5, a financial services provider, expects no planned outages. For them an outage means that they are not running as their business is largely online. Some said an outage could be during a night, outside of working hours or during a weekend. An opposite extreme was company 32, delicacies and machines production, which said *"planned outages are usually done during working hours. We don't mind as we are able to adapt to that."* It is worth explaining that this company is mostly offline, and production is not dependent on ICT. Two companies mentioned that it is important for them to be informed about a planned outage.

Speed of support

Speed of support is the second most important criterion and is divided into a *speed of reaction* to an incident and a *speed of resolution* of an incident. These two are quite equally represented, though reaction speed is slightly more frequent. It might be a psychological phenomenon that when there is a problem, people are more anxious to see somebody is trying to help them fast than when the actual resolution comes. Three companies are expecting immediate reactions during work hours. Interesting is that all of these companies have an external ICT service. Two companies were expecting a next business day on a non-functioning server. Company 17, food sales and logistics, said that they expect *"a securement by a larger company which offers faster servicing than an individual person, features substitutability and higher quality"*. Regarding the speed of resolution, 2 companies are expecting resolution in matter of hours, 4 are satisfied with up to 24 hours and company 21, insurance services, can even handle up to 3 days of resolution time. Important to say is, this is a micro company taking care of mostly long-time clients.

Previous experience

Company 5 from financial services answered the question what they requirements are that *"they were high but now we live in a reality. Even with big players everything does not always work the way it is written in a contract. In reality there is a need to compromise."* Contrary to that other 2 companies were very satisfied with their contractors and said they can rely on them even at 3 a.m. during a weekend or that they come when necessary and find a solution in matter of hours. Company 13, a digital marketing agency, said that they *"trust the big players"*.

Performance

Companies require stability even in case of a huge burst of visitor traffic, such as 500 000 visitors at once, as in case of company 8, a large online financial services provider. Company 28, metal processing, said that their *"requirements are rising constantly, as there are more and more data, which we need."*

Security

Security was not a very mentioned criterion, even though it is the most mentioned criterion in some later questions. Two companies required high security of their data. Company 16, interior design and production, said that *"we worry about data on our server. It would be a perfect cookbook for our competition. That is why we do not have a remote access."* Contrary to that company 13, a marketing agency, said that "*if we would by any chance lose our data, it will not endanger us too much."*

6.1.22 Question 19: Infrastructure monitoring

Question: *"Do you monitor your infrastructure by any means? How?"*

Table *Monitoring of infrastructure* shows numbers of companies which monitor fully (yes), partly, do not monitor (no) or are not aware of monitoring their infrastructure.

34 out of 39 companies answered this question. Companies 15, 16, 20, 25, 26 did not answer the question.

Table 20 Monitoring of infrastructure

	Yes	**No**	**Partly**	**Don't know**
Monitoring	17	10	6	1

17 companies claimed that they do monitor their infrastructure. 10 out of them said they have a monitoring system (a SIEM). 5 companies out of the ones who said "yes" also specified that it is done by their contractor or provider.

10 companies admitted they do not monitor at all. 4 of them specified that they solve issues when they emerge.

6 companies were sorted under "partly" monitoring as 3 of them are outsourcing this to a third party while not having it under control and other 3 have monitoring systems but they are not fully implemented or configured.

1 respondent conceded he does not know whether they do any monitoring.

9 respondents described that in case of an incident they would receive a notification. 5 companies of the ones who said "yes", also claimed they have a non-stop monitoring.

In summary could be said that about a half of companies monitor their infrastructure and mostly have a way to be notified about emerged incidents, whereas the other half mostly does not monitor at all or the monitoring is limited or out of their control. Therefore, for most

companies migrating to cloud would most likely increase their business continuity assurance, alternatively it would be advisable to acquire a monitoring service by a third party or do their own monitoring if they have staff for that and if it really assures their operation in the same quality as a professional service (as most of companies do not have their ICT staff available 24/7).

6.1.23 Question 20: On-premises servers vs. hosting

Question: *"What advantages and disadvantages do you perceive regarding internal operation of servers vs. their rental through cloud?"*

This question yielded 5 categories and a wide array of subcategories. Therefore, it was necessary to divide it into 5 separate tables by categories ordered by their representation among all the answers. The tables are ordered as follows:

1. *Hosting disadvantages*
2. *Hosting advantages*
3. *On-premises servers advantage*s (available in *Appendix T:*)
4. *Neutral answers on on-premises vs. hosting* (available in *Appendix U:*)
5. *On-premises servers disadvantages* (available in *Appendix V:*)

31 out of 39 companies answered this question. Companies 13, 16, 21, 24, 27, 30, 32, 35 did not answer the question.

Hosting disadvantages

Table *Hosting disadvantages* encompasses answers of the largest audience to this question – 20 companies. The 3 most important disadvantages are described and discussed below. Additional hosting disadvantages are in *Appendix S: Additional hosting disadvantages (question 20).*

Table 21 Hosting disadvantages

Order no.	Category	Subcategory	No. of associations	No. of companies	Description
1	Hosting disadvantages		46	20	
	1	Security	16	13	Risks of data on internet, loss of control
	2	Unnecessity	6	5	Internal team, existing purchases
	3	Price	5	5	Expensive if to be the same as on-premises

Security

By far the most feared disadvantage of hosting is its security. 42% of all companies who were asked the above stated question responded in a way that they did not consider hosting services secure. Particularly 6 of them mentioned data security as a problem. Two companies

were concerned that they would not have their data on their premises. Three companies were worried about lack of control and not knowing who has access to their data. One company also mentioned that they consider a shared infrastructure risky as actions of one company might affect other companies. Two companies also thought that a hosting provider is a more interesting hackers' target, which could worsen its security. One of them specifies that "*data in cloud are more easily attackable. That doesn't mean it should be a major barrier, though. Electronic banking is also attackable and when it is secured properly, it is alright. The matter is, what cloud it is, who is managing it.*"

Unnecessity

Significantly lower but still the second most mentioned was by 5 companies the unnecessity of hosting. This is quite often true for well established companies who, as they say, have their internal ICT staff who take care of the servers and in such cases, they also usually have purchased system licenses and HW. Therefore, for some companies it is quite understandable they refrain from hosting, though they might not be well aware of all of its benefits. An interesting answer on this matter was that "*an always current SW doesn't have to be always considered as an advantage from a user's perspective*". This answer would better suite later question targeted on cloud in general as hosting does not affect users very much, but it reflects the fact that users often do not like to learn to work in a new system and they prefer if especially user interface remains the same for as long as possible if they are satisfied with it.

Price

Third most mentioned problem of hosting is its price. Three companies said it does not bring them an economic advantage. One company specified that *"it would be very expensive if it should be the same as what we have on-premises"*. These opinions are closely related to the previous reason *Unnecessity*. If a company has already built up infrastructure and has specialized employees to manage it, often they do not realize economic advantages by migrating to cloud as they would not realize the full potential of their existing investments and perhaps would have to dismiss some employees. In SMEs, though, a company usually only has one or very few ICT employees which they cannot dismiss as they care for other areas of ICT as well. Therefore, they might not realize such cost savings as newly established companies or companies with large amount of ICT staff.

Hosting advantages

Table *Hosting advantages* (on next page) lists all identified benefits of hosting by 16 companies. The 5 most significant ones are described and discussed in greater detail.

Simplicity

As a main advantage of hosting is seen its simplicity, and that is by 39% of companies who answered this question. They value that they do not need any know-how to operate servers in hosting, they do not need to buy their own servers and server licenses and basically, they do not need to worry about it, which was the main advantage mentioned by 9 companies.

Company 8 from financial services sector who runs a number of their own apps also pointed out that it is *"easy to procure various types of HW for different types of applications"*.

Flexibility, Securing operation quality and security

As these three advantages were equally represented in acquired answers, they are presented together. Companies mostly appreciate scalability which comes with hosting and the fact that they only pay for what they use. Hosting is also by 5 companies seen as better securing the quality of operation, as there are better technologies such as cooling or electricity outage backup systems, smoother performance and always up-to-date HW and SW. Even though security is seen by a large portion of companies as a main disadvantage of hosting, some companies also realize that security in hosting can be better in many ways. They mentioned better physical security such as fire safety systems but also greater protection against external threats or contrary to that against internal embezzlement. Company 5 from financial services sector stated that *"it is easier to comply with security directives than when on-premises"*. The same company also valued back up services available in hosting.

Contractor quality

Two companies mentioned that they consider hosting companies to most efficiently use their resources and so to optimally use the available performance. One company also saw as an advantage that a hosting provider shall have better staffing than they have internally.

Table 22 Hosting advantages

Order no.	Category	Subcategory	No. of associations	No. of companies	Description
2	Hosting advantages		44	16	
	1	Simplicity	15	12	No know-how, HW or SW requirements, no worries
	2	Flexibility	8	5	Scalability, pay-what-you-use, quick adaptability
	3	Securing operation quality	8	5	Better equipment, better technology, smoother performance, less downtime
	4	Security	8	5	Physical security, backup, external and internal security
	5	Contractor quality	3	3	Efficiency, better staffing
	6	Price	1	1	No HW maintenance fees
	7	Control	1	1	Control assured by a contract

6.1.24 Question 21: Housing

Question: *"What is your opinion on an option to not operate your own server room, but instead to move your servers into a server room of a specialized company and let them take care of them?"*

Table (Dis)*Interest in and reasons for (not) using housing services* sums up opinions gathered on topic of housing ordered according to their significance.

15 out of 39 companies answered this question. Question was not answered by companies 2, 4-9, 11, 13, 15, 16, 18, 20-22, 25-27, 29-31, 34, 37, 39. Due to low number of responses it is not safe to make any major conclusions and this table including its description is only available in *Appendix W: Opinions on housing services (question 21).*

6.1.25 Question 22: Cloud applications

Question: *"Do you use any applications in cloud?"*

Table *Cloud apps usage* shows numbers of companies who use or do not use any cloud applications based on their responses to this question.

36 out of 39 companies answered this question. Companies 11, 22 and 37 did not answer the question.

Table 23 Cloud apps usage

	Yes	**No**	**Not sure**
Using cloud apps	27	8	1

Answers of 27 companies, which is 75% of the ones who answered, were categorized under positive answer "Yes" stating that they do use some sort of a cloud app. These apps were divided into 7 subcategories:

1. Google Apps
2. Information systems
3. Marketing and sales
4. Microsoft Apps
5. Storage
6. Productivity Apps other than Google or MS
7. All in cloud

8 companies stated that they do not use any cloud app and one respondent was not sure while he assumed that they use some, but he could not remember.

Important to note is that hints in this question created for many respondents better understanding of what everything can be a cloud app and therefore there are present also such obvious answers such as a company website or an e-mail.

Though, the numbers state quite clearly that most of companies use at least one kind of cloud apps even though they may not had been aware of that before.

If compared to the research conducted by Kondáčová in 2015[9] as referenced in chapter *Literature review*, results suggest there is a dramatic increase in usage of cloud apps and cloud services in general by SMEs, as according to her research there were only 30% of companies using some kind of cloud service.

6.1.26 Question 23: Private cloud

Question: *"Could you describe what you imagine under a term 'private cloud'?"*

Respondent's definitions of what a private cloud is are found in table *Private cloud definitions* below, ordered by significance of the categories. They provide an insight into a knowledge of this cloud option by respondents.

27 out of 39 companies answered this question. Companies 11, 18, 19, 22, 24, 26, 27, 29, 30, 35, 37, 39 did not answer the question.

Table 24 Private cloud definitions

Order no.	Category	No. of associations	No. of companies	Description
1	Dedicated cloud	16	13	A dedicated and separated infrastructure, ultra-secure, no sharing of performance
2	"Own" cloud	8	8	Our own infrastructure if accessible from outside (such as VPN) or generally virtualized
3	Personal cloud	5	5	Personal use cloud services for a private person
4	Other	4	4	Cloud for internally operated apps, a rented internally operated space, other
5	Don't know	4	4	Not sure, no clue

Dedicated cloud

Most of companies' answers could be characterized as a dedicated cloud, which is good. Number wise it is an exact one third of respondents, 13. They think of a private cloud as of a dedicated infrastructure only to them, even in a separate locked room (in one case), which is highly secure, and they could know where their servers are located. One company also stated that it would be *"set up for their specific needs"*.

"Own" cloud

Answers which could be characterized as an "own" cloud were the second most mentioned. This answer generally also can be correct, depending on understanding and a specific definition of private cloud as explained earlier in this thesis. Companies defined it as an *"infrastructure at our facilities"* or *"whatever is accessible through internet. We have a VPN, so*

[9] A bachelor thesis called "Analýza trhu Cloud Computing"

in theory we have our own cloud.", stated company 31, pharmaceutical production. Some thought that an "own" cloud is in a form of virtualization of their own infrastructure. Two companies thought it could be a cloud shared only by a group of their own companies, such as holding. An easy answer was company's 1, audio-visual technique, *"what I have at my facilities and is accessible from the outside"*.

Descriptions of the remaining categories are available in *Appendix X: Additional answers to question 23 about what a private cloud is.*

6.1.27 Analysis of question 24: ICT improvement decision factors

Question: *"Which factors do you take into account when making a decision regarding improvement of your current ICT?"*

Table *ICT improvement decision factors* provides a list of identified factors leading to a company's decision to improve their ICT. All factors are ordered by significance. Other factors are available in table in *Appendix Y: Additional ICT improvement decision factors (question* 24).

37 out of 39 companies answered this question. There is no associated answer for companies 25 and 37.

Table 25 ICT improvement decision factors

Order no.	Category	Subcategory	No. of associations	No. of companies	Description
1	Price		27	23	Costs, ROI, price/benefits/performance ratios
2	Simplicity		28	18	
	1	For user	20	16	Friendly UI, work simplification, need of training
	2	For admin	8	7	Deployment, configuration, management, manuals
3	Need		24	13	Current (topicality), non-functionality of current equipment, user requirements
4	Quality		18	12	Reliability, Speed, Availability
5	Security		15	11	Maintaining or improving, compliance with requirements and standards

Price

Price comes here first. Ten respondents stated price without any further commenting. Five of them would be interested in costs of the improvement. Three mentioned looking at ROI (Return on Investment), some mentioned price/benefits or price/performance ratios. Two respondents stated that finances are not so important, or they are negotiable.

Simplicity

Simplicity turned out to be a very important topic and is divided into 2 subcategories – users and admins. More important seems to be the user dimension. This phenomenon might have a connection to the fact that most interviewed persons were not ICT admins themselves, whereas they were managers who need to ensure employee productivity. They were concerned about simplicity of use for the users, whether it makes their work easier and if they would need training for that. Regarding ICT admins the requirements were an easy deployment, configuration, management and operation as well as easy manuals.

Need

Quite logically, when a company is introduced to possible enhancements in area of ICT, they ask themselves whether they need it. It is very important whether the need is current. If the need is not yet here, they might not be interested. Contrary to it, if the need is very current, they want the solution now and not in 2 years. Connected to that is how old is their current infrastructure, equipment or environment in general. If for example servers are not yet obsolete, companies are hesitant to buy new ones or migrate to cloud as they want to fully realize their investment. Another important criterion are user requirements. If employees need something for their work, companies are motivated to secure that.

Quality

Quality is also an important criterion. In terms of quality the most mentioned was reliability or stability which can be both of the current solution or the future. Another point of interest is speed of a system and mainly speed in general. Also, availability comes as an important decision criterion. Company 14, cables installation, stated that *"we like better a renowned producer as it gives us a guarantee of some sort of support and that the support is going to be available also after several years"*. Company 26, jewelry production and sales, mentioned that even design of some devices can be determinative if the devices are to be seen by their customers.

Security

Companies mostly mentioned a general secureness of a solution, 4 of them mentioned that increasing security is important. Others were concerned with compliance with security standards such as ISO 27 000. An interesting requirement of company 5, financial services, was a *"solution with a limitation of user inputs – we don't want our users to be too 'creative'."* As an example, this person talked about Microsoft Excel as a powerful tool but too open to user inputs.

6.1.28 Analysis of question 25: On-premises vs. cloud decision factors

Question: *"Which factors do you consider when deciding whether to operate something internally or in an external cloud?"*

Table *On-premises vs. cloud decision factors* introduces the most important identified factors ordered by their significance. The 5 most significant ones are described in greater detail. Less significant factors are in table available in *Appendix Z: Additional On-premises vs. cloud decision factors (question 25)*.

Table 26 On-premises vs. cloud decision factors

Order no.	Category	No. of associations	No. of companies	Description
1	Security	20	16	Data sensitivity, control and ownership
2	Price	14	14	TCO, form of payment
3	Functionality	15	11	Availability, compatibility, flexibility, speed
4	Contractor	11	10	Quality, expertise, experience
5	Connectivity	8	6	Quality of internet connection requirements
6	Simplicity	6	6	Seamlessness, time requirements

Security

Security comes as the largest topic when deciding whether to go to cloud or operate local ICT services. Companies mostly did not specify whether they assume either of the solutions better in terms of security, they only said they would consider this criterion. Individually they expressed fears or doubts or also supports. An interesting fear was what happens to data if number of user licenses decreases. Another stated that they want their data internally. Others were concerned with the level of their control, guarantee of keeping data, their sensitivity, complying with GDPR or securing protection against user mistakes. One person stated that "*security in cloud is better*" and another that they "*are not afraid of data security*".

Price

Price comes as the second most mentioned criterion. That does not mean everyone considers it important. Six companies mentioned price, costs or investment requirements as important. On the other hand, one person said that price is not the most important and another one that price is not important. Four companies are interested in TCO comparison, that is in which type comes cheaper in a long run if all associated costs are calculated in. For 2 companies, also a form of payment – either a regular small payment or a large one-time investment was an important assessment criterion.

Functionality

Availability comes as a biggest concern regarding functionality. Second most mentioned concern is a compatibility or a synergy with current infrastructure. As company 25, software for financial services, put it: *"The future is in a cloud. Even we are aimed that way, but first we need to make our infrastructure ready. The inability of migrating to cloud is a sort of incompetence of given company. For now, we prefer internal solutions as we think that our systems are not yet ready for the external world in various ways."* Among other requirements are speed and flexibility.

Contractor

For contractor requirements the answers varied significantly. Distinguished can be quality in terms of personal communication and available team, always ready to solve problems, next expertise/experience expressed through ability to react to certain problems and having a long history in the field and good references. Company 20, trade company and industrial holding, stated that "we have long-time relations with various contractors who can deliver non-cloud solution", thus saying that they see no reason in acquiring a cloud solution if they know people who can deliver on-premises.

Connectivity

Quite common and very justifiable concern is quality of internet connection. Companies are worried whether their current internet connectivity is sufficient for seamless cloud experience. From author's experience this is a valid concern in Czech environment as quality of internet providers is still not very high.

6.1.29 Analysis of question 26: ICT contractor criteria

Question: *"What is important to you when choosing an ICT contractor?"*

38 out of 39 companies answered this question, while it was not answered by company 37.

Table *ICT contractor criteria* (on next page) sums up the most significant findings about factors influencing decisions about ICT contractors. All factors are ordered by significance. Additional factors are available in *Appendix AA: Additional ICT contractor criteria (question 26*).

