

*Thesis no: XXX-20YY-NN*



# Identification of cloud service use-cases and quality aspects: end-user perspective

Learnability, Operability and Security quality  
attributes and their corresponding use cases

Pol Haghverdian  
Martin Olsson

This thesis is submitted to the Faculty of Computing at Blekinge Institute of Technology in partial fulfillment of the requirements for the degree of Bachelor of Science. The thesis is equivalent to 10 weeks of full time studies.

**Contact Information:**

Author(s): Martin Olsson

E-mail: maod13@student.bth.se

Pol Haghverdian

E-mail: poha13@student.bth.se

University advisor:

Eriks Klotins

Department of Software Engineering

Faculty of Computing  
Blekinge Institute of Technology  
SE-371 79 Karlskrona, Sweden

Internet : [www.bth.se](http://www.bth.se)  
Phone : +46 455 38 50 00  
Fax : +46 455 38 50 57

---

## Abstract

**Context.** With the entry of smart-phones on the market in the beginning of 2007, the integration of an mp3 player, camera and gps into an all in one device. As the integration was realized, creating and storing own content became easier. Therefore the need of more storage became a problem as the smart-phones were limited in capacity. The 3G network was on the rise and the cloud solutions could help to contribute to the storage problems users started to have.

**Objectives.** In this study we will evaluate what can be done with use cases in terms of quality attributes, seeing it from a users perspective by having users rank use cases for cloud services. With further investigation we will make a contribution of what the differences between public and personal clouds are.

**Methods.** Use-cases were found by the conducted empirical study and were based on a Systematic mapping review. In this review, a number of article sources are used, including Google search, Bth summon and Google scholar. Studies were selected after reading the articles and checked if the papers matched our defined inclusion criteria. We also designed a survey with variable amount of questions depending on what the participant would answer. The questions were featured in terms of functionality interpreted from the use-cases found in the SLM.

**Results.** Through our SLM we found six different use-cases which were Recovery, Collaborative working, Password protection, Backup, Version tracking and Media streaming. The identified quality attributes gave two or more mappings to their corresponding use-case. As for the comparison between different clouds, only two out of six use-cases where implemented for the Personal cloud.

**Conclusions.** This gave us the conclusion that the vendors have been mostly focusing on the storage part of the Personal cloud, but there are solutions in order to increase the functionalities. Those solutions will probably not fit everyone as it includes open source software, with skills of handling installation and other procedures by the user.

**Keywords:**

cloud, service, ranking, use-case

---

# Contents

<b>Abstract</b>	<b>i</b>
<b>1 Introduction</b>	<b>1</b>
<b>2 Background Related Work</b>	<b>2</b>
2.1 Public Cloud . . . . .	2
2.2 Personal Cloud . . . . .	2
2.3 ISO 9126 . . . . .	2
2.4 Abbreviation dictionary . . . . .	3
<b>3 Research Methodology</b>	<b>4</b>
3.1 Research questions . . . . .	4
3.2 Systematic literature Mapping . . . . .	4
3.2.1 Search format . . . . .	6
3.2.2 Inclusion criteria . . . . .	6
3.2.3 Data extraction form . . . . .	7
3.3 Survey . . . . .	8
3.3.1 Goal with the survey . . . . .	8
3.3.2 Description . . . . .	8
3.3.3 Survey design . . . . .	8
3.3.4 Survey distribution . . . . .	9
3.3.5 Validity threat . . . . .	9
3.3.6 Target population . . . . .	10
<b>4 Results</b>	<b>12</b>
4.1 Systematic literature Mapping . . . . .	12
4.1.1 Collaborative working . . . . .	12
4.1.2 Password protection . . . . .	12
4.1.3 Backup . . . . .	13
4.1.4 Version tracking . . . . .	13
4.1.5 Media streaming . . . . .	13
4.1.6 Recovery . . . . .	13
4.1.7 Quality attributes . . . . .	14
4.1.8 Public and Personal Cloud . . . . .	14

4.2	Survey . . . . .	15
4.2.1	General statistics . . . . .	15
4.2.2	General Survey use case ranking . . . . .	18
4.2.3	Security . . . . .	19
4.2.4	Learnability . . . . .	21
4.2.5	Operability . . . . .	25
4.2.6	Submitted use cases by participants in our survey . . . . .	29
<b>5</b>	<b>Analysis</b>	<b>31</b>
5.1	Research Question 1 - What are the use cases of utilizing a cloud service? . . . . .	31
5.2	Research Question 2 - What qualities are important? . . . . .	31
5.2.1	Learnability . . . . .	31
5.2.2	Security . . . . .	32
5.2.3	Operability . . . . .	33
5.2.4	Statistical analysis . . . . .	33
5.2.5	Category ranking conclusion . . . . .	35
5.3	Research Question 3 - How does public and personal cloud use cases compare? . . . . .	35
<b>6</b>	<b>Conclusions and Future Work</b>	<b>37</b>
	<b>Appendices</b>	<b>39</b>
<b>A</b>		<b>40</b>
A.1	Survey questions . . . . .	40
A.2	Survey flow diagram . . . . .	41
A.3	SLM snowball sheet data . . . . .	42
A.4	Data Extraction Form Table . . . . .	43
	<b>References</b>	<b>44</b>