References

References are the most significant criterion. Since almost none of the companies interviewed were new in business, most of them had established relationships with some ICT contractors. Therefore, 9 companies stated that their experience with a current or previous contractor is an important assessment criterion. Another interesting fact is that 11 companies considered important a personal recommendation from a trusted person, such as a friend. Some accented on the other hand they would not trust reviews published on contractor's website and would check these references with real customers, e.g. by calling them.

Table 27 ICT contractor criteria

Order no.	Category	Subcategory	No. of associations	No. of companies	Description
1	References		53	28	Personal experience, recommendations, customer reviews
2	Price		31	26	Price, price to quality, usability, performance ratios, price comparisons
3	Agility		36	19	
	1	Speed	18	12	Delivery, service, bringing solution
	2	Availability	13	12	Flexibility, service, delivery
	3	Distance	5	4	Travel time, local contractor
4	Quality		15	14	Contractor, service, product
5	Support		17	13	Immediate availability of support, customer service, willingness

Price

Price was the second most often mentioned criterion, though it might not be the most important based on the answers. In 15 cases there was a comment to price stating that the price needs to be justified but not that it is a main decision factor. Therefore, it seems companies do not want to pay an unusually high price, but they are willing to pay if they see the benefits. Respondent from company 20, trade company and industrial holding, stated that "price can be dictated from the side of a customer nowadays".

Agility

Agility was a third category based on significance and also the only one containing subcategories. The speed of response and service were with 15 associations the most significant from the many identified codes. Five companies expressed their requirement for the company to be close to them (within 1 hour) so the service would be reachable. Companies wish that they would be taken care of as fast as possible as non-functioning ICT causes problems to the whole company.

Quality

Quality was the fourth most mentioned criterion of choosing a contractor. Unfortunately, from quality itself it is not easy to state how it should be assessed. Mentioned were quality of contractor, work, product, service, where contractor and services were the most significant. For goods there were quality criteria mentioned as a renowned solution or an official distribution.

Support

Support as a fifth most mentioned category has a lot in common with agility. The most significant with 7 associations here is willingness, specifically willingness to quickly solve a problem.

6.1.30 Question 27: ICT visions

Question: *"How could you improve your company using ICT? In which areas do you see potential of using ICT for improving your business operation? Where ICT could drive your business?"*

37 out of 39 companies answered this question producing 60 visions. Companies 27 and 38 did not answer the question.

33 out of these 60 visions were evaluated as suitable for a cloud solution, another 18 answers would perhaps suit cloud, 5 answers are not applicable to cloud and the remaining 2 are not suitable for cloud.

All of these visions in full including author's recommendations can be found in *Question 27 Categorization table - ICT visions* (in Czech) in *Appendix A: Digital additions to this Thesis.*

6.2 Research summary and recommendations

In this subsection a summary of acquired findings is provided accompanied by author's comments and recommendations on how these findings can be approached with cloud services.

6.2.1 ICT Costs

Most of companies calculate their ICT costs based on their accounting or budgeting but most of the time they only calculate HW, infrastructure and software related costs plus their ICT staff wages or ICT services consumed. Seldom they calculate overhead costs, such as space and workplace equipment, energies consumed, transportation, or financial costs associated with their investments. Therefore, it might be difficult for them to correctly asses the decision to go to cloud from financial point of view as they are not having all the inputs.

ICT disaster costs

Regarding ICT disaster costs, majority of companies have no idea of their costs associated to a non-functioning ICT for a specified time period. On the other hand, they usually have a quite specific idea of how long they can run without ICT. Therefore, they could choose their SLA based on this criterion. In order to assess whether it is a cost-effective solution, though, it is useful to at least estimate company's ICT disaster costs which they could compare with a price of their chosen SLA on cloud.

6.2.2 ICT Security

Most companies consider a greatest security risk a human factor. Most feared are attacks and viruses, followed by both intentional and unintentional misconduct of their employees. The biggest concern regarding security is protecting data with regard to its possible theft, loss, leak and modification respectively. From other security risks identified significant are the business continuity related, such as any technical problems of HW and SW and staffing causing disruption to normal business operation.

Many of the risks can be mitigated by using cloud services, as it is easy to control who has access to data and what they can do with it (for instance there can be systems in place preventing sending or downloading any confidential data) and there are much greater security measures than in most data centers of SMEs. Even though, companies are often afraid of giving their data off premises to a third party, using encryption, for instance, can effectively shelter their data from unwanted eyes. Regarding protection against attacks, many think they are safer on their premises as, for example, they do not consider themselves an interesting hacker target, whereas they could become an unintended victim as a result of an attack on their cloud provider. Even though, this is possible, the security measures against cyber threats in professional cloud centers are (or should be) much higher than most companies can afford. The same applies to business continuity assuring technologies which make cloud much more reliable solution than on-premises for many SMEs.

6.2.3 General perception of cloud

As results of the research show, for most companies, cloud is a quality service but at the same time for many of them it seems to be a service providing data storage outside the company. Therefore, it is likely that SMEs managers still do not have a complete picture of what cloud services can offer and cloud providers shall try to reach out to them more and work on better explanation on what a cloud is.

Private cloud

About two thirds of companies answered the question regarding their definition of private cloud and it is positive that for most of them it is a dedicated non-shared infrastructure either on their premises or in cloud. On the other hand, for little less than 50% of respondents it is (also) something else, which is completely incorrect, or they admitted they do not know. Since even the “right” answers were often rather guesses or they were correct only partially and since private cloud could be a solution for many who fear of security in public clouds, it is advisable that companies acquaint themselves more with this cloud option and cloud providers put more effort into advertising this option.

6.2.4 Data backup

Data backup is an important topic to most of companies and mostly they are trying to do it conscientiously. Research showed that about 60% of companies use (also) some sort of external backup of their data. This supports the fact that many companies think of cloud as

of external storage as many of them use it to store and backup their data. They are from bigger part confident about their backups, mostly because of good experience with renewal of lost files and missing experience with a major problem such as a need to recover a whole backup.

Cloud backup advantages

Cloud backup is seen as advantageous mostly in its *security*, *simplicity* and *costs*. Security is perceived as higher because of geographic separation and better technical safety measures. Simplicity is valued for less work engaged in managing backups and the whole environment, easy setup, management and data sharing options which in the end cause that companies backing up to cloud do not need to worry about their backups. Of course, companies realizing cost savings on cloud backup are emphasizing that they do not need to invest in an expensive HW and its management.

Cloud backup disadvantages

Main disadvantages of cloud backup are again *security*, next *connectivity* and again *costs*. This is very interesting and suggests there is an argument on for whom cloud is secure and cheap. Companies who see backing up to cloud as insecure are worried about giving their data to a third party and losing control over them. Quite reasonable fear is related to connectivity issues. Companies in the Czech Republic still often do not have such a reliable internet connection that they would entrust it to smoothly run a cloud backup (and cloud services in general). Some companies which have built up their own infrastructure and who need to backup large amounts of data claim that cloud is expensive for them and it is an extra cost.

6.2.5 Servers

Research showed that 82% of companies operate servers, either on-premises or in cloud. The most common combination (14 out of 39 cases) of location and management of servers are servers located on premises operated by an external ICT service. Little less than 50% of companies have at least part of their servers located externally, usually in some hosting or housing centers but sometimes also at their external ICT services provider. Combined with the fact that the companies who claimed not to operate any servers are completely in cloud (except of one), it is clear that using cloud services such as hosting/housing or using only SaaS applications is not an uncommon praxis in SMEs, even though often they use cloud only for part of their activities.

Server operation quality criteria

When judging server operation quality, the most important criteria categories are *availability* and *speed of support*. These are further specified into specific requirements.

First, *functionality*, should be 24/7, providing 99,5% and higher availability and assuring that at least e-mail and web are running, as these are critical to most of companies. 35% of companies who answered the question expect no or minimum *unplanned outages* and mostly a very fast resolution of such an incident. The requirements regarding *planned outages* differ

significantly from no planned outages accepted for a company who is completely dependent on running servers to planned outages which can be done during working hours for a company whose operation is very independent on ICT.

Reaction speed and *speed of resolution* are two very close but not the same measures of *speed of support*. The first is the expected time till someone reacts to emerged server problem, the second the expected time till resolution of a problem. Logically, the higher the speed the better. Companies mostly specified reaction speed as immediate or within couple of hours and speed of resolution within 24 hours.

Infrastructure monitoring

About half of companies claim to monitor their infrastructure, whereas the other half does not monitor at all or just partially. Only 15% of companies who answered the question regarding monitoring claim to have a non-stop monitoring which suggests that this is an area where using cloud services could significantly increase smoothness of their servers' operation as cloud providers do their own monitoring usually.

Hosting disadvantages

As most severe disadvantages of server hosting were identified *security, unnecessity* and *price*. Security is by far the biggest concern of 42% companies for the same reasons as with cloud backup – data on internet out of companies' premises and with lowered control. For companies who have their internal ICT team and who have already invested in their ICT infrastructure it seems as unnecessary which connects to price which they consider high, especially if in the cloud they should reach the same level as what they have already built up on-premises.

Hosting advantages

Among main hosting advantages we can find *simplicity*, *flexibility*, *securing operation quality* and, contrary to perceived hosting disadvantages, *security*. Nearly 40% of companies value that they do not need to worry about HW or SW requirements and they do not need any know-how to operate servers. Hosting is scalable, quickly adaptable to their current needs and allows them to pay for just what they use. They believe that hosting centers provide better technology, smoother performance and less downtime than what they would be able to achieve internally. And these companies realizing benefits of hosting also see that security is much higher than what most SMEs can accomplish on premises, as there are various systems in place to keep their servers and data secure.

Housing

Server housing was only answered by about 40% of companies so it is not very safe to make any major conclusions. Based on data available companies are not so much interested in this option as it has the same disadvantages to them as hosting plus it lacks some of its advantages, such as scalability and simplicity. Though, there are also companies who are interested in this option or who are already using it.

6.2.6 On-premises vs. cloud decision factors

The 5 most important decision factors on whether to be on premises or in cloud are *security, price*, *functionality*, *connectivity* and *simplicity*.

Security comes as a major decision maker and most importantly companies assess data sensitivity, control over them and their ownership. For sensitive or critical data, private cloud may be a good option. Data control and ownership should be well specified in an SLA with cloud provider.

Price is an often-mentioned decision factor, not necessarily the most important one based on respondents' answers. TCO and a preferred form of payment are inputs of proper decision making in this regard. Cloud advantage is the ability to pay on monthly basis but in a long run it might be more expensive than having one's own ICT resources. Therefore, it is advisable to first decide which option – cloud or on-premises – is better fit in other criteria and then decide whether the price is acceptable.

Functionality, of course, is important. The most important is availability, which is very good for cloud. Very important is also compatibility with current infrastructure and software, which, on the other hand, can be a problem with standardized cloud solutions. However, major cloud players usually provide integrations with other major solutions.

Quality of current internet connection such as speed, bandwidth and reliability are *Connectivity* related assessment criteria. In the Czech Republic these are still worth considering as resulted from the research, because the many benefits of using cloud could be severely lowered by an insufficient internet quality.

Simplicity such as not having to worry about the solution or time required to make it work and manage it is another important criterion which often could be solved by using cloud services, which are mostly "ready to go" and do not need any further implementation from the user side apart from possible minor customizations.

6.2.7 ICT improvement decision factors

The 5 most important decision factors regarding improving ICT are *price*, *simplicity*, *need*, *quality* and *security*.

Price was the most mentioned factor, as previously not necessarily the most important one. Companies usually said they look at some sort of price/benefit/performance ratios or return on investment. For some companies definitely, cloud can be a very interesting option in terms of costs.

Simplicity was divided into user and admin simplicity where user is much more important, and it is clear that companies today require solutions which are easy to understand and use. Since simplicity is the number one perceived advantage of hosting, it is expectable that in this criterion for most companies, cloud solutions will excel.

Very logically the third most important factor is the *need* of an ICT improvement. If company's current ICT resources are insufficient or users have some specific requirements, there is a need for an improvement. If, on the other hand, everything is working fine, there is no need to invest e.g. into new servers or to migrate to cloud when there is still a working infrastructure in place and when there is internal ICT staff to do the job.

Regarding *quality,* reliability, speed and availability are the basic metrics of quality and logically, all of these need to be as high as possible. Again, cloud is much more reliable than most infrastructures SMEs operate internally, it is faster and more available. The only obstacle here can be connectivity issues.

Security was expected to be among the most important decision factors as it was also mentioned as both the biggest disadvantage of hosting and one of its advantages and as a major decision maker for cloud vs. on-premises solutions in general. Companies want to at least keep their current security level or increase it and they need to ensure compliance with regulatory requirements and standards. Even though, cloud is by many considered a less secure solution, in many cases it can dramatically increase security. Quality cloud solutions are following security standards and some of them even provide effective ways to comply with regulations, such as GDPR.

6.2.8 ICT contractor decision factors

Among 5 most mentioned criteria of choosing an ICT contractor are *references*, *price*, *agility*, *quality* and *support*.

References are a factor which 74% of companies would consider when choosing a new ICT contractor. Customer reviews are important, though some said they do not consider them trustworthy and would definitely verify them with current or past customers of given contractor. Quite logically, about every fifth company said they would consider their experience with current or previous contractors. Interestingly, almost 30% of respondents would decide based on personal recommendation of a trusted person. This suggests that personal connections are still very important in this type of business.

Price, as in all previous cases, is important but not the most important. Companies need to have a feeling that price is justified and fair and some also consider it negotiable. For cloud solutions on one hand, cloud services may be generally cheaper than operating one's own ICT services and customers usually only pay what they consumed during last month. On the other hand, the prices are often non-negotiable which can be also true for SLAs in cases of global providers.

Agility, that is speed of service (response and resolution times), availability of the service and its flexibility and with that connected distance of the contractor as for cases when the ICT service needs to come to customer's facilities in order to solve an incident, it is important how fast they can get there. Considering distance of the contractor for cloud services could result very badly for cloud providers if they have their facilities in other country but it would not be a very correct assessment. Generally, also for cloud providers, it is advisable to choose

local providers or providers having local data centers as response times shall be faster in all means.

Of course, it is important what is the *quality* of contractor's work, services, products and technologies. However, no specific criteria of assessing quality of contractor emerged from the research. One of advantages of cloud solutions is it is easy to try them in small scale, experience the type of work and support of a provider and if satisfied scale up used services and migrate to cloud completely.

Regarding *support* companies expect its immediate availability, good customer service which, especially, is willing to engage with their requirements, no matter what they are. Major cloud services are very automated and because of that in most cases it is not necessary to use their support. On the other hand, it often can be difficult to reach anyone "human" in case of a trouble. If a personal support is important to a company, then choosing a local cloud provider may be a good option.

6.3 Chapter summary

Chapter 6 *Results of research on cloud adoption potential by Czech SMEs managers* brings a detailed analysis of all the answers collected during the research. In total these were 39 interviews producing answers to 27 questions each, thus bringing 1500 short answers. These short answers were coded and categorized in one to two levels in order to simplify the vast amount of the data into such form than an analysis would be possible. The analysis itself provided mostly tables listing identified criteria on given topic in their order of significance and discussions of these criteria. Some of these criteria are used in the process of creating the Model, as described in next chapter in section *Choosing decision making categories and criteria for the Model*. Section *Research summary and recommendations* of this chapter summarizes the most important acquired findings and enriches them of the author's comments on how these findings relate to cloud solutions.

7 Design of the Cloud Migration Decision Support Model for SMEs

Chapter *Design of the Cloud Migration Decision Support Model for SMEs* fulfils the main goal of this Thesis – to design a model supporting decision making of SMEs whether they should consider cloud as a solution to their ICT and business needs. A part of this chapter is a short description of the Model creation, then the Model itself is presented and explained in section *Introducing the Model,* followed by a section about recommended usage. The Model was created directly using acquired results of the Research presented in previous chapter.

7.1 Choosing decision making categories and criteria for the Model

When creating the Model, results of the performed Research were direct inputs of the Model. Following 5 areas were considered when creating the Model:

1. Hosting advantages
2. Hosting disadvantages
3. On-premises vs. Cloud decision factors
4. ICT improvement decision factors
5. ICT contractor criteria

From each of these areas the most important criteria were chosen (3 to 5 top criteria listed in their respective tables presented in previous chapter). These 12 criteria were then aggregated into 7 categories. Based on each criterion's significance in given area they were evaluated with points from 5 to 1 (5 for the top criterion out of 5 criteria, 1 for the least significant criterion out of the other ones). This assessment produced this order of categories:

1. Price (14 points)
2. Quality (11 points)
3. Security (10 points)
4. Simplicity (9 points)
5. Agility (7 points)
6. Need (5 points)
7. References (5 points)

Price consists of criteria Form of payment, TCO and Price/Benefit ratio.

Quality consists of criteria Quality, Business continuity, Functionality, Connectivity, and further Availability, Compatibility and Performance.

Security consists of Human factor, Regulation, Standards criteria and was enhanced of Data sensitivity, Physical security, Cyber security and GDPR as other important criteria influencing security.

Simplicity consists of User and Admin simplicity as criteria and is further enhanced of Operation simplicity and Responsibility in an attempt to cover companies' often cited needs to not have to worry about their ICT.

Agility consists further of Flexibility and Support and another criterion was added – Time to launch.

References consists of criteria Reviews and Recommendations.

7.2 Designing the Model

Since decision-making involves certain steps which managers need to evaluate, to ease them this process mind maps were chosen for a graphical representation of the Model.

Name of the decision area, such as the Quality, stands on the very top and below are the subordinate criteria on a vertical timeline axis, graphically symbolizing the order of the criteria.

For creation of the model was used software XMind 7.

Each criterion is enhanced of an assessment question which is directly followed by possible answers and subsequent recommendations.

For a full understanding, the Model is further enhanced of a description of each criterion below each mind map later in this Thesis. These are not necessary if the reader is well-acquainted with the complexity and meaning of given criterion and associated question.

7.3 Introducing the Model

Based on the 7 categories emerged from the Research defined in previous section, 7 assessment steps in following order were established:

1. Need
2. Quality
3. Security
4. Simplicity
5. Agility
6. References
7. Price

Order of the steps reflects partly significance of each category and partly their logical order. A *need* was not the most mentioned assessment category, but it makes sense to first determine whether there is a need for an ICT improvement and then evaluate whether for that need cloud is a suitable solution. Price, on the other hand, was the most mentioned category and it stands at the very end. This is for 2 reasons. First, most companies mentioned Price as a decision criterion, but they also specified it is not the most important and depends on price/benefit ratio and comparison with alternatives. Second, it makes sense to evaluate

price when benefits and limitations of chosen solution are clear. The other criteria are ordered according to their relative significance, but the order is not really important in the final assessment.

Each of the 7 steps is accompanied by a main question and then further specified into specific requirements which also have their questions. Answers to these specific questions lead to recommendations.

The outcome of this Model, if used in full, brings a clear recommendation whether cloud is a suitable solution. However, the final decision is subjective and depends on decision makers and their perceived benefits of cloud which are clearly seen in the answers to the model questions.

The purpose of the Model is therefore to help decision makers discover scenarios under which cloud solutions are worth considering and, in some cases, it also recommends a specific cloud solution, such as public, private or hybrid.

The Model is targeted on decision support of SMEs as it emerged from the Research conducted on this audience. Still, this Model is quite general and therefore is recommended to companies of all sizes.

Preconditions

By *internal resources* are meant in the Model both internally owned technologies (infrastructure and systems) as well as specialist ICT employees managing these technologies.

7.3.2 Need

Main question: *Are you in need of improving your ICT?*

Image 2 Need assessment - First step of Cloud Migration Decision Support Model

The purpose of the *Need* step is simply to assess whether there is currently a need to change or improve anything regarding ICT. If there is no current need, companies can still use the model to see what direction they could take in the future.

7.3.3 Quality

Main question: *What quality requirements do you have regarding ICT?*

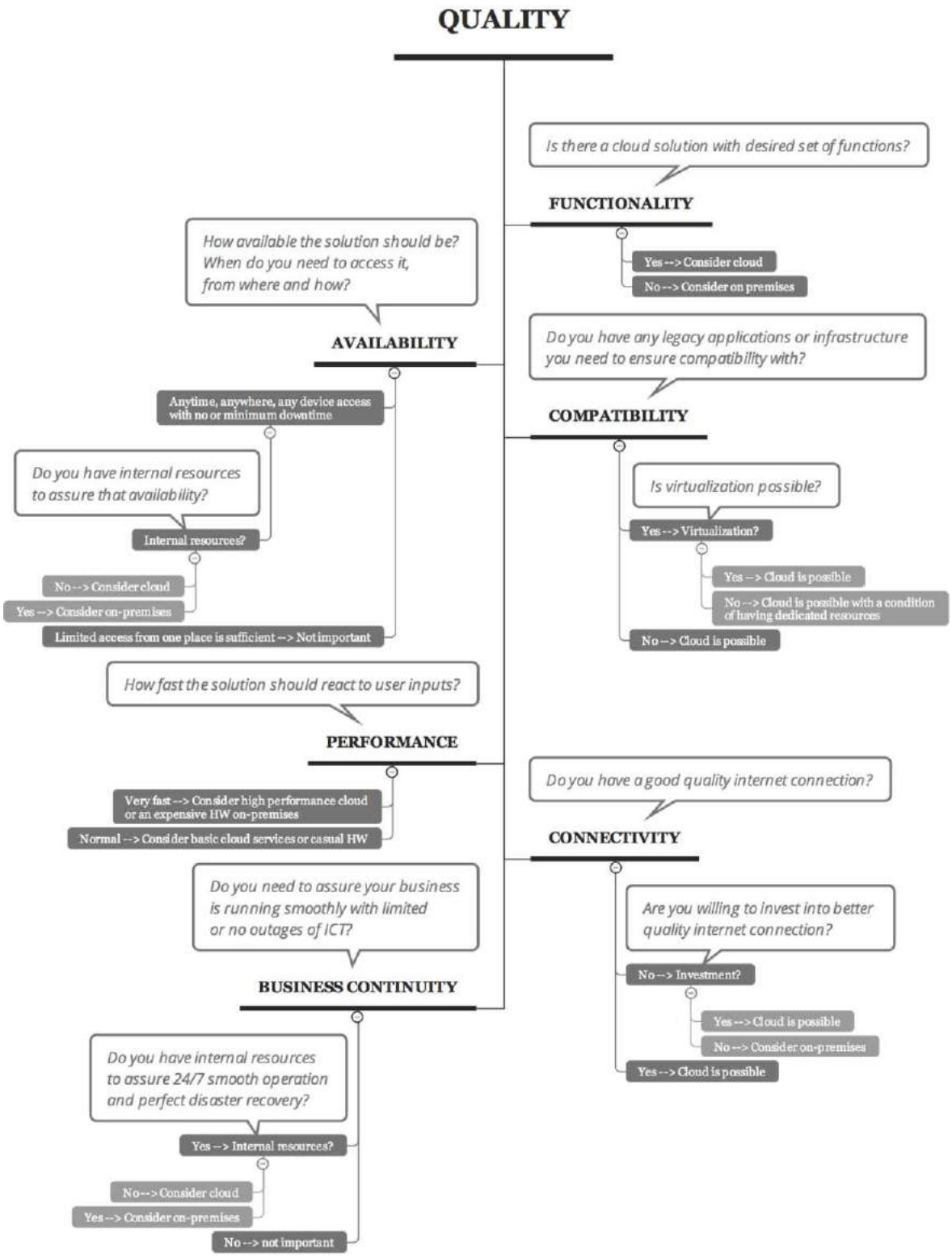

Image 3 Quality assessment - Second step of Cloud Migration Decision Support Model

Functionality

Based on the Research functionality is the most important trait of a solution, that is whether it does what is needed. Most of the time there is a cloud version of anything a company might need today – infrastructure, platforms or applications. However, it still can happen a company needs something what cannot be easily obtained as a cloud service and then it might make more sense to acquire and provision that locally. Even traditional applications can be often provisioned as a cloud service, though.

Availability

Availability is all about how effective a company needs its employees to be. If they only use ICT resources during traditional working hours and they are not highly dependent on it, then it is likely that internally ran solutions will be sufficient or very cheap cloud services can be used. If on the other hand high availability is required in order to allow users to work anytime, anywhere and from any device, highly available team to assure this availability is needed or a cloud service with a high SLA.

Compatibility

Compatibility is a very important criterion for companies which already have existing infrastructure and applications. Since one of the basic concepts upon which cloud computing stands is virtualization, it is important to assess whether current infrastructure or applications can be virtualized. If yes, then it is not a problem to move infrastructure to a housing provider or simply virtualize it in a private cloud and applications can be also moved to cloud. If virtualization is not possible, it is still possible to migrate to cloud but in such case dedicated resources are needed for each such application.

Performance

Companies requiring very fast responses or operating resources-intensive applications will need to consider a high-performance cloud or buying an expensive HW for their on-premises solution. For normal use basic cloud services can be considered or casual HW. Cloud applications (SaaS) are usually very fast performing. Advantage of cloud is that there is usually virtually endless performance available and it only depends on what the company needs and how much are they willing to pay for it.

Connectivity

In order to assure good experience with using cloud, it is necessary to have a fast and reliable internet connection. If currently this is not provided, a company needs to decide first whether they are willing to invest in this area. If not, cloud will not be a good choice for them. As described by (Microsoft, 2017) a truly high connectivity to a cloud for very demanding customers can only be assured using an ExpressRoute, which is a dedicated connection between a company's network and Microsoft. Similar connections can be made to other providers as well.

Business continuity

For companies which are dependent on their ICT, having outage of their ICT for several hours can cause them a serious harm and financial losses. Therefore, they need to assess whether they have internal resources to assure that ICT operation is smooth most of the time and exact procedures on what needs to be done in case of disaster. If they do not have internal resources to do that, cloud services can seriously increase their business continuity.

7.3.4 Security

Main question: *What security requirements do you have regarding ICT?*

Data sensitivity

Since the biggest fear regarding cloud is giving data to a third party it is first important to assess how sensitive really is the data in question. If it is very sensitive or critical to business, a private cloud or traditional ICT are likely to be the right path for most companies. For normal data, on the other hand, it is alright to use public cloud. Most companies today have both sensitive and normal data and therefore a hybrid cloud is a solution for many modern enterprises. Hybrid means, in this regard, that sensitive data is kept in a private cloud and other data and applications run in a public cloud.

Physical security

Companies fear of security in cloud while usually not realizing the insufficiencies in their own security. Regarding physical security, cloud centers are usually equipped with non-stop guarding, biometric or other form of identification, anonymization of servers (so finding a server of a specific company is virtually impossible unless the person knows), fire and flood prevention systems and they have redundant electricity and internet connections, so the risk of outages is very limited. If a company cannot insure this kind of security on-premises and security is important to them, they should consider cloud or expect to invest heavily into their data center.

Cyber security

Attacks and viruses, the largest identified security threat. How do companies protect from them on-premises? Quality cloud services are guarded by most advanced security technologies, such as enterprise-level firewalls, anti-viruses, encryption and DLP systems which assure nothing happens to their customers' data. The quality of security, of course, depends on quality and price of a cloud service but building a truly secure environment on-premises can be a very costly investment. If companies are not capable of assuring using the same security technologies as cloud providers, they are advised to consider cloud.

Human factor

Intentional and unintentional user mistakes are threats to many companies. Secure cloud solutions feature technologies ensuring defined user rights, so it is possible to set up who can see what and what actions can they do with it. Some solutions even have systems in place

that can detect and or prevent security breaches such as an attempt to download sensitive data or send it outside of organization. Companies who are not capable of preventing these risks on-premises should consider suitable cloud solutions.

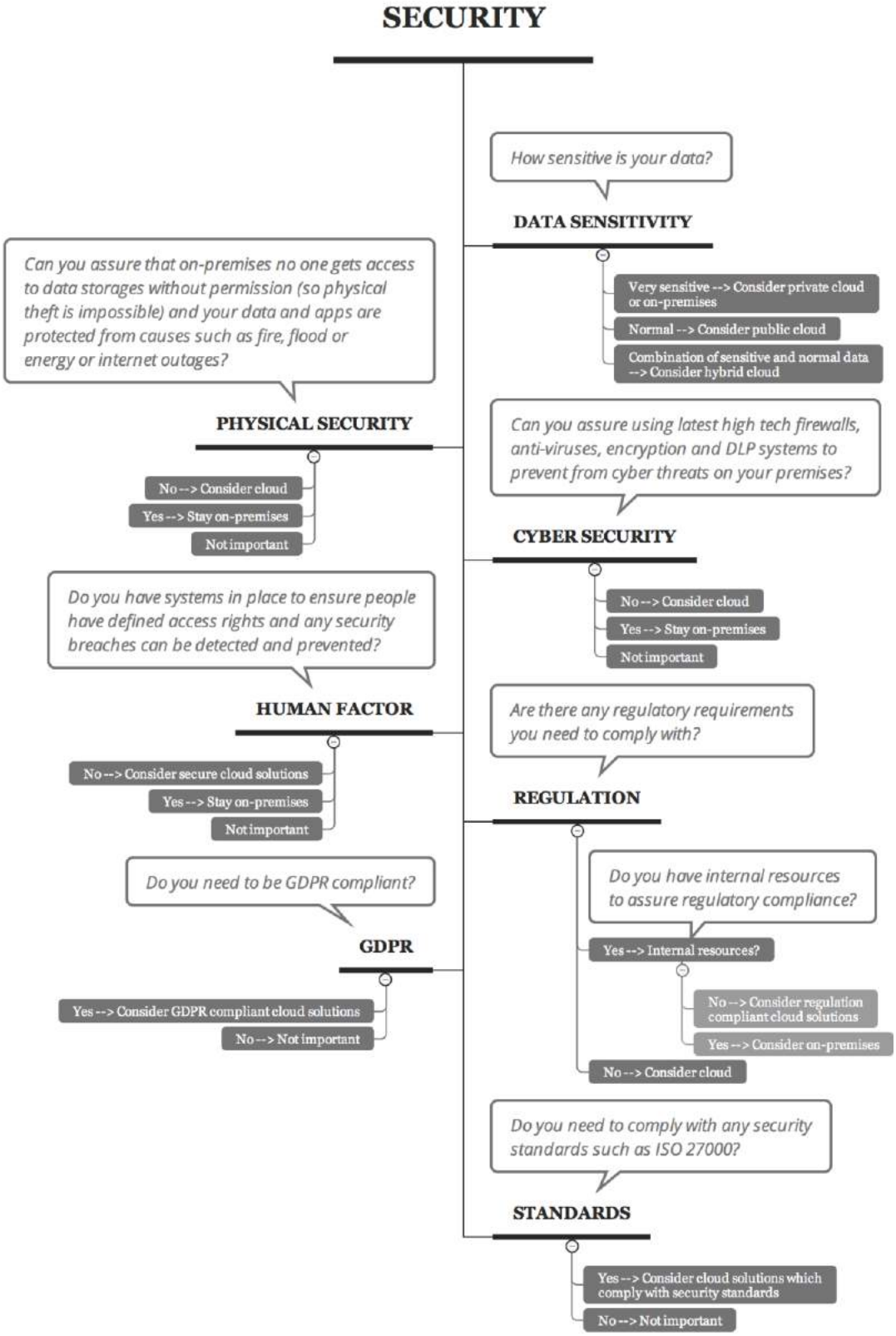

Image 4 Security assessment – third step of Cloud Migration Decision Support Model

Regulation

Financial and other institutions are bounded by a lot of regulation like who can operate and dispose of their data. If they are, sometimes a private cloud is their only cloud option. However, many things can be also solved through regulatory compliant cloud solutions/providers. If none of these are possible, then traditional data center or a private cloud on-premises is needed.

GDPR

Most companies are affected by a regulation regarding data protection. Contrary to belief of many companies that safest are their data on their premises, some GDPR consultants assume that many companies will move to cloud as many cloud providers and cloud services are GDPR compliant whereas many traditional on-premises data storages are not. Cloud services especially provide technologies to better organize and guard data containing personal data. By using a cloud service, part of duties of GDPR are also transmitted onto a cloud provider.

Standards

Well managed companies use security standards such as ISO 27 000 to ensure security of their ICT. If they do, compliant cloud solutions are necessary or their own ICT.

7.3.5 Simplicity

Main question: *How simple do you expect the solution to be?*

Operation simplicity

Procuring, implementing and managing a traditional ICT is complicated as it requires employing a skilled ICT staff, doing regular tenders and managing physical and virtual assets. By using cloud solutions all of this can be simplified to just choosing a cloud provider and everything else is simple and fast as it is highly automated and done by a cloud provider. This is especially useful for companies without internal ICT staff and experience.

Responsibility

Is a company's business ICT or something else? Who they want to be responsible for proper functioning of ICT which can fully support the business? By using cloud services companies get rid of the responsibility for their ICT and they can fully devote to what their best at. For many companies, as resulted from the Research, this is a major advantage.

User simplicity

Best solutions (in certain regard) are such to which users can quickly adapt with no or little training. An advantage of cloud solutions is they are usually very modern, developed in recent years and therefore very user-centric, meaning their interface is very easy to understand. Of course, a traditional solution can be also simple to use but generally if looking for user simplicity, cloud should be considered.

Admin requirements

Not only end-users are important to cloud providers, but also administrators. Cloud solutions are designed in a way that they are easy to implement, manage and scale and if any training is required, it shall be easily accessible, often in online tutorials. Even in case of a private cloud operated on-premises, these technologies ease the work of internal ICT staff. If admin simplicity is important, cloud should be considered.

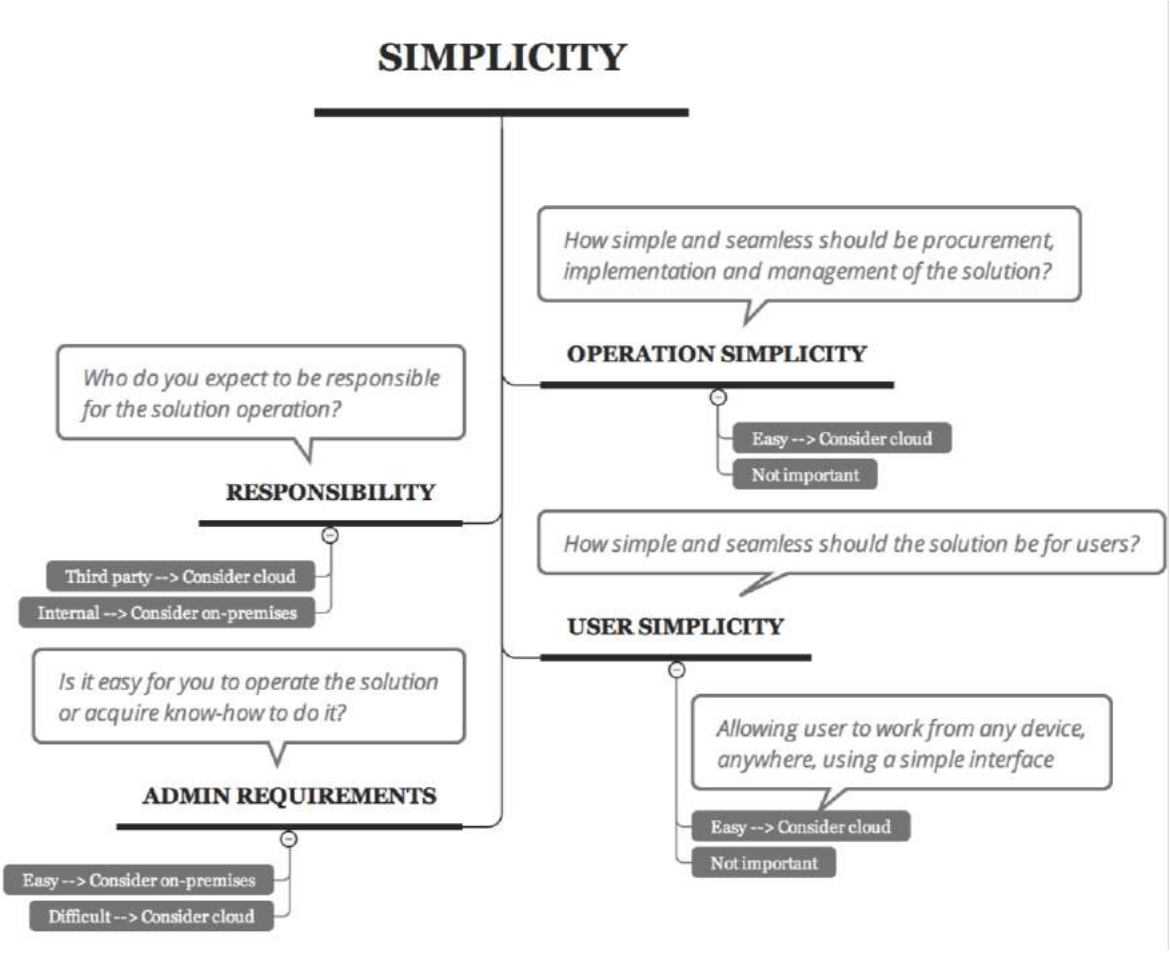

Image 5 Simplicity assessment - fourth step of Cloud Migration Decision Support Model

7.3.6 Agility

Main question: *How agile do you expect the solution to be?*

Time to launch

Time is money and a solution required today might not be current in 2 years or perhaps this time would mean losing a competitive advantage. If a company needs a fast solution, cloud is a perfect option as it is usually accessible and directly usable the same or next day. Therefore, it is very useful also for testing purposes when a prototype needs to be launched fast and later it can be moved to internal data center if required.

Flexibility

Planning for growth requires buying lot more powerful solutions at times when they are not yet needed in order to omit challenging regular upgrades. And what happens if the decision was wrong and this solution will not be needed anymore? Cloud provides high flexibility through scalability of the service. Usually customers only pay for what they use so the service always adjusts to current needs and always is possible to order more services (or less), easily, with no administrative hassle and work.

Support

Cloud solutions provide highly automated services, so support is often not needed because operations such as increasing performance or adding users can usually be done by a self-service. It might happen, that global cloud providers do not pay a very high attention to small and middle-sized customers. If a personal approach is important to a company, then considering local cloud providers may bring expected kind of support. It might not be as automated, but support will be in local language and generally willing to solve any sort of inquiry. If there is a requirement for a very specific and dedicated support with always changing needs, then perhaps support of internal ICT staff is necessary.