There is a rising need for consumers, as they are storing more data on their devices when adopting to smartphone and tablets[1]. As the bandwidth of the network carrier has increased[2] being cheaper of using, and the files stored on phone is starting to exceed the memory, the need for storing these files somewhere else have become more frequent. The public cloud, which is an online service platform that can be used in order to store data and provide functionalities will fill this gap.

By proposing an analysis to current use-cases of cloud services and personal cloud, we will find out which one of those use-cases are important or relevant for the consumer. The use-cases will be mapped to product qualities in order to get the overall picture of their relevance. We will finally compare cloud services and personal cloud in terms of their corresponding quality attributes and use-cases against each other.

According to Gartner and their prediction, average storage per household will grow from 464 gigabytes in 2011 to 3.3 terabytes in 2016[1]. The increased adoption of tablets and smartphones allows people capture large amounts of both photos and videos, and gartner predicts that consumer digital storage needs will grow from 329 exabytes in 2011 to 4.1 zettabytes in 2016[1]. This means that one third of the consumers data will be on the cloud by 2016.

As more devices are getting connected to the internet, the mobile internet will be setting new pressure from 3G up to 4G technologies. By 2020, 85 percent of the world will have at least a 3G connection, while 60 percent of the world will be on 4G[3]. Transitions to faster mobile internet will push storage and will lead to higher usage of cloud services.

By presenting the rankings of the use cases for personal and public cloud we aim for increased understanding seen from the end-users perspective on cloud quality.

Some studies in relation to supplier perspective on quality has been done for software as a service in cloud computing, where mathematical measurements was done relation to the ISO 9126 software quality attributes.[4]. Our study however is focused on the user's perspective.

## Chapter 2

---

# Background Related Work

## 2.1 Public Cloud

Companies that focus on Cloud, have data centers dedicated to enable users to utilize their hardware through the provided software over the Internet[5]. The computation is basically done on the data-centers, which are highly scalable and can be simple as a web based email service[6]. These kinds of conditions creates a big relief to the end users, where they simply don't need to install software locally on their computers[5][6]. Users can access the service whenever they want, share their data and collaborate easily with others[5].

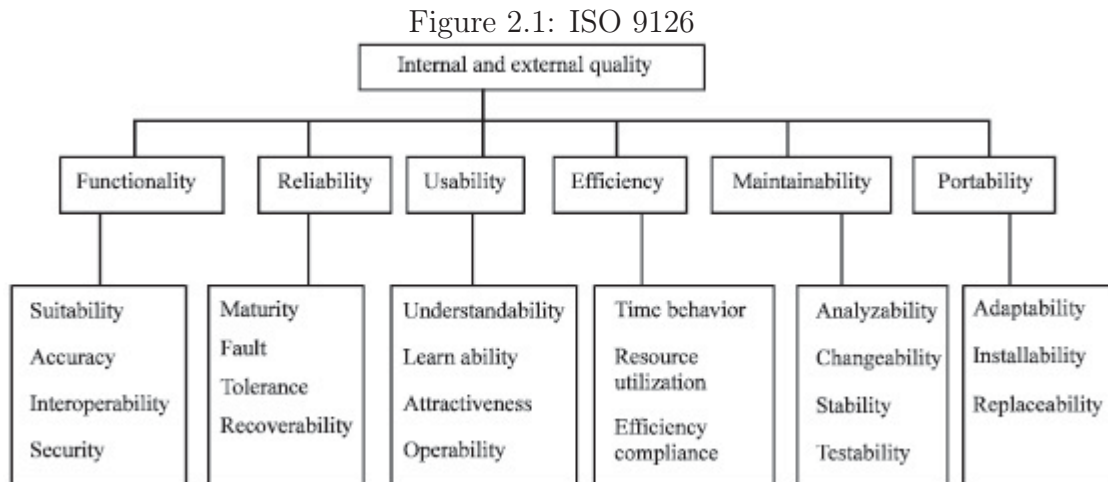
## 2.2 Personal Cloud

On a personal cloud you decide over your own data such as store, delete and modify[7]. As long as the data is accessible over the network, nobody can access the data which is stored on your personal cloud without your permission[7]. The decision who you want to share your data with relies on yourself and which you also can deny that privilege to[7]. You decide which application to use with your data regardless of vendor. You define your own terms of service for those who is interacting with the data[7].

A NAS *Network Attached Storage* is an example of a personal cloud[8][9]. It is basically a PC because its built with the same component as one[9]. The easiness relies on the simple OS that is provided, which focus on doing a portion of tasks[8].