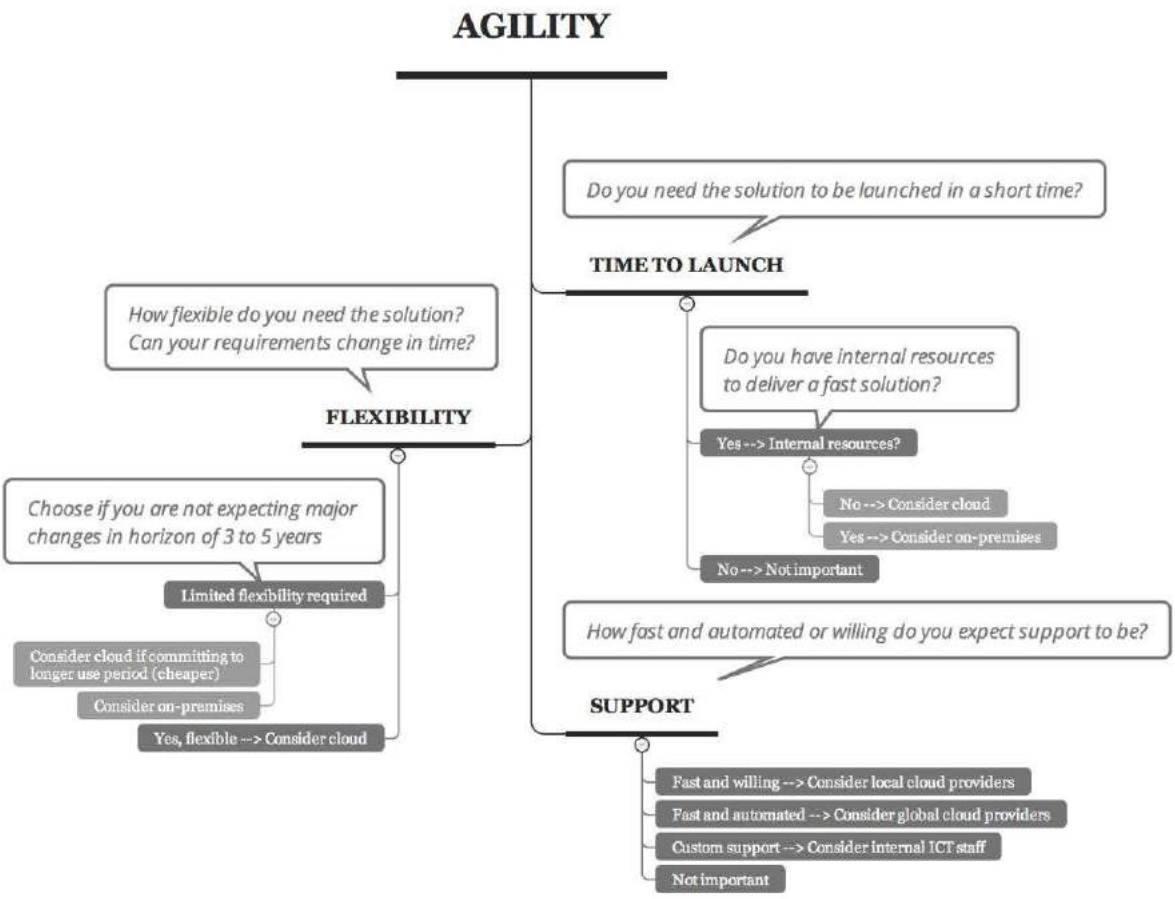

Image 6 Agility assessment - fifth step of Cloud Migration Decision Support Model

7.3.7 References

Main question: *Does proposed solution or provider have good references?*

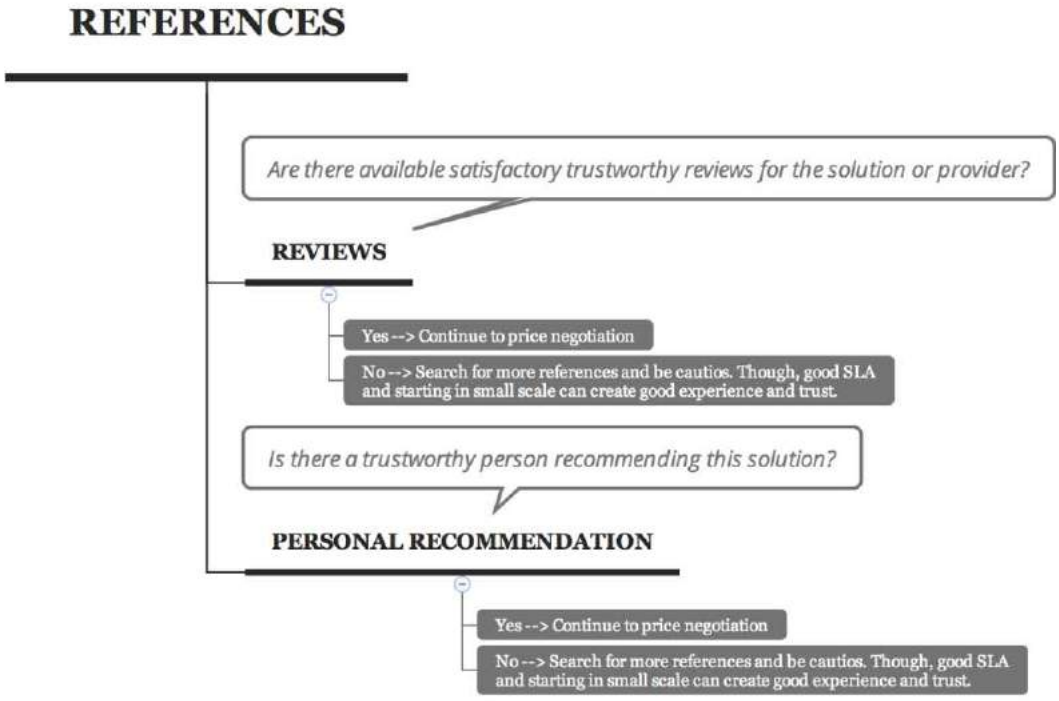

Image 7 References assessment - sixth step of Cloud Migration Decision Support Model

Reviews

Since cloud solutions are used over the internet, offered on the internet and generally used by customers very acquainted with the internet, very often it is possible to find trustworthy reviews comparing different cloud alternatives. If for a specific cloud solution these materials are insufficient, then asking for a personal recommendation or searching elsewhere might be considered. Thanks to high flexibility of cloud solutions it is also possible to try the solution in a small scale and if satisfied, purchase more resources. Many cloud solutions, especially cloud applications, also have demos, free or trial versions which are by far the best way to review the solution – personally.

Personal recommendation

In the Czech Republic a personal recommendation is a very important assessment criterion as resulted from the Research. Therefore, if a specific cloud solution or provider is recommended by a trustworthy person, it might be safe to try. On the other hand, in case that all trustworthy people in a company's surroundings are saying no to cloud in general but none of them have ever tried business cloud solutions, they might not be the best advisors. A personal recommendation is most likely useful regarding choosing a specific cloud provider from someone who is already or has been using a solution from this provider.

7.3.8 Price

Main question: *Is the price acceptable for what it offers?*

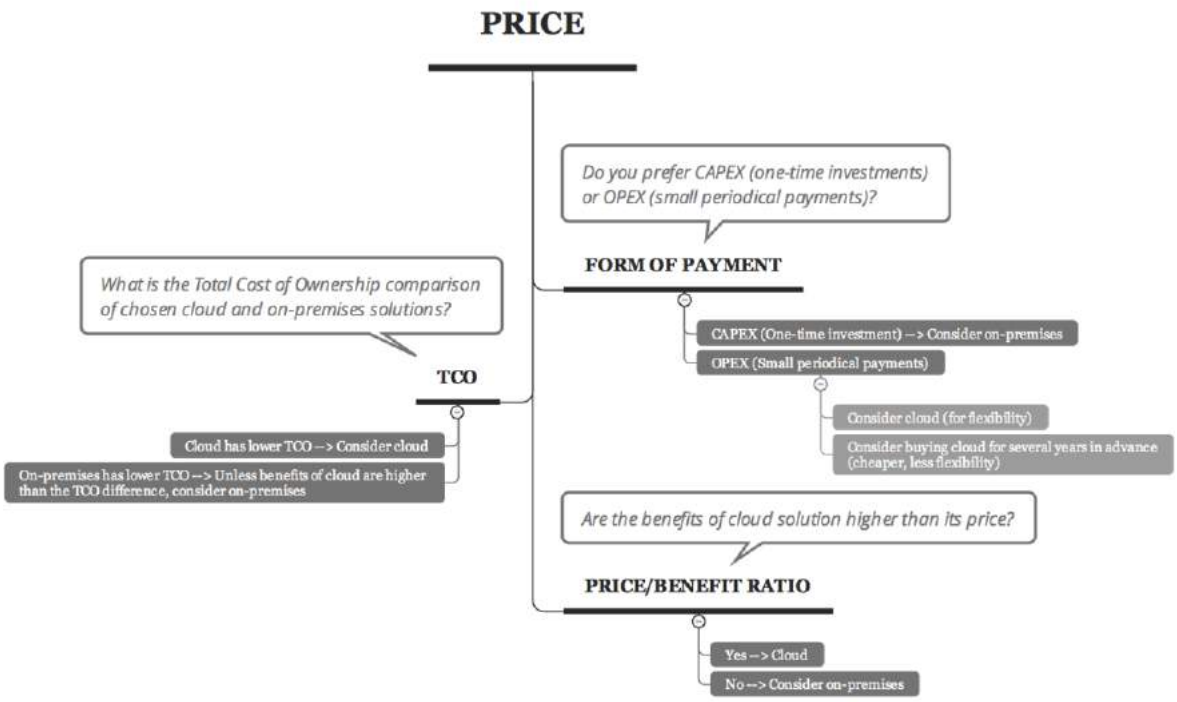

Image 8 Price assessment - seventh step of Cloud Migration Decision Support Model

Form of payment

Large investments are difficult for cash-flow and often innovations must be postponed till money is available. Cloud allows for a pay-as-you-go model which provides usually monthly payments billed based on a monthly (or even more granulated – up to minutes) usage. This helps to streamline a company's cash-flow, allows for a high predictability, an easy budget creation and highly controllable costs which can be easily cut in case of a need.

TCO

As resulted from the Research, when calculating ICT costs, calculated in should be HW, SW, services, ICT department costs and facilities. Obvious costs are a purchase of a server and other equipment, system/software licenses, wages of internal ICT staff or price for an external or cloud service. However, calculated in should be also other costs such as consumed electricity, heating, cooling, security and space for a proper TCO comparison. This cost analysis provides a clear view on whether cloud is a cost-saving or cost-increasing solution for a given company. Of course, a company can decide not to calculate in certain internal costs if they remain even if cloud service is used (such as ICT staff in many cases).

Price/benefit ratio

If TCO analysis was done properly, it shall be clear now whether cloud or on-premises solution is more cost-effective. The final decision, though, depends on a price/benefit ratio.

If TCO of cloud is higher than TCO of on-premises solution but its earlier identified benefits are subjectively higher than the price difference, than it still is a reasonable decision to go with cloud. If cloud is cheaper, on the other hand, but does not provide some crucial requirements (for instance not every cloud is secure), company should consider rather investing into on-premises solutions or higher quality/more secure cloud solutions.

7.4 Using the Model

Cloud Migration Decision Support Model can be used by companies of all sizes to assess whether cloud solutions are considerable option for their ICT or business needs. Model was developed for SMEs managers as a tool to ease their decision making regarding ICT. It is recommended to use the model in this sequence of assessment criteria:

Need → Quality → Security → Simplicity → Agility → References → Price

Mind maps of each criterion serve as a useful road map of what should be considered and what kind of question is necessary to ask oneself. It is recommended to use the Model's diagrams directly (electronically or printed) when assessing the situation by circling chosen answers and annotating them if there are any unclarities or comments. The Model in both Xmind file and images is available also in *Appendix A: Digital additions to this Thesis*.

For recording answers and simplification of the evaluation process, companies can use *Cloud Migration Decision Support Model Answer Sheet (an Excel file)* available *in Appendix A: Digital additions to this Thesis*. This Answer Sheet, however, *is not* by any means *a substitute of the Model* as it does not provide its questions and so it would confuse its user if used separately. Companies can omit questions which they do not consider relevant or do not want to answer, though, for a full assessment answering all the questions is recommended.

The time needed to fill in the Model can vary based on availability of the data required to conscientiously answer the questions. For managers, who have a very clear knowledge of their current environment and possibilities, answering the model should take only few minutes. More time-consuming can be perhaps comparing TCO of the solutions. In any case, answering the Model should help companies realize strengths and weaknesses of their ICT and objectively assess their current situation.

7.5 Chapter summary

Chapter *Design of the Cloud Migration Decision Support Model for SMEs* presented the fulfillment of the main goal of this Thesis – creating the Model supporting decision-making of SMEs on whether they should consider cloud as a solution to their ICT and business needs. The Model creation with relation to the previously acquired *Results of research on cloud adoption potential by Czech SMEs managers* was described and the Model itself was presented, each step was described in detail and a recommended usage introduced. The Model consists of 7 assessment steps: *Need, Quality, Security, Simplicity, Agility, References* and *Price*. The *Validation of the Model* is available in next chapter.

8 Validation of the Model

Chapter *Validation of the Model* describes usage of the Model in 5 Czech SMEs. Each company is briefly described, its need is identified, and then model answers are presented in form of a completed Excel table (available in appendices). Thereafter these answers are commented including the final result from the Model and finally a validator's comment from each company is provided.

Since validators asked to remain fully anonymized (including their companies) they will be further referred to as simply Company A, B, C, D and E respectively.

8.1 Validation by Company A

The Model was used by an IT manager of company A doing business in managing sports facilities.

8.1.1 Introducing Company A

Company A is a Czech middle-sized Company with approximately 100 employees. It is a limited liability company, sponsored by a city. Their activities are managing sports facilities, including stadiums and swimming pools in their city.

60 of their 100 employees are administrative and management workers, the other 40 are technicians and cashiers.

The Company manages in total 10 sports facilities in 30 km radius. A quality internet connection is present at the headquarters, not so much at the sports centres.

There are 3 people in ICT department who manage all the ICT technology the company uses. In order to manage ICT for so many users at 10 different locations, they use technologies for remote management, such as VPN and Citrix. Citrix technologies allow them to manage ICT resources at their remote locations even with low quality of internet connection.

They operate their own data center with virtualized servers on Citrix technology. On these servers they virtualize some of the business apps. Because of that they are able to manage these applications from one place and easily distribute them to all employees who need them for their work.

8.1.2 Identified need of company A

Currently the Company is in need of upgrading their HW infrastructure from Lenovo. Their current servers used for virtualization are 7 years old, running non-stop. This is already an honorable age for servers. Company does not have any backup infrastructure, so they are worried that in case of a disaster they would have a major problem and a long downtime. They are paying maintenance on their servers. Therefore, they have a guarantee from Lenovo

that they would ensure new servers running in 24 hours (which already is too long for the Company). However, in case of a problem with data during a disaster, they would have to be renewed from backups which would further increase the downtime. The IT manager is worried that a complete renewal of the infrastructure as they have it now could take a week in case of a major disaster, which of course would be a big problem for the company. The company has already had a problem with their data during a system failure, therefore they are aware of the risks and want to mitigate them.

Their desire is therefore a new and redundant infrastructure which would not only provide enough performance but also enough security and business continuity assurance. A cloud is a considered solution.

8.1.3 Answers to the Model by company A

For answers go to *Appendix BB: Answers to the Model by company A*.

8.1.4 Comments to the Model results for company A

Even though, there are certain areas in which a cloud solution would be beneficial to the Company, the overall assessment result is upgrading their on-premises infrastructure, not migrating to cloud.

The main reasons are these:

Compatibility

According to the IT Manager, the Company operates number of legacy applications which cannot be virtualized, or it is very difficult to virtualize them. Each update then means virtualizing them again. This is very ineffective, especially if done for only one or two users. Other users need to access some applications available through the internet. However, some of these specific applications are so deprecated that they need to be accessed using a specific version of a specific browser and a specific version of JAVA. This is often true in case of software of government, municipalities, health insurance companies and some banking applications. For this reason, desktops cannot be virtualized, only servers and some applications.

Connectivity

Since quality internet connection is only available at headquarters, connectivity is an issue. There are 10 sports facilities in 30 km radius and to some of them there is no landline telephone connection, let alone fiber optics which are completely inexistent. Some of the centers are very small in terms of computers, counting just about 3 PCs. For these reasons investment into building a higher quality internet connection would be tremendous and unjustifiable.

Data sensitivity

Company has an information system containing both sensitive data and data critical to business operation, which they do not want to have outside the company.

Responsibility

Connected to data sensitivity is responsibility. The IT Manager prefers his internal ICT team being responsible for assuring the ICT services as he does not have a good experience with leaving a complete responsibility on a contractor.

TCO

TCO is higher for a cloud solution as many of the benefits of cloud such as higher physical security due to guarded and surveilled building 24/7, backup energy sources or air conditioning are not counted in as these are needed for other company's operations anyway.

8.1.5 Company A validator's comment

"I consider the structure of the Model very interesting. Some questions were not easy for me as, regarding ICT in our company, we have 2 very separated worlds. One is an office world and other is the operation world. Therefore, not always an answer to the question was straightforward for me as these 2 worlds have different needs, limitations and possibilities.

This Model is for me something I can go through and subsequently realize, what all is there waiting for me, if I have not forgot anything, what is the current state. It is great that I can go through it once again in a year and see the differences and decide whether a reevaluation of the strategy is needed. Perhaps more than a specific recommendation, for me it is a useful checklist. I get to organize my thoughts."

8.2 Validation by Company B

Validator from company B, a trade company, was a partner and manager of the company. This Validator was also a Research respondent for company 15.

8.2.1 Introducing Company B

Company B is a small Czech trade company buying consumer goods in China and selling them through a dealer network in the Czech Republic and Slovakia. They have several distribution centers in the Czech Republic.

There is no ICT staff and they acquire all ICT related services by outsourcing.

For stock management and accounting they use Czech economic system Pohoda. This system they have locally installed both at the dealers' sites and the distribution centers as well as at the headquarters. For syncing the data, they currently use manual transmission of data via corporate e-mail.

8.2.2 Identified need of company B

Since the current system of sharing data from the economic system among interested parties is neither convenient nor the fastest and safest, they consider having a central database and centrally operated system Pohoda accessible for all the parties.

8.2.3 Answers to the Model by company B

For answers go to *Appendix CC: Answers to the Model by company B.*

8.2.4 Comments to the Model results for company B

The result of the Model came out positive for the cloud solution. The need was ideal for an on-premises/cloud assessment as it was about the way of operation of an economic system Pohoda which can easily be hosted and there are several companies who provide this service.

TCO was not assessed as neither the costs of current solution were known nor the exact price of the cloud (hosted) version of software Pohoda. However, the validator acknowledged that the price is likely to be acceptable for the benefits it offers.

In almost all the categories cloud came out as a recommended solution. This is due to the fact that company B is a small company with no internal ICT and no ICT know-how and they are already used to outsourcing of ICT.

Human factor was considered not important as the validator said he trusts his people. Time to launch was also not important as they have the solution described earlier since 5 years ago and it is working for them. Therefore, they are not in rush with the new solution.

They enjoy paying monthly but at the same they do not require a high flexibility and are willing to commit to a long-term cloud plan in order to receive a better price. They expect there will be someone they can call to in case of a problem or a question and therefore a local cloud provider is recommended.

So far, they have not received any reviews or recommendations on a cloud solution.

Based on the results of the Model, company B was recommended to consider using services of one of the local providers of hosted software Pohoda.

8.2.5 Company B validator's comment

"Regarding decision criteria, I think they truly encompass everything. There is nothing missing I can think of now.

The Model is simplified, as there were about 2 situations in which I wanted to answer something which was not there. This is something I would point out, but I would not change that.

For perfecting the Model, it would be great if it could go through a new research, gather feedback from companies with different needs and then be adjusted slightly again. However, I think this is not meant to be a part of a master's Thesis as this result is very good already.

From the position of a manager the Model certainly brought me to a thought to reconsider our past decision and think again whether the cloud solution would be more advantageous for us."

8.3 Validation by Company C

Company C is the same company as Company 12 in the Research earlier. The respondent and validator, however, are not the same person. Validator of company C is their ICT contractor - a person responsible for consultations and coordination of all ICT related services provided by the company he is representing to the company C. This validation can be considered a validation by an ICT consultant.

8.3.1 Introducing Company C

Company C is a middle-sized company with about 130 ICT users doing business in clothing industry. They have no internal ICT staff and acquire all ICT related services through a contractor. They have an SLA with this contractor exactly defining their relation and the level of service provided.

Company C has headquarters and a network of retail boutiques. For proper operation of the retail shops they use a VPN connection to their centrally located servers, on which information system, CRM and other business-related applications are running. If this connection fails, it brings significant problems as, especially, the comfort for a customer is lowered. In such case a shop assistant does not have access to databases and therefore is only able to provide products and services available at the retail shop itself, which is significantly less.

Their servers are located in housing, thus bringing the physical security level of cloud environment.

8.3.2 Identified need of company C

The need for which the Model was used is assuring of "high availability of our service and applications". This is a very broad need which made answering of some questions difficult to the validator. It encompasses assuring the availability of all the applications and services mentioned in previous paragraphs about what they need at the retail shops.

8.3.3 Answers to the Model by company C

For answers go to *Appendix DD: Answers to the Model by company C*.

8.3.4 Comments to the Model results for company C

The results showed that on-premises solution is at the moment better for satisfying the broad needs for which the Model was used in this company.

It is important to note, that the company is already using Housing services bringing them part of the benefits of full cloud solutions and so they are, so to say, a "one leg in cloud" already. They have been considering in recent past also full cloud services, such as server hosting, but for now they have a sufficient own infrastructure and when calculating the TCO, hosting was for them significantly more expensive. According to the validator this is due to the fact that hosting companies have to purchase and operate the best infrastructure available in order to assure providing the high SLAs they promise. This reflects in price. In his opinion, an SME is never able to reach such level of availability using their internal resources, but it is always a question of what the real need is and how much are they willing to pay for it.

Commenting on the results available in *Appendix DD: Answers to the Model by company C,* functionality is considered unsatisfied in cloud as the validator believes a cloud solution would not assure a fast responding SQL server they need for proper functionality of their business applications.

In all the questions where internal resources are available, by internal is meant the IT team of ICT contractor. Human factor is considered not important as they never had a problem with their employees. Therefore, only some security measures in this regard are assured.

TCO comparison was not evaluated as currently they do not have this calculated in full. Due to having currently everything needed built up and knowing server hosting would be more expensive for them in a long run, the price/benefit ratio was evaluated as negative regarding cloud.

8.3.5 Company C validator's comment

"The Model is simplified in the way that it mostly gives 2 options – a cloud or an on-premises solution. However, the reality today is usually not so 'black and white'. Each company has their own needs. Some of them want cloud, some do not want to even hear about it, mainly because of security. Nowadays many companies go to cloud with their Exchange server, because it is easy, reliable, backed up. Soon, I believe, there will be no company having their own Exchange server. Production servers, on the other hand, are still mostly kept on-premises for the reasons of response speed and security.

The Model is therefore in many cases not so well suitable for an assessment of a whole ICT of a company, but it can be used for a specific need assessment. For instance, Exchange Server is surprisingly really beneficial in cloud and not more expensive which is something that could be found out using the Model.

In order for the Model to be really useful in a consultant's daily life, it shall have at its beginning questions regarding assessment of current ICT situation in a given company – how many users are there, what infrastructure and technologies do they have already and so on.

The Model is an easy guide for someone, who is not from an ICT world, for managers, who need to make fast decisions. For them it will be valuable. For a first-round analysis for non-IT people it makes sense."

8.4 Validation by Company D

Company D is the same company as company 30 in the Research earlier. The validator is the same person as the respondent of the Research, a division director also responsible for ICT.

8.4.1 Introducing Company D

Company D is a Czech middle-sized company conducting business in production and construction. They have 250 ICT users, 150 of them with domain user account.

Their headquarters is in the Czech Republic and they have further 3 branches, one in the Czech Republic, one in Slovakia and one in Hungary. Almost all domain users have access to DMS and SharePoint, about 70 users work with their information system and about 20 people with CRM.

All of these users are serviced by 2 internal technicians in terms of desktop stations and local network management. For infrastructure management they use services of an ICT contractor in amount of 20-30 hours per month. Information system is managed by another ICT contractor in amount of about 40 hours per month.

They consider ICT a driver of their company. Their ICT staff is evaluated based on their performance, so they themselves create projects and have them approved so they could get a reward for their work.

Company has implemented financial cost centers for each company's department. Therefore, if any department wants anything from ICT department, they have to buy their services. Thanks to that "ICT department is not doing all the work which others do not like to do", as explained by the validator.

8.4.2 Identified need of company D

Company D is currently considering migrating their Microsoft Exchange Server to cloud.

8.4.3 Answers to the Model by company D

For answers go to *Appendix EE: Answers to the Model by company D*.

8.4.4 Comments to the Model results for company D

The recommended solution for company D based on Model results is cloud. This is consistent with what the company actually plans to do and also in line with the experience of ICT consultant presented in validation of company C.

In Step 2, Quality, all criteria are pro-cloud. In step 3, Security, hybrid cloud is recommended regarding data sensitivity due to existence of combination of sensitive and normal data. However, if the company decides to trust its cloud provider, even sensitive data can be in public cloud. Cyber security and Human factor are well assured on-premises in this company but the need for a simple and agile solution are more important. Further, company has both good reviews and personal recommendations on Exchange Server in cloud. They prefer small periodical payments and according to their calculations cloud solution of Exchange Server also has a lower TCO. Combined with all the pros, the price/benefit ratio comes out as positive for a cloud solution in this case.

8.4.5 Company D validator's comment

"I see a logic in the Model, it doesn't seem badly. I can't really imagine that a company could make its decision based on any kind of model. The Model is certainly of a recommending nature.

What I am missing in the Model are some sort of weights. Optimal would be if each criterion would have its weight as different companies emphasize different things in their decision-making. In order to simplify this, a 'standard weights setup' could be established based on an empiric research conducted in several companies on what weights do they assign to those criteria. These standard weights would be normally used in the Model and users could change them if they wanted to. Such Model would bring a specific recommendation to a company.

On the other hand, this requires further research and further modelling and so that is not a work for a master's thesis."

8.5 Validation by Company E

Company E is the same company as company 28 in the Research earlier. The validator is the same person as the respondent of the Research, a managing director and sales director.

8.5.1 Introducing Company E

Company E is a small company conducting business in metal processing. They have 12 ICT users and no internal ICT staff, only one person who coordinates ICT contractors.

They currently operate 1 server which they use as both a file server and an application server running their accounting SW and CRM. They have hosted e-mail and web. Back up is done daily on-premises on a separate disk array, in addition they also back up to their ICT contractor's disks.

8.5.2 Identified need of company E

Company E's current need is a renewal of the server. They either need a new one or they consider a cloud solution – a hosted server. Their requirements are a "strong server with fast response to cover information sharing at 12 work stations".

8.5.3 Answers to the Model by company E

For answers go to *Appendix FF: Answers to the Model by company E.*

8.5.4 Comments to the Model results for company E

Quite surprisingly the overall assessment of the Model produced on-premises servers as a better solution for this company. This is mainly because of TCO comparison. Since the company already is considering this option for several months, they already had both options calculated. Buying their own server including its maintenance and management by an ICT contractor comes out cheaper than a hosting offering they received.

The form of payment did not produce a result as the form of payment was not necessarily a decisive factor. The validator explained that if he purchases a server, he may acquire credit to finance that, thus also having the possibility of OPEX which often is better for them in case of a large amount of money.

In step Agility, all criteria are pro cloud, the same applies to simplicity. In terms of security, the validator claimed to be able to assure cyber security and regulatory compliance. However, the only regulation they need to comply with is GDPR, which is a regulation though, so he answered correctly. They solve this by a combination of internal resources and an external GDPR consulting company. The question about standards was wrongly understood by the validator, as he answered he needs to comply with security standards, but he meant that he expects the cloud solution to follow certain security standards.

Regarding quality, there are no barriers to cloud, however business continuity can be assured using internal resources, or more precisely using resources of their ICT contractor.

8.5.5 Company E validator's comment

The validator had problems understanding what is meant by internal resources, so he recommended that definition of certain terms would be added as preconditions of the Model. He also recommended that provided Excel table would be enhanced in a way that the questions from the Model would be directly in the table as in his opinion it is not very user-friendly to fill-in a table and have to look into a model somewhere else and it would also help clarify some common mistakes all of the validator did like answering the sub-questions also in the cases when they were not supposed to.

The validator commented the Model: "Yes, it is useful to have such Model, I need specific questions with recommendations which allow me to sort my thoughts and find the right solution to a problem. Among the criteria I am missing the 'expected time of usage' of the solution as it significantly impacts costs and some other criteria. Otherwise I think criteria are alright. Sometimes it is great, if one can define his own criteria. So, the Model could be amended with a set of one's own criteria.

If the Model is perfected in terms of user-friendliness and it will allow me to define also my own criteria, I can imagine using it. After all, when we are purchasing a TV on an e-shop, we

also first define criteria for sorting out the most suitable ones and then we make the final decision based on some finer criteria. So, a similar principle would work here as well, probably."

8.6 Other model reviews

Company 20, a trade company and industrial holding, considered the model interesting, though in their opinion unsuitable for companies of their nature. They are a small industrial holding and as a mother company they only need a fairly simple information system. Company director's opinion was that the Model is too complicated for a top-level manager.

Company 7, banking services, also considered the Model interesting and as the IT manager from this company said, "it presents an interesting and practically useful guide". He also added that "in our organization is the migration to cloud under current legislation impossible. Actually, at the end of the last week I talked at a conference with colleagues from banking sector and also they perceive usage of public cloud in banking as very limited."

8.7 Chapter summary

Chapter 8 *Validation of the Model*, proved the Model's practical usability by introducing 5 conducted studies in Czech SMEs of different sizes and nature. In 3 cases the result of the Model came out positive for an on-premises solution, in 2 cases for a cloud solution.

All of the validators basically considered the Model useful and interesting, at least to someone or for specific use cases. All of them suggested specific things they would appreciate in the Model, in its logic or practical usability, so the validation was very useful as it uncovered areas of possible future work on the Model.

First discovered finding is that it is easier to use the Model on a specific need, such as provisioning of a specific ICT service either on-premises or in cloud (good example is an Exchange Server or a hosted server in general), as using it on the whole ICT of a company brings conflicts which are often not possible to be solved only using predefined options.

Second discovery is that the attached Answer Sheet in Excel table (intended to be only a supportive tool) was actually considered by many companies the primary thing to look at. Because of that they often talked of the Model as of a questionnaire and foremost they did not use the Model itself much to answer questions which often brought conflicting answers which needed to be solved via calling them and clarifying these conflicts.

Regarding the recommendations, it was advised to assign weights to criteria based on empiric research, allow users to define also some of their own criteria (and in that case also their own answers), enhance the table in a way that it is more straightforward (containing the whole questions and perhaps clickable explanatory notes), include an introductory analysis of the company's ICT environment such as how many users and what applications and infrastructure they have. Model could be further perfected by gaining feedback from even more companies and for some it would be beneficial to simplify it.

Conclusion

The Aim of this Thesis was to design a Cloud Migration Decision Support Model for SMEs, helping them make the right decision on whether cloud or on-premises solutions are their better fit. This main goal was fully satisfied by creating the graphical Model which consists of 7 assessment steps:

Need → Quality → Security → Simplicity → Agility → References → Price

These 7 steps serve as categories under which are more specific criteria to be addressed when considering a migration to cloud. All of these criteria are equipped with a question, of which the answer provides a recommendation on whether a cloud or on-premises solution is likely to be more suitable in a given situation for a given company.

The Model was validated in 5 studies by small and middle-sized Czech companies. This validation proved Model's usability as well as helped identify its limitations and future work directions. Several other companies confirmed, that Model is interesting to them and they find it useful. Model can be used for a company's self-assessment or as a useful tool for ICT consultants to obtain answers to critical questions and accelerate a client's decision to migrate to cloud, if appropriate.

The fulfillment of the main objectives is summarized in a table below:

Table 28 Main thesis objectives fulfilment

Main Thesis objective	**Type of fulfilment**	**Chapter of fulfilment**
Design Cloud Migration Decision Support Model for SMEs based on qualitative market research results	A graphical 7-step assessment model, including explanations was created	7 – Design of the Cloud Migration Decision Support Model for SMEs
Conduct a qualitative market research on cloud adoption potential by Czech SMEs managers in 39 SMEs and identify the most important criteria on whether to migrate to cloud	Interviews with 39 companies were conducted and qualitatively analyzed resulting in a market analysis and discovering the required criteria serving as inputs to the Model	6 – Results of research on cloud adoption potential by Czech SMEs managers

In order to fulfil the main objectives, additional objectives were fulfilled:

Table 29 Additional thesis objectives fulfilment

Additional Thesis objective	Type of fulfilment	Chapter of fulfilment
Describe briefly theory of ICT and cloud related terms	Important terms and concepts were identified and described including connections between them	2 – ICT and cloud
Summarize theory of conducting a qualitative market research	Theory from available recognized sources was reviewed and summarized	4 – Qualitative research
Describe in detail methods used to conduct this research	All the methods used to conduct the research were described in detail providing a complete know-how	5 – Designing and conducting a qualitative market research in ICT
Validate the Model usability in real SMEs	The Model was validated by conducting studies in 5 SMEs and reviewed by several other business representatives	8 – Validation of the Model

As identified in the above tables, all objectives of this Thesis were met. Thanks to that expected outcomes are satisfied in full.

The most important outcome, the Cloud Migration Decision Support Model for SMEs, is created, explained and validated by several real SMEs, enhanced of an Answer Sheet in form of an Excel table for filling out the questions asked in the Model (the Model, validations and Answer Sheet are all also available in *Appendix A: Digital additions to this Thesis).*

Second most important output of the Thesis, the analysis of the qualitative market research results on cloud adoption potential, was realized and its 1500 pieces of answers and many pages of information are summarized into a 6-page summary. This analysis itself provides a useful overview of what state the market is in and based on what criteria SMEs managers adopt cloud, innovate their ICT and choose their ICT contractors, among other.

Third great output of this Thesis is a by-product of conducting the extensive market research. A complete know-how on conducting a qualitative market research, acquiring respondents and analyzing data from unstructured interviews was created and is provided to any future researchers, no matter whether academic or business.

Fourth output are the data from interviews provided in *Data processing table including Research data (an Excel file in Czech)* in *Appendix A: Digital additions to this Thesis*. These could serve other researchers as both a frame of reference and or data for their own research.

As minor output, but useful to business owners, IT managers and anyone interested and unacquainted with ICT technologies with focus on cloud and security, the brief theory provided at the beginning of this Thesis in chapter *ICT and cloud* can be considered.

As resulted from the validation, the Model has certain limitations. For some managers it might be too complex to be quickly answered. In more cases, however, the validators uncovered areas which could be further enhanced. A future work on the Model could be done by enriching it of weights to weigh the pros and cons resulting from the Model. It could also allow users to define their own criteria. In some cases, they would enjoy having more possible outcomes available and Model's usability could be very much improved by a smarter design of its interface better leading the users to correct answers in their case. A future work could also be done on simplifying the model for specific use cases.

A solution could be creating a smart web application which would first discover needs and current company's ICT environment and then adjust its criteria and questions to these conditions. After that it would lead users step by step, not distracting them by any other questions at a time. There would be predefined weights to all criteria thanks to which the Model would produce a clear recommendation after its completion. These weights could be adjusted by users. Such an application would be a very useful enhancement which could not be covered in terms of this Thesis but is an interesting topic for future theses or future work in general.

In praxis it is likely the Model, as it is now, would often be used by ICT consultants rather than by managers themselves. It is certain that the author plans to use this Model in his future occupation as an ICT consultant and most likely will use the recommendations above to further enhance it.

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Appendices

Appendix A: Digital additions to this Thesis

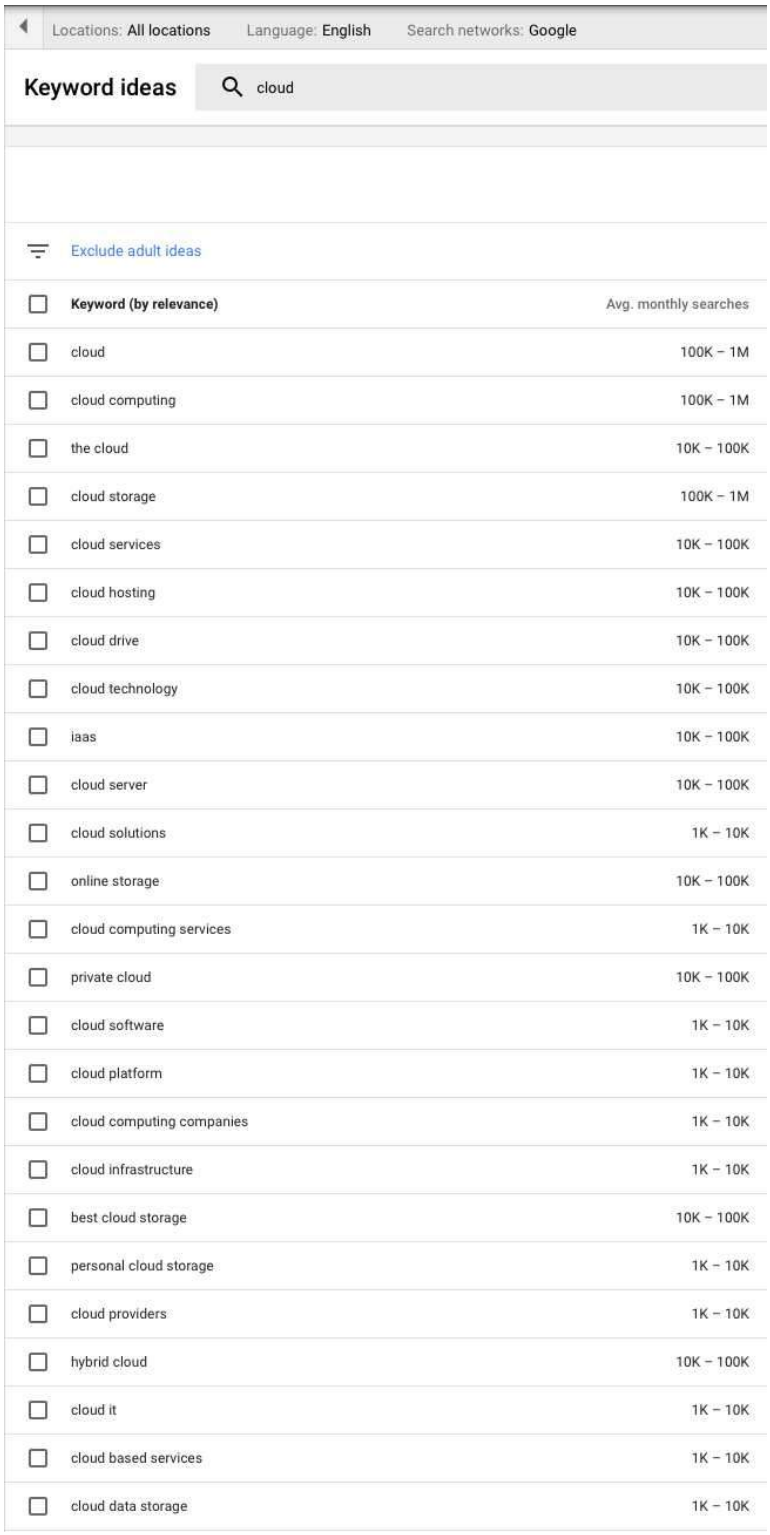
All of the below listed documents are available on an enclosed CD or better on http://www.cmdsm.knettig.cz where they can be updated in the future. The URL belongs to the author and the subdomain CMDSM (**C**loud **M**igration **D**ecision **S**upport **M**odel) shall remain allocated for the purpose of this Model and Thesis.

In case of unavailability of any of the documents, please contact the author on his address jan@knettig.cz.

Enclosed documents are:

1. Cloud Migration Decision Support Model Answer Sheet (an Excel file)
2. Cloud Migration Decision Support Model Mind Map (an Xmind file)
3. Individual diagrams of Cloud Migration Decision Support Model (png files)
4. Model validation answer sheets from companies A to E (Excel files)
5. Data categorization tables for questions 4 to 27 including research data (Excel and Numbers files in Czech)
6. Data processing table including Research data (an Excel file in Czech)
7. Research interview template (a Word file in Czech)
8. Interviewed companies specification (a Word file)

Appendix B: Google Keywords Planner on search term “Cloud” globally on March 5, 2018, search Language: English



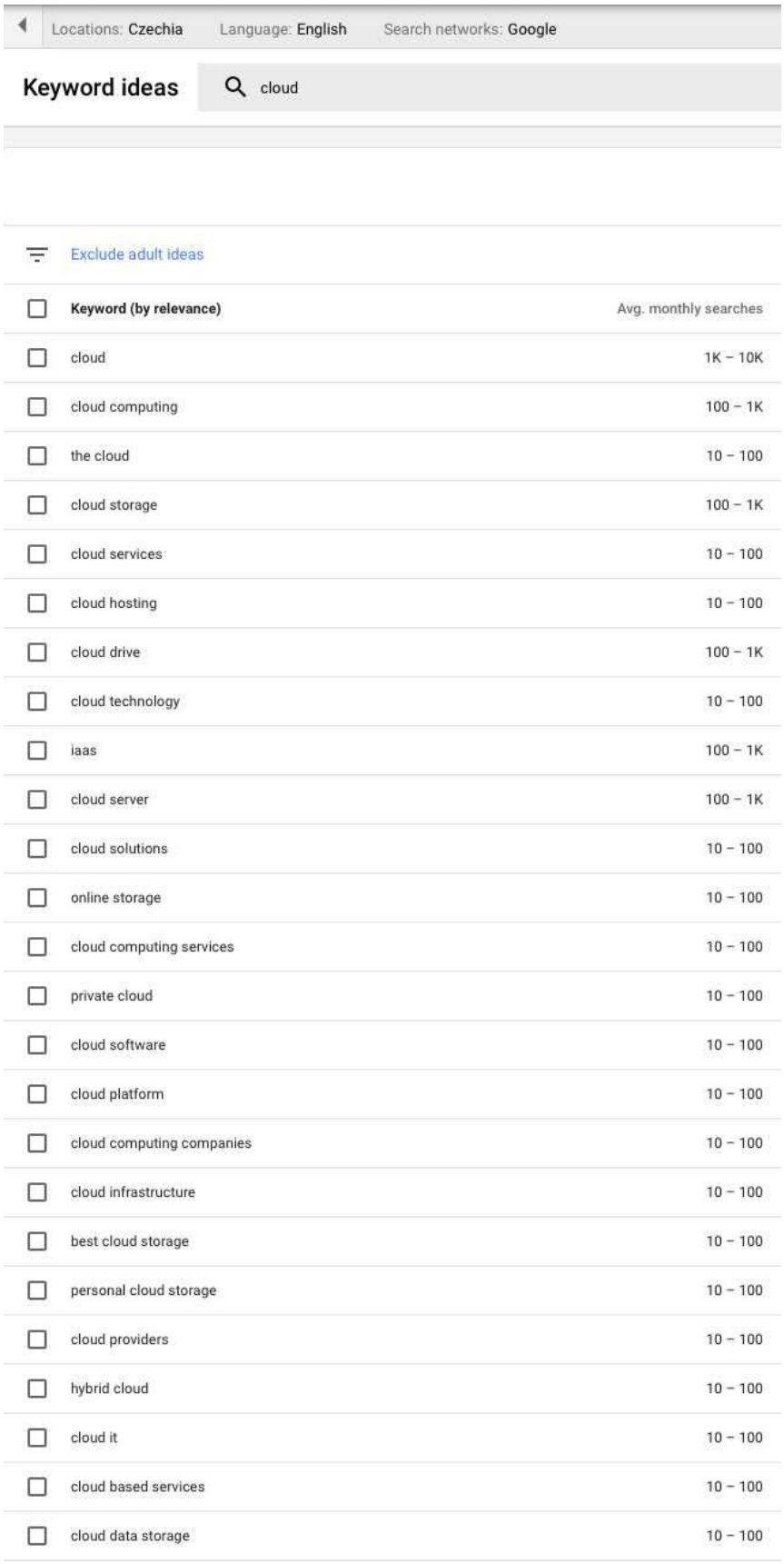
Locations: All locations Language: English Search networks: Google

Keyword ideas cloud

Exclude adult ideas

Keyword (by relevance)	Avg. monthly searches
cloud	100K – 1M
cloud computing	100K – 1M
the cloud	10K – 100K
cloud storage	100K – 1M
cloud services	10K – 100K
cloud hosting	10K – 100K
cloud drive	10K – 100K
cloud technology	10K – 100K
iaas	10K – 100K
cloud server	10K – 100K
cloud solutions	1K – 10K
online storage	10K – 100K
cloud computing services	1K – 10K
private cloud	10K – 100K
cloud software	1K – 10K
cloud platform	1K – 10K
cloud computing companies	1K – 10K
cloud infrastructure	1K – 10K
best cloud storage	10K – 100K
personal cloud storage	1K – 10K
cloud providers	1K – 10K
hybrid cloud	10K – 100K
cloud it	1K – 10K
cloud based services	1K – 10K
cloud data storage	1K – 10K

Appendix C: Google Keywords Planner on search term “Cloud” in Czechia on March 5, 2018, search Language: English



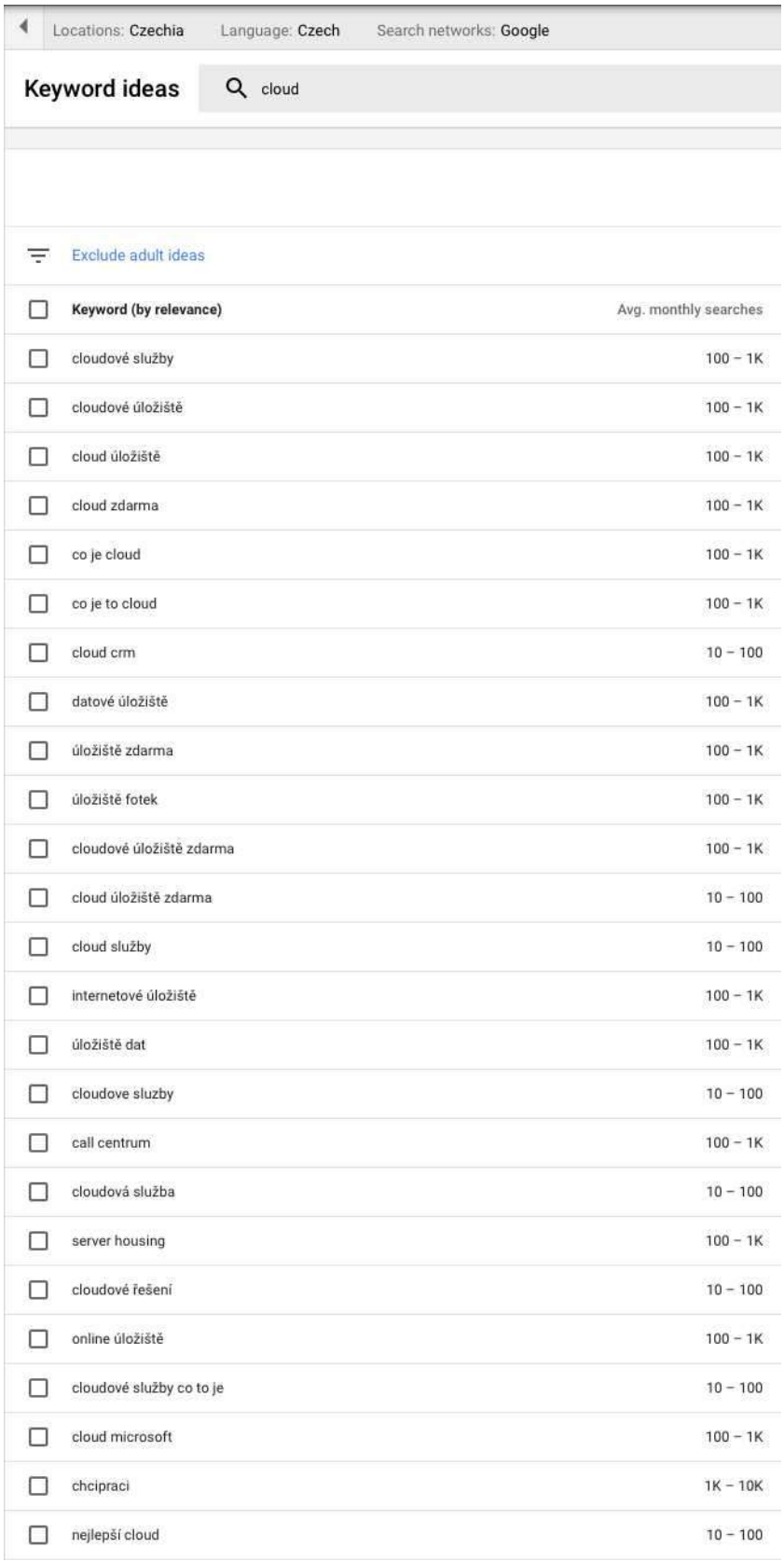
Locations: Czechia Language: English Search networks: Google

Keyword ideas cloud

Exclude adult ideas

Keyword (by relevance)	Avg. monthly searches
cloud	1K – 10K
cloud computing	100 – 1K
the cloud	10 – 100
cloud storage	100 – 1K
cloud services	10 – 100
cloud hosting	10 – 100
cloud drive	100 – 1K
cloud technology	10 – 100
iaas	100 – 1K
cloud server	100 – 1K
cloud solutions	10 – 100
online storage	10 – 100
cloud computing services	10 – 100
private cloud	10 – 100
cloud software	10 – 100
cloud platform	10 – 100
cloud computing companies	10 – 100
cloud infrastructure	10 – 100
best cloud storage	10 – 100
personal cloud storage	10 – 100
cloud providers	10 – 100
hybrid cloud	10 – 100
cloud it	10 – 100
cloud based services	10 – 100
cloud data storage	10 – 100

Appendix D: Google Keywords Planner on search term “Cloud” in Czechia on March 5, 2018, search Language: Czech



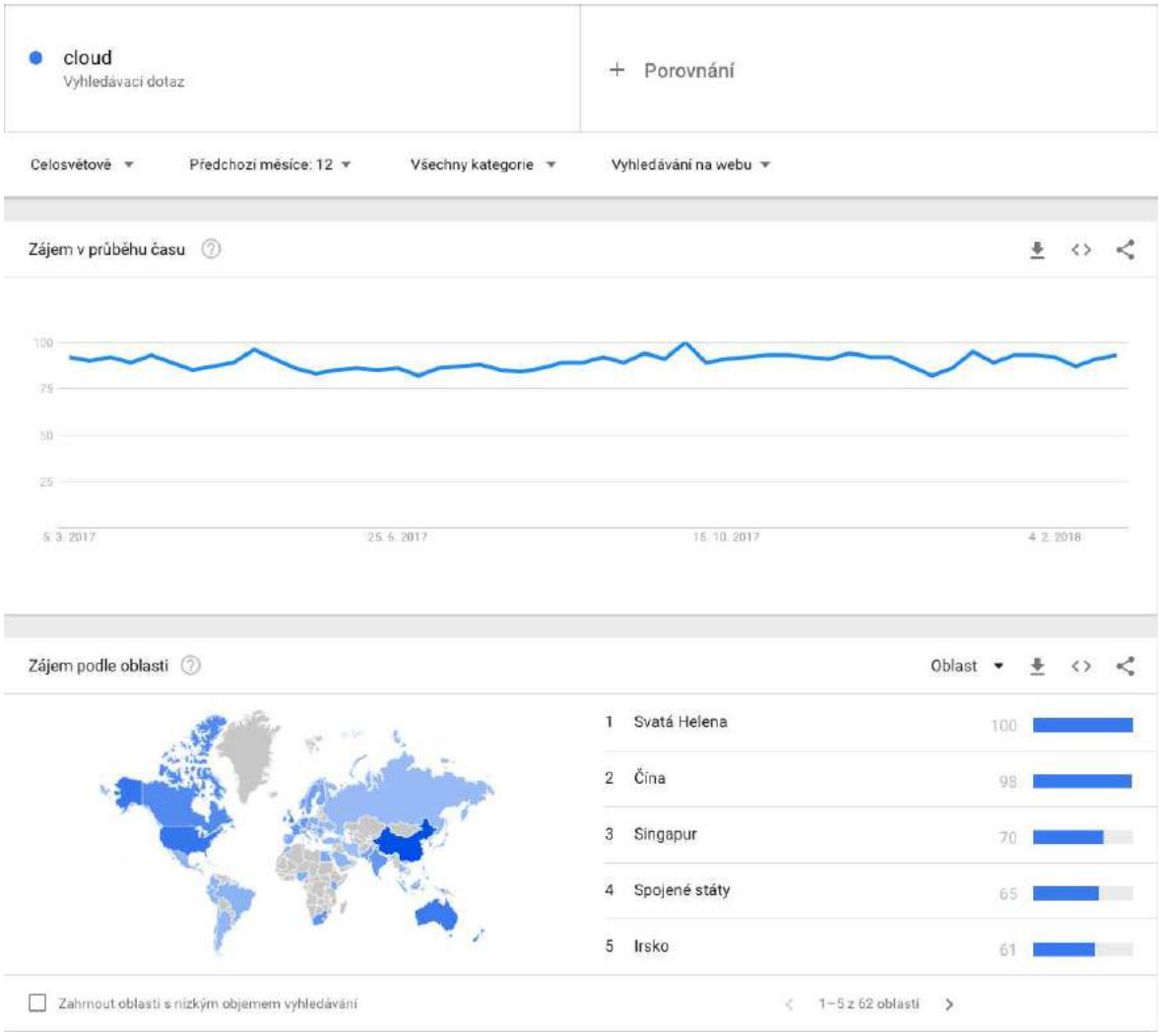
Locations: Czechia Language: Czech Search networks: Google

Keyword ideas cloud

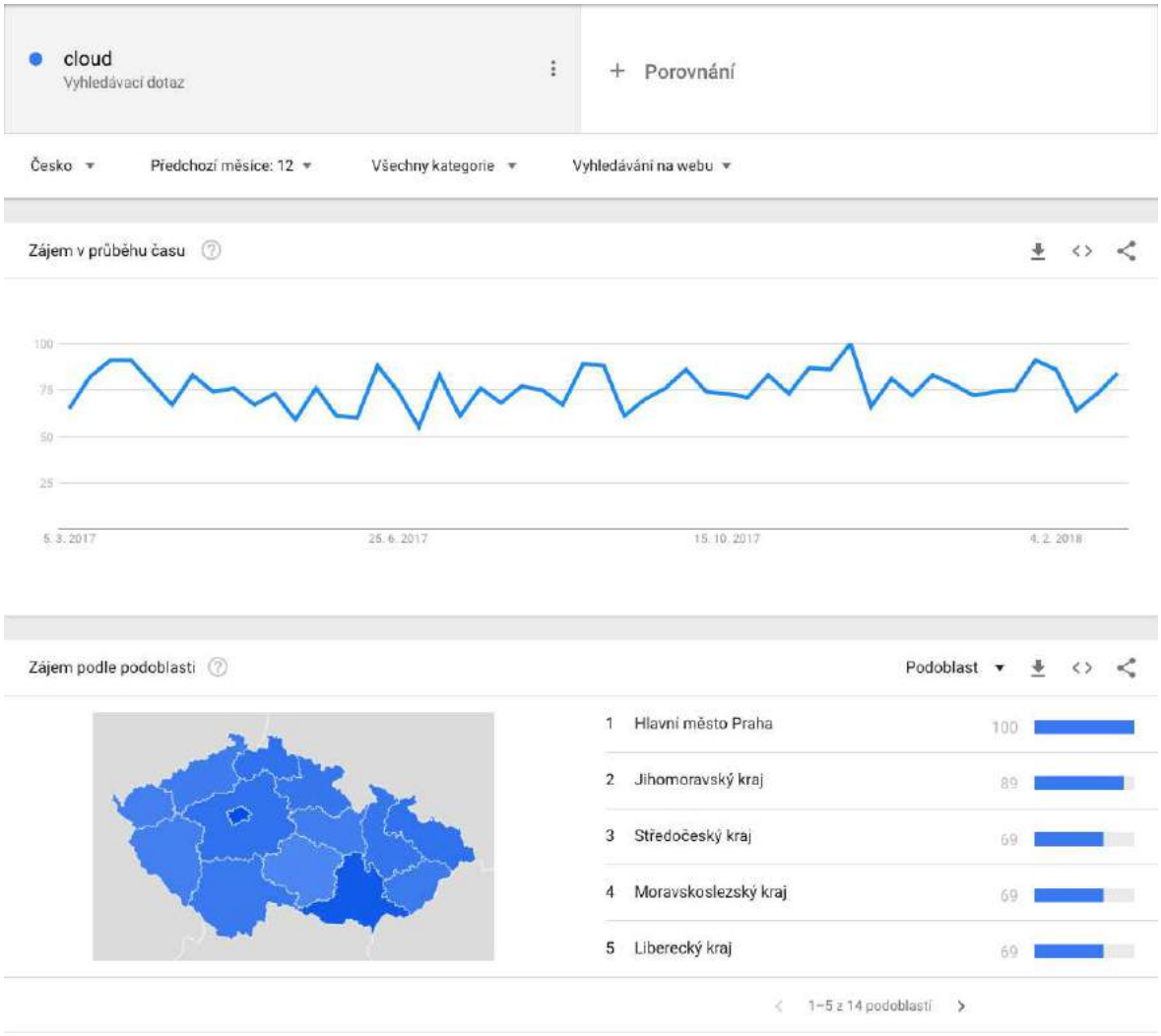
Exclude adult ideas

Keyword (by relevance)	Avg. monthly searches
cloudové služby	100 – 1K
cloudové úložiště	100 – 1K
cloud úložiště	100 – 1K
cloud zdarma	100 – 1K
co je cloud	100 – 1K
co je to cloud	100 – 1K
cloud crm	10 – 100
datové úložiště	100 – 1K
úložiště zdarma	100 – 1K
úložiště fotek	100 – 1K
cloudové úložiště zdarma	100 – 1K
cloud úložiště zdarma	10 – 100
cloud služby	10 – 100
internetové úložiště	100 – 1K
úložiště dat	100 – 1K
cloudove sluzby	10 – 100
call centrum	100 – 1K
cloudová služba	10 – 100
server housing	100 – 1K
cloudové řešení	10 – 100
online úložiště	100 – 1K
cloudové služby co to je	10 – 100
cloud microsoft	100 – 1K
chcipraci	1K – 10K
nejlepší cloud	10 – 100

Appendix E: Google Trends on word “Cloud” globally on March 3, 2018



Appendix F: Google Trends on word “Cloud” in Czechia on March 3, 2018



Appendix G: Filtering criteria in database of companies Albertina

- Registration no.
- Trade name
- Address
- Region
- Legal form
- Area of business activity – CZ-NACE predominant, CZ-NACE complete, registered scope of business, number of the registered activities, CPV classification, complementary information, groups and memberships
- Commercial Register entry
- Other registration data – type of ownership, date of foundation, institutional sector, commercial court, revenue authority, administration district of the authorized municipality, administration district of a municipality with extended authority

- Name of person
- Position in a company
- Sector of responsibility
- Type of person – date of birth, sex, country of origin
- Annual turnover
- Basic capital
- Number of employees
- Related persons – shares in other companies, owners, number of branches
- Date of updating the database entry

Appendix H: Initial business activity categories for sample definition

- C 13 Textile production (31 companies)
- C 21 Production of elementary pharmaceutical products (20 companies)
- F 41.1 Development activities (47 companies)
- G 46.47 Wholesale of furniture, carpets and lighting fixtures (22 companies)
- H 52 Cargo handling (15 companies)
- I 55.1 Hotels (240 companies)
    - Small companies (175 companies)
    - Medium-sized companies (65 companies)
- J 59 Activities in the field of films, TV programs and musical publishing (19 companies)
- K 65 Insurance, reinsurance, pension funding, except compulsory social security (24 companies)
- L 68 Real estate activities (27 companies)
- M 69.1 Legal activities (154 companies)
    - Small companies (137 companies)
    - Medium-sized companies (17 companies)
- N 79.12 Travel agency activities (48 companies)
- Q 86.1 Institutional health care (28 companies)
- R 91 Activities of libraries, archives, museums, other cultural organizations (32 companies)

The numbers of companies in parentheses indicate number of companies which registered themselves in a commercial register as being active in these areas while also being coherent with other criteria specified earlier in this Thesis.

Appendix I: Negatives and positives of using Albertina

Negatives of using Albertina

While using Albertina, some problems were identified. Knowing these issues may help its developers improve their product or help other researchers omit these use cases and so to save time.

First, filtering companies by NACE is useful but not very reliable. From author's experience, only approximately half of screened companies were conducting their main business in the field stated in commercial register using NACE. Others were active in more or less distant fields.

Second, in 4 out of 25 cases the phone number available in Albertina was faulty. In one case it was a number to a reception desk of administrative building where the company was located. In another case it was a different company which could have been a customer of the desired company but the person on the phone never heard about this company. In other cases, the number was unreachable.

Third, when filtering out companies with IT Director it happened in 10% cases that the "IT Director" was actually only an "IT Specialist" which was irrelevant to this research as these people usually have no or limited decision power.

Fourth, even though it is possible to filter out companies with IT Director and his/her name is available in Albertina, there is no number or e-mail address assigned to this person. Therefore, it doesn't make things any easier and it was necessary to call a number found on company's website – usually a reception desk.

Fifth, there are usually several people listed in each company's profile. Often, there are also several e-mail addresses and several phone numbers. However, these addresses, phone numbers and names are listed without association, therefore when calling a number listed in Albertina, it is impossible to know whether this number belongs to a reception desk or to a CEO. This makes calling numbers from Albertina practically useless. On the other hand, often on companies' websites numbers and e-mails to company management are published. Even though this information is public, it is not usually present in Albertina.

Positives of using Albertina

Albertina is, despite its inaccurate targeting, very useful in filtering companies since by using free tools, such as server *firmy.cz*, this is impossible to do in a great detail. This server lacks enough filtering criteria, the only available are field of activity and business location.

Another advantage is that Albertina contains also some data which cannot be found on server *justice.cz*. Particularly this can be data about physical persons running business on behalf of their own name.

Appendix J: Call script scenario

1. *Greeting*
2. *Introducing yourself* – name and university
3. *Purpose of calling*
    a. What am I doing – writing thesis on a certain topic
    b. What do I need – have a talk with a certain person
4. *Proposal*
    a. Case: *talking to a wrong person* (secretary etc.) → ask for a connection with a competent person (reconnection, mobile, telephone or e-mail)
        i. Case: successful → go back to start with a new person
        ii. Case: "why" → explain the importance of competence of certain person to answer questions; go back to Proposal
        iii. Case: "too busy" → explain that it will be short and ready, convenient for the other person; go back to Proposal
        iv. Case: negative answer → go to Farewell
    b. Case: *talking to a right person* → ask to make an appointment for an interview
        i. Case: positive answer → go to Meeting place and time negotiation
        ii. Case: "more info" → explain purpose of thesis, describe content of interview, say what's in there for the other person; go to Proposal
        iii. Case: negative answer → go to Farewell
5. *Meeting place and time negotiation*
6. *Farewell*

Appendix K: Calls tracking table

Following information was tracked in an Excel table:

1. Status (what state the negotiation is in)
2. Company name
3. Contact person
4. Position in company
5. Telephone number
6. Telephone type (Direct / Secretary / Assistant / Reception desk)
7. E-mail address
8. Company website URL
9. Company address
10. Short company description
11. Origin of contact (cold calling / recommending person)
12. Date of first contact
13. Date of last contact
14. Next action (e.g. call specific person / call at specific time / call again / send e-mail / wait for an answer / make an interview)

15. Result (what has been arranged)
16. Note (other notes)

Since this table contains various personal data, it is not published in this Thesis.

Appendix L: Interviewed companies

Table 30 Interviewed companies overview

Company ID	Field of activity	No. of internal ICT users	No. of internal ICT staff	Position of interviewee
1	Audio-visual technique	220	5	IT Manager
2	Physical security	50	1-2 (other ICT staff working for customers)	Sales and Technical Director
3	Stocks	95	20 (10 of them are software developers)	ICT director
4	Municipal services	35 (up to 250 internal ICT users if working with all systems would be classified as working with ICT)	0 (external ICT service)	Vice Chairman of the Board of Directors
5	Financial services	70	4	ICT Director
6	Financial services	110	10	Key Account Managers Director, Marketing Director
7	Banking services	180	15	ICT Director
8	Financial services	60 (+1800 external consultants)	9 (2 ICT, 2 data, 2 analysts, 1 support, 2 management)	Technology Development Manager
9	Human Resources Agency	15	1	Managing Director
10	ICT services	50	2-4 (other ICT staff working for customers)	Managing Director
11	Isolations	10	0 (external ICT service)	Managing Director

Company ID	Field of activity	No. of internal ICT users	No. of internal ICT staff	Position of interviewee
12	Clothing	130	0 (external ICT service)	Economic Director, member of the Board of Directors
13	Marketing agency	200	3 (developers not considered ICT staff)	Managing Director
14	Cables installation	4 (other people not using ICT)	0 (external ICT service)	Managing Director
15	Interior design and production	11	0 (external ICT service)	Managing Director
16	Interior design and production	10	0 (external ICT service)	Managing Director
17	Food sales and logistics	25 (out of 110)	0,5 (only an ICT coordinator, external ICT service)	Economic Director
18	Computer games	200	3	ICT Director
19	Alcohol trade	44	1	Director
20	Trade company, industrial holding	250	0 (external ICT service)	CEO
21	Insurance services	3	0 (external ICT service)	Managing Director
22	Car dealership	50	0 (external ICT service)	Director
23	Scenic and interior design and production	41	0 (external ICT service)	Managing Director
24	Service of specialized equipment	30	0 (external ICT service)	Managing Director
25	Software for financial services	700	4	ICT Director
26	Jewellery	120	4	ICT Manager
27	Bookkeeping	1	0 (external ICT service)	Managing Director
28	Metal processing	12	0 (external ICT service)	Managing Director

Company ID	Field of activity	No. of internal ICT users	No. of internal ICT staff	Position of interviewee
29	Beverages production	3	0 (no ICT)	Managing Director
30	Production and construction	250 (150 with domain user account)	3 (+ 1 external infrastructure company and 1 external IS company)	Division Director
31	Pharmaceutical production	100	1	ICT Manager
32	Delicacies and machines production	4 (out of 15)	0 (external ICT service)	Chairman
33	Lights production	160	4 (2 for HW and SW, 2 for IS)	Head of ICT department
34	Real estate development	60-70	1	Director of the Tender Sector
35	Real estate development	60-100	1	Managing Director
36	Software development	45	1-20 (1 ICT staff, rest developers)	Managing Director
37	Software development	150 (250 including contractors)	2	ICT Director
38	Medical devices and technologies	250	8	ICT Manager
39	Material testing	10	0 (external ICT service)	Managing Director

Appendix M: Perception of the situation: non-functioning ICT (question 9)

For many companies it was not possible to tell the exact costs associated with non-functioning ICT, but often they were able to evaluate criticality of such issue. Answers are categorized into 4 categories listed below in table *Perception of the situation: non-functioning ICT* and ordered by number of companies associated to each category.

23 companies provided this type of answer. 2 of them are in more than one category. These answers are the ones in category *Never happened* as both companies regarded non-functioning ICT as a major problem but both them added that it never happened that their ICT would be non-functioning, or non-functioning for half a day or longer.

Table 31 Perception of the situation: non-functioning ICT

Order no.	Category	No. of companies	Description
1	Problem	14	Non-functioning ICT is a problem for the company
2	Non-critical	6	ICT is not crucial for company operation or it is very diversified
3	Not likely	3	Very diversified technologies, services and contractors in different locations
4	Never happened	2	Never had to use a crisis scenario, never had an outage for a half day and longer

Most of companies, therefore, regard a non-functioning ICT as a problem. Answers *Not likely* are of companies who have so diversified technologies and services, that the risk of non-functioning ICT is very low. On the other hand, they did this diversification also in order to lower the risk of business discontinuity. Only for about one quarter of companies a non-functioning ICT is not perceived as critical.

Appendix N: Other factors influencing ICT security (question 10)

Table 32 Other factors influencing ICT security on next page presents *Business continuity*, *Physical and natural threats* and *Regulation* as other factors having impact on ICT security from the point of view of the respondents of this research based on answers to question 10.

All of these factors were not quite as significant as Human factor and Data related threats but still 20% of companies asked answered that they fear some sort of causes of business discontinuity. These can be either staffing issues, such as lack of people who can solve a problem, or technical issues when a HW or SW problem causes a temporary paralysis of a company. Only less than 10% of companies mentioned security risks under Physical and natural threats, such as fire, flood or simple utility outages and Regulation related issues, as with penalties resulting from non-compliance with some regulation, such as GDPR.

Table 32 Other factors influencing ICT security

Order no.	Category	Subcategory	No. of associations	No. of companies	Description
3	Business continuity		10	8	Any causes of business discontinuity, such as technical issues or staffing issues
	1	Technical issues	4	2	Technical problems of HW and SW
4	Physical and natural threats		5	3	Fire, flood, utilities outages
5	Regulation		4	3	Sanctions (GDPR and other)
6	Don't know		2	2	No idea of ICT security risks

Appendix O: Feelings associated with ICT security risks (question 10)

Table *Feelings associated with ICT security risks* stands out of other categories defined based on answers to question 10 as it does not present what the companies fear of but how much they fear. Two emerged subcategories, *No stress* and *Stress*, have relatively equal representation

Table 33 Feelings associated with ICT security risks

Order no.	Category	Subcategory	No. of associations	No. of companies	Description
N/A	Feeling		11	9	
	1	No stress	6	5	Not in possession of highly confidential data, too small or not in highly competitive industry
	2	Stress	4	4	Seeing great ICT security risks and feeling afraid

As most of companies did not express their feelings regarding ICT security, it is not possible to generalize these answers to the whole sample. Respondents who said they are not stressed with ICT security risks reasoned that they are not in possession of highly confidential data, they were too small to be an interesting hacker target, or they thought they were not in such a competitive industry, that some of their competitors would like to attack them. On the other hand, respondents whose answers were categorized as *Stress* said that they see great risks in ICT security and even said that they are literally worried.

Appendix P: Other things that cloud is (question 12)

Table *Other things that cloud is according to respondents* lists 6 other definitions of cloud ordered by their significance. They are generally very insignificant and described well enough in the *Description* column, therefore no further description is provided.

Table 34 Other things that cloud is according to respondents

Order no.	Category	No. of associations	No. of companies	Description
6	On-premise solution	4	3	VPN, virtualization and central database considered a cloud
7	Don't know	3	3	No idea, just a little idea about what cloud is
8	Internet accessible	3	3	Anything accessible from outside through internet using internet browser, such as apps and services
9	Specific cloud service	5	2	Dropbox, Google Drive, OneDrive, Spotify, YouTube
10	Application	2	2	Remote apps and browser accessible apps
11	Cheap performance	2	2	Good for testing, especially for pay-as-you-go model

Appendix Q: Cloud usage (question 12)

Table *Cloud usage* reflects the numbers of companies who use or do not use cloud based on answers to this question. As this was not directly asked, most of companies did not mention whether they use or do not use cloud and so the numbers are not quite relevant. Interesting are some of the reasons for not using cloud solutions and these are mentioned in greater detail below the table.

Table 35 Cloud usage

Order no.	Category	No. of associations	No. of companies	Description
1	Not using cloud	10	10	Would need dedicated infrastructure, incompatibility with our IS, no need for cloud, afraid of connectivity issues
2	Using cloud	1	1	Using only cloud, private for internal use and public for testing

2 companies said that they do not use public cloud services and a third added that they would need a dedicated infrastructure if they should go to cloud. Company 4, municipal services,

explained that "*99% of our activities comes out of our headquarters, so I don't have a need to have data somewhere in America. It would be different if we would have branches and sales representatives.*" Company 23 has a problem with their IS, stating that "*we have absolutely nothing in cloud, which I pity. Our IS is built on Lotus notes and it has to run on our own server due to its license terms.*" Two other companies were worried about dependability on internet connection.

Appendix R: On-premises backup advantages and disadvantages and other answers (question 15)

Table *On-premises backup advantages and disadvantages and other answers* summarizes the remaining answers on cloud vs. on-premises backup question. The table is ordered by significance and all categories are discussed in greater detail below the table, although the numbers of companies associated to these answers are not very significant.

Table 36 On-premises backup advantages and disadvantages and other answers

Order no.	Category Subcategory	No. of associations	No. of companies	Description
3	Other answers	7	5	Equal options; using private cloud; don't know
4	On-premises backup advantages	6	5	Greater security and control, good experience
5	On-premises backup disadvantages	7	3	Difficult to secure and manage, high costs

Other answers

Among other answers were mostly private cloud solutions. Company 36, software development and cloud apps, expressed their satisfaction with backing up on servers in a housing in Prague as they have faster response than services placed in Dublin, for instance. Company 2, physical security, was happy about private cloud security but mentioned that it is costly. Company 3, stocks, assumed that the options are equal and there was also one company who admitted that they do not understand the difference.

On-premises backup advantages

Generally, companies finding advantages of on-premises backup find it to be more secure, providing them with greater control and also easier. Company 17, food sales and logistics, said that *"it seems to me better to have everything on-premises than to contact O2 when there is a problem."*

On-premises backup disadvantages

Contrary to advantages, 3 companies saw on-premises backup as less secure against theft or fire, more demanding on know-how and management and also causing high costs.

Appendix S: Additional hosting disadvantages (question 20)

Table 37 Hosting disadvantages

Order no.	Category	Subcategory	No. of associations	No. of companies	Description
1	Hosting disadvantages		46	20	
	4	Quality	4	3	Availability, infrastructure
	5	Compatibility	3	3	Existing environment
	6	Connectivity	3	3	Internet dependency, latency, investments
	7	Administration	3	2	Documentation and management
	8	Contractor requirements	3	2	Auditability, regulatory compliance, flexibility
	9	Compliance	2	2	Compliance with regulatory and internal standards
	10	Remote management	1	1	Worsening of app management simplicity

Among other hosting disadvantages were, quite surprisingly, availability and infrastructure, as some companies have an opinion that their own infrastructure might be of higher quality and better reachable. Next, compatibility with current environment is a legitimate objection to hosting for companies with complex existing infrastructure and systems. Connectivity is another issue, as many companies, quite rightfully, worry about internet quality needed to run servers in hosting reliably. There are some companies who mentioned that they have internet outages several times a year. Though, one company in a different question mentioned that VPN has double the connectivity requirements than cloud so for companies with many employees who need to work out of office cloud can actually be less connectivity demanding than usual on-premises solutions. Some companies thought that hosting would mean more administration for them, mainly documentation and management due to regulation imposed on some companies. The same (pharmaceutical) company also mentioned that regulation imposes special requirements on contractors such as their auditability and compliance with many regulations. Related to that is required compliance with other regulations or internal standards. One company thought that it would be more difficult for them to remotely manage their apps which does not seem very relevant.

Appendix T: On-premises servers advantages (question 20)

Table *On-premises servers advantages* summarizes all found positives of on-premises servers operation. They are described and discussed in greater detail below the table.

Table 38 On-premises servers advantages

Order no.	Category	Subcategory	No. of associations	No. of companies	Description
3	On-premises advantages		14	10	
	1	Simplicity	4	3	Existing know-how, staff or contractor and equipment
	2	Security	3	3	Data inside the company, security policy enforcement
	3	Management	2	2	Internal know-how or external company
	4	Performance	2	2	Dedicated, speed
	5	Price	2	2	Cheaper (for high-performance servers)
	6	Legislation	1	1	Easier to reach compliance

Simplicity

Interestingly, the main advantage of hosting for some companies, but much smaller portion in total numbers, is the same as the main advantage of on-premises servers. It is again so for some companies which already have built-up infrastructure and have either internal or external staff who have the know-how to operate it. Then if they have this already set up, they do not see a reason to change that, they consider it a faster and easier solution.

Security

Logically, since security is supposedly the main cloud disadvantage, it should be an advantage of on-premises solution. Some companies feel more secure regarding their data if they have them on their premises. Company 28 from metal processing industry said that *"some production processes are secret, and we don't want them to be outside the company"*.

Management

Management argument is similar to *simplicity*. If a company has established ways of operating servers on their premises, they consider its management as an advantage compared to hosting which they do not have an experience with yet.

Appendix U: Neutral stands towards on-premises servers vs. hosting (question 20)

Table *Neutral answers on on-premises vs. hosting* is very short as there were only 8 associations from 6 companies made and therefore no subcategories determined. Findings are described and discussed in greater detail below the table.

Table 39 Neutral answers on on-premises vs. hosting

Order no.	Category	No. of associations	No. of companies	Description
4	Neutral	8	6	Equal costs, no pros/cons, sensitivity of data decides

Answers of in total 6 companies were assessed as neutral. Two companies said that they do not see neither advantages nor disadvantages of either solution. Company 17 from food logistics sector said that *"in case when sensitive data is not dealt with, I don't care."* Company 33, a large lights producer, said they "*would eventually want it from their IS supplier, so there would be a clear responsibility for its functionality."* One company speculated that total costs of both alternatives would be the same. A comprehensive neutral answer was provided by company 20, a trade company and industry holding, which said that *"it is not necessary to have everything in cloud. We still have functioning servers, so we don't need to change them. In future we might go to cloud, if it is more advantageous for us."* Company 39 from material testing field had its opinion straight: *"I can't assess that [on-premises vs. hosting], but mainly we don't want to worry about it".*

Appendix V: On-premises servers disadvantages (question 20)

Table *On-premises servers disadvantages* on next page summarizes the few gathered drawbacks of operating on-premises servers which are further discussed in greater detail.

Securing operation quality

Since securing operation quality was identified as one of the most significant hosting advantages, it seems logical as it is also identified as a negative of on-premises solutions. However, it is important to state that there were only 3 companies addressing disadvantages of on-premises servers in this question. One company said that it is difficult to manage. Company 26 from jewelry industry admitted they do not have the preconditions for building a quality server room. Company from ICT industry said that internally it is difficult to provide proper cooling or a real monitoring of infrastructure. This seems as a logical argument from this company as they are also a hosting and monitoring provider.

Table 40 On-premises servers disadvantages

Order no.	Category	Subcategory	No. of associations	No. of companies	Description
5	On-premises disadvantages		9	3	
	1	Securing operation quality	4	3	Difficult to manage and to ensure right conditions
	2	Price	3	2	Expensive if same as cloud, energy consumption
	3	Administration	1	1	Tender making
	4	Security	1	1	Security

Price

Price came out as the third biggest disadvantage of hosting, contrary to that some companies consider price a disadvantage of on-premises servers. So, again company 26 from jewelry industry considers on-premises more expensive if they should reach the same level of security. This is very interesting, since it is a big company and they are currently migrating to cloud. Many companies consider cloud less secure and more expensive, but this company sees it as cheaper and more secure. The same company also said that *"when scaling up processors, we would pay a lot for virtualization licenses"*. Company 10 said that operating servers on premises also consumes energy which needs to be considered. Therefore, a price is very dependent on what does the company calculate in the price of their on-premises servers.

Administration and security

Administration and security related problems of on-premises servers were both mentioned by only one company, company 10. They see internal security as a problem and also a need of doing tenders for new servers as burdensome. Again, this company is a hosting provider which doesn't mean they are mistaken but other companies mostly did not mention the same problems, so either they do not consider these a problem or they are not aware of the fact it is a problem.

Appendix W: Opinions on housing services (question 21)

Table 41 *(Dis)Interest in and reasons for (not) using housing services* presents the 5 most mentioned categories regarding housing services. These categories are further discussed.

No interest

Unflatteringly for housing services, a "No interest" category stands on top of defined categories. In total 7 out of 15 respondents expressed themselves in a way resulting in a lack of interest. Company 28, metal processing, said that they will *"rather let the current equipment run to its lifetime end and then they would perhaps move to cloud completely"*. Company 33, a lights producer, said that *"good is, that we can use our existing licenses and servers. The main advantage – scalability – is gone, though."* Among other responses was that *"a disadvantage is that we have to pay for that"*, which is a valid argument if the company has a very professional server room or does not have high expectations or does not realize the benefits of housing. Last opinion in this manner was from company 1, audio-visual technique, that *"it is limiting to have to run to housing every time we need to test something"*. This seems as a valid argument for those companies who need to make often physical adjustments on the servers, which in author's opinion are not that many.

Table 41 (Dis)Interest in and reasons for (not) using housing services

Order no.	Category	No. of associations	No. of companies	Description
1	No interest	8	7	Lack of scalability, distance, extra costs, little added value
2	Control	4	4	Loss of control, ownership rights doubts
3	Interest	4	4	Higher quality, obstacles to migration
4	Own capacities	4	3	Internal skilled ICT staff and space or external company
5	Security	4	3	Data outside the company as a security breach
6	Already using	2	2	Already using housing service

Control

Control, or more precisely a loss of control was the most cited fear regarding housing. Company 17, food sales and logistics, literally said they *"consider it a loss of control"*. Two companies were worried whether they keep ownership rights to their servers.

Interest

Four companies generally expressed their interest in using housing services, usually they have some obstacles in doing so, though. Company 24, service of specialized equipment, said they *"would not hinder themselves from this idea if they could keep the current speed"*. Company 36, software development, expressed their opinion that *"it is unrealistic to do this at 'home' – at*

'home' there is no cooling system, connectivity, security, backup backup." An interesting obstacle is facing company 23, scenic and interior design and production, which said that *"we would like to do it, we've been dealing with it, but because of Lotus information system it would bring more troubles than benefits. But we are heading there, I would like to have it."*

Own capacities

If the company currently employs skilled ICT staff and they have space for a server room it might be a reason for them to not realize benefits of housing which was a case of 2 companies. One company did not have their own ICT staff, but they were using an external ICT company to care for their internally operated servers.

Security

All 4 answers could be summarized as seeing data outside the company as a security breach. Company 10, ICT services, had doubts on whether it is safe and that they *"would like to back up also somewhere else"*. Company 38, medical devices and technologies, stated that *"I can imagine centralizing management within our group but not that we would give it out to a contractor"*.

Appendix X: Additional answers to question 23 about what a private cloud is

Personal cloud

Five companies who were asked this question did not know the correct answer and either guessed or thought it could be a cloud for personal use, such as Dropbox, Google Drive, iCloud and similar services. One person specifically defined it as a *"cloud for personal use, not corporate"*. Another person thought it is a *"place, where I can store my data and access it from anywhere. Only I can access it, no one else"*.

Other

Answers under "Other" category were according to the researcher unassignable to any of the other categories. One answer was that it is a *"cloud owned by a private company"*, another that *"a company rents a space, where they manage it themselves"*. One company thought it is *"a cloud, that we use for applications, which we operate ourselves."* An interesting opinion was of company 10, ICT services, which said that *"for SMEs I consider it a nonsense, as it would be too difficult to build and manage."*

Don't know

This category contains answers of people who admitted they are not sure what a private cloud is, or they literally do not have a clue.

Appendix Y: Additional ICT improvement decision factors (question 24)

Table 42 ICT improvement decision factors

Order no.	Category	Subcategory	No. of associations	No. of companies	Description
6	Benefits		12	10	Business impact, cost savings, risk diversification
7	Support		9	8	Existence of maintenance, tech support, speed, reliability, availability
8	Time		9	7	Length of shutdown, time savings, time investment
9	Processes		8	7	Tailor-made or customization, simplification and improvements
10	Efficiency		6	6	Increase efficiency, speed of access
11	Legislation		6	6	Compliance
12	Functionality		5	4	AI and prediction, sophistication
13	Compatibility		4	4	Current equipment, strategy
14	Flexibility		4	3	Scalability, variability
15	Recommendation		4	3	Based on requirements, IT admin's opinion, references
16	Standardization		3	3	Compliance with standards, outcomes standardization
17	Competition		2	1	Competitive advantage or catch up

Appendix Z: Additional On-premises vs. cloud decision factors (question 25)

Table 43 Additional on-premises vs. cloud decision factors

Order no.	Category	No. of associations	No. of companies	Description
7	Ability of internal operation	3	3	Staff availability and expertise, quality of internal infrastructure
8	Available options	3	3	Existence of also either on premise or cloud solution
9	Pro-Cloud	3	3	Already in cloud
10	Usage	3	2	Testing, utilization

Appendix AA: Additional ICT contractor criteria (question 26)

Table 44 Additional ICT contractor criteria

Order no.	Category Subcategory	No. of associations	No. of companies	Description
6	Company background	19	10	Stability, time on market, economics
7	Contractor's experience	13	10	Finished projects, experience with market, certain technologies, users
8	Trust	9	9	Trustworthiness, transparency
9	Offer	10	9	Complexness of services
10	Suitability of a solution	11	9	Functionality, flexibility, customizability, tailor-made solution
11	Reliability	9	8	Contractor, product/service, meeting deadlines and promises
12	Team	14	7	Size, guarantee of availability, substitutability
13	Communication	9	6	Personal approach and contact, customer communication
14	Demo of a product/service	4	4	Ability to see or try
15	Presentation	4	4	Website, presentation, information available on internet
16	Guarantee	4	4	SLA, sanctions, claiming conditions
17	Expertise	3	3	Education, expertise based on praxis
18	Understanding	7	3	Our business, talking our language, thinking our way
19	Future of contractor	3	2	Long-time support, vision
20	Security	3	1	Control of data, data and SW ownership, NDA

Appendix BB: Answers to the Model by company A

Step 1: NEED

Need	Yes

Step 2: QUALITY

Functionality	No --> Consider on premises	
Availability	Anytime, anywhere, any device access with no or minimum downtime	
	Internal resources?	Yes --> Consider on-premises
Compatibility	Yes --> Virtualization?	
	Virtualization?	No --> Cloud is possible with a condition of having dedicated resources
Performance	Normal --> Consider basic cloud services or casual HW	
Connectivity	No --> Investment?	
	Investment?	No --> Consider on-premises
Business continuity	Yes --> Internal resources?	
	Internal resources?	Yes --> Consider on-premises

Step 3: Security

Data sensitivity	Very sensitive --> Consider private cloud or on-premises
Physical security	Yes --> Stay on-premises
Cyber security	No --> Consider cloud
Human factor	No --> Consider secure cloud solutions
Regulation	No --> Consider cloud
	Intenal resources?
GDPR	Yes --> Consider GDPR compliant cloud solutions
Standards	No --> Not important

Step 4: Simplicity

Operation simplicity	Easy --> Consider cloud
Responsibility	Internal --> Consider on-premises
User simplicity	Easy --> Consider cloud
Admin requirements	Difficult --> Consider cloud

Step 5: Agility

Time to launch	No --> Not important	
	Intenal resources?	
Flexibility	Yes, flexible --> Consider cloud	
	Limited required?	
Support	Custom support --> Consider internal ICT staff	

Step 6: References

Reviews	No --> Search for more references and be cautios. Though, good SLA and starting in small scale car
Personal recommendation	Yes --> Continue to price negotiation

Step 7: Price

Form of payment	CAPEX (One-time investment) --> Consider on-premises	
	OPEX?	
TCO	On-premises has lower TCO --> Unless benefits of cloud are higher than the TCO difference, consic	
Price/Benefit ratio	No --> Consider other options	

Image 9 Answers to the Model by company A

Appendix CC: Answers to the Model by company B

Step 1: NEED

Need	Yes	For which need are you considering this model? Please answer in your words:
		Central data storage and access to economic system Pohoda

Step 2: QUALITY

Functionality	Yes --> Consider cloud	
Availability	Anytime, anywhere, any device access with no or minimum downtime	
	Internal resources?	No --> Consider cloud
Compatibility	No --> Cloud is possible	
	Virtualization?	
Performance	Very fast --> Consider high performance cloud or an expensive HW on-premises	
Connectivity	Yes --> Cloud is possible	
	Investment?	
Business continuity	No --> not important	
	Internal resources?	

Step 3: Security

Data sensitivity	Normal --> Consider public cloud	
Physical security	No --> Consider cloud	
Cyber security	No --> Consider cloud	
Human factor	Not important	
Regulation	No --> Consider cloud	
	Intenal resources?	
GDPR	Yes --> Consider GDPR compliant cloud solutions	
Standards	No --> Not important	

Step 4: Simplicity

Operation simplicity	Easy --> Consider cloud	
Responsibility	Third party --> Consider cloud	
User simplicity	Easy --> Consider cloud	
Admin requirements	Difficult --> Consider cloud	

Step 5: Agility

Time to launch	No --> Not important	
	Intenal resources?	
Flexibility	Limited flexibility required	
	Limited required?	Consider cloud if committing to longer use period (cheaper
Support	Fast and willing --> Consider local cloud providers	

Step 6: References

Reviews	No --> Search for more references and be cautios. Though, good SLA and starting in small scale can
Personal recommendation	No --> Search for more references and be cautios. Though, good SLA and starting in small scale can

Step 7: Price

Form of payment	OPEX (Small periodical payments)	
	OPEX?	Consider buying cloud for several years in advance (cheaper
TCO		
Price/Benefit ratio	Yes --> Cloud	

Image 10 Answers to the Model by company B

Appendix DD: Answers to the Model by company C

Step 1: NEED

Need	Yes	For which need are you considering this model? Please answer in your words:
		High availability of our services and aplications.

Step 2: QUALITY

Functionality	No --> Consider on premises	
Availability	Anytime, anywhere, any device access with no or minimum downtime	
	Internal resources?	Yes --> Consider on-premises
Compatibility	Yes --> Virtualization?	
	Virtualization?	Yes --> Cloud is possible
Performance	Normal --> Consider basic cloud services or casual HW	
Connectivity	Yes --> Cloud is possible	
	Investment?	
Business continuity	Yes --> Internal resources?	
	Internal resources?	Yes --> Consider on-premises

Step 3: Security

Data sensitivity	Combination of sensitive and normal data --> Consider hybrid cloud	
Physical security	Yes --> Stay on-premises	
Cyber security	Yes --> Stay on-premises	
Human factor	Not important	Not important
Regulation	Yes --> Internal resources?	
	Intenal resources?	Yes --> Consider on-premises
GDPR	No --> Not important	
Standards	Yes --> Consider cloud solutions which comply with security standards	

Step 4: Simplicity

Operation simplicity	Not important	
Responsibility	Internal --> Consider on-premises	
User simplicity	Not important	
Admin requirements	Easy --> Consider on-premises	

Step 5: Agility

Time to launch	Yes --> Internal resources?	
	Intenal resources?	Yes --> Consider on-premises
Flexibility	Limited flexibility required	
	Limited required?	Consider cloud if committing to longer use period (cheaper
Support	Custom support --> Consider internal ICT staff	

Step 6: References

Reviews	No --> Search for more references and be cautios. Though, good SLA and starting in small scale ca
Personal recommendation	No --> Search for more references and be cautios. Though, good SLA and starting in small scale ca

Step 7: Price

Form of payment	CAPEX (One-time investment) --> Consider on-premises	
	OPEX?	
TCO		
Price/Benefit ratio	No --> Consider other options	

Image 11 Answers to the Model by validating company C

Appendix EE: Answers to the Model by company D

Step 1: NEED		
Need	Yes	For which need are you considering this model? Please answer in your words:
		MS Exchange
Step 2: QUALITY		
Functionality	Yes --> Consider cloud	
Availability	Anytime, anywhere, any device access with no or minimum downtime	
	Internal resources?	No --> Consider cloud
Compatibility	No --> Cloud is possible	
	Virtualization?	
Performance	Normal --> Consider basic cloud services or casual HW	
Connectivity	Yes --> Cloud is possible	
	Investment?	
Business continuity	No --> not important	
	Internal resources?	
Step 3: Security		
Data sensitivity	Combination of sensitive and normal data --> Consider hybrid cloud	
Physical security	No --> Consider cloud	
Cyber security	Yes --> Stay on-premises	
Human factor	Yes --> Stay on-premises	
Regulation	No --> Consider cloud	
	Intenal resources?	
GDPR	Yes --> Consider GDPR compliant cloud solutions	
Standards	No --> Not important	
Step 4: Simplicity		
Operation simplicity	Easy --> Consider cloud	
Responsibility	Third party --> Consider cloud	
User simplicity	Easy --> Consider cloud	
Admin requirements	Easy --> Consider on-premises	
Step 5: Agility		
Time to launch	Yes --> Internal resources?	
	Intenal resources?	No --> Consider cloud
Flexibility	Yes, flexible --> Consider cloud	
	Limited required?	
Support	Fast and willing --> Consider local cloud providers	
Step 6: References		
Reviews	Yes --> Continue to price negotiation	
Personal recommendation	Yes --> Continue to price negotiation	
Step 7: Price		
Form of payment	OPEX (Small periodical payments)	
	OPEX?	Consider cloud (for flexibility)
TCO	Cloud has lower TCO --> Consider cloud	
Price/Benefit ratio	Yes --> Cloud	

Image 12 Answers to the Model by company D

Appendix FF: Answers to the Model by company E

Step 1: NEED

Need	Yes	For which need are you considering this model? Please answer in your words:
		Strong server with fast response to cover information sharing at 12 work stations.

Step 2: QUALITY

Functionality	Yes --> Consider cloud	
Availability	Anytime, anywhere, any device access with no or minimum downtime	
	Internal resources?	No --> Consider cloud
Compatibility	Yes --> Virtualization?	
	Virtualization?	Yes --> Cloud is possible
Performance	Normal --> Consider basic cloud services or casual HW	
Connectivity	Yes --> Cloud is possible	
	Investment?	
Business continuity	Yes --> Internal resources?	
	Internal resources?	Yes --> Consider on-premises

Step 3: Security

Data sensitivity	Combination of sensitive and normal data --> Consider hybrid cloud	
Physical security	No --> Consider cloud	
Cyber security	Yes --> Stay on-premises	
Human factor	No --> Consider secure cloud solutions	
Regulation	Yes --> Internal resources?	
	Intenal resources?	Yes --> Consider on-premises
GDPR	Yes --> Consider GDPR compliant cloud solutions	
Standards	Yes --> Consider cloud solutions which comply with security standards	

Step 4: Simplicity

Operation simplicity	Easy --> Consider cloud	
Responsibility	Third party --> Consider cloud	
User simplicity	Easy --> Consider cloud	
Admin requirements	Difficult --> Consider cloud	

Step 5: Agility

Time to launch	Yes --> Internal resources?	
	Intenal resources?	No --> Consider cloud
Flexibility	Yes, flexible --> Consider cloud	
	Limited required?	
Support	Fast and willing --> Consider local cloud providers	

Step 6: References

Reviews	No --> Search for more references and be cautios. Though, good SLA and starting in small scale c
Personal recommendation	Yes --> Continue to price negotiation

Step 7: Price

Form of payment		
	OPEX?	
TCO	On-premises has lower TCO --> Unless benefits of cloud are higher than the	
Price/Benefit ratio	No --> Consider other options	

Image 13 Answers to the Model by company E