## 2.3 ISO 9126

The ISO 9126 standard categorize different product quality attributes, such as functionality, usability etc among others. The standard lists a total of 22 attributes[10].



Picture is showing the ISO 9126 their characteristics and sub-characteristics

Many different studies has been done on the cloud services front, and by that we mean SaaS, IaaS and PaaS and their corresponding quality attributes which has mostly been focused from a business and provider perspective. One study was made by Atieh Khanjani, where he listed 33 different attributes for the SaaS platform[11]. Similar research has been made by Samir Areeg[12].

## 2.4 Abbreviation dictionary

The thought behind this chapter is to gather all the spoken abbreviations in this thesis in order to easily look it up if any questions arise about their meanings.

- Systematic Mapping Review, which involves a systematic method for going through literature.
- Use case - Speaks about a functionality for either personal cloud or a public cloud, and is in regards to survey often referred to as a functionality.
- Cloud service - A term which define both public and personal cloud.
- SaaS - Software as a Service. You're not forced to have a permanently installed software on your computer, but instead able to retrieve it online on demand[13]



### 3.1 Research questions

Our goal is to find what use-cases cloud services are offering today and how they are ranked by the user. Find the differences between public and personal cloud in terms of their use-cases and quality attributes.

**RQ 1.1 What are the use cases of utilizing public cloud?**

**RQ 1.2 What are the use cases of utilizing personal cloud?**

By conducting a Systematic mapping review we are able to answer and investigate which use-cases are available for both public and personal cloud. We will use a numerous search engines and with proper keywords find relevant papers. The articles will be reviewed with our defined inclusion criteria in order to filter out inadequate papers.

**RQ2 - What quality factors are important?**

A survey will be created and distributed to those who are matching our target population. The survey questions will be directly related to use-cases found from the systematic mapping review.

**RQ3 - How does Public and personal cloud use-cases compare?**

We will make an analysis in conjunction with our results gained from our survey and together with the use cases we found in our SLM study.

### 3.2 Systematic literature Mapping

We will search for potential use cases for public and personal cloud which will help us find the relevant studies. Defined in the data extraction form and using search keywords while utilizing the snowball sampling method will help us finding the relevant papers.

Our goal with the review is to find use-cases from a end-user perspective, which is utilized in public and personal cloud. We use the ISO9126 in order to map the found use-cases to their corresponding quality attribute if possible.

We have based the data collected from our snowball gathering approach in a google sheets document for easy collaboration between our two project members. From that document we have setup a number of columns of names based on our Data Extraction form which can be found in 3.2.3.

Our starting approach with the snowball method was in conjunction with our specified keywords in 3.2.1 here below. In which we got a set of research papers and performed forward as well as backward snowball sampling, which is mentioned as a recommendation by Webster and Watson in Jalali's paper[14]. After that we proceeded to add our set of original references which we had from the beginning from our topic and proposal documents (in which this thesis paper derived from). We felt we had to go through them (as they matched our keywords), and performed forward and backward snowball sampling on them as well.

We also colour marked each article with the colours of green and red depending if they passed our inclusion criteria or not. The articles which we were unsure about in the first iteration were marked with colour of orange, however we later went through these again in a second iteration and finally marked them red or green.

Other references presented in this thesis has been found through multiple databases and search engines. If the source presented is an article from a magazine, then a methodology has not been utilized for those types of sources as they lack references. The ones that are peer-reviewed papers, such as the scientific category where there has been a need to find more information on the subject, then snowball sampling has been performed in order to retrieve a broader information span. During our SLM we also found papers that could be use for referencing other information in this thesis, therefore they were saved for a future use. We used the following search engines and scientific databases to get our information:

- Google search engine
- BTH
- Diva-portal
- BTH - summon
- Google Scholar
- Ieee Xplore
- ACM Digital Library

### 3.2.1 Search format

We used these keywords in order to minimize our search result. After finding appropriate articles which was defined in data extraction form, we began to use the snowballing method to collect future relevant references data.

- Local storage AND use case
- Use case
- Cloud service AND use case
- Cloud AND storage
- Cloud
- Cloud AND storage AND services
- Hard AND drive
- Cloud Service

### 3.2.2 Inclusion criteria

- Publication date 2008 and onward. The first open source cloud platform Open-nebula, which was developed by Nasa and became the first open-source cloud software for deploying cloud services. From that year and onwards will be a good starting point to find relevant articles[15].
- Only accept use-cases seen from a user's perspective in terms of the quality attributes learnability, security and operability which can be found and defined in subsection 3.3.3 which derives from the ISO 9126 standard which is stated in 2.3.
- Papers that mentions relevant keywords from 3.2.1.
- No duplicate papers.
- Industrial publication based articles
- Because of lack of academic papers on use-cases regarding cloud services, we have had to include reports and journals as well.

### **3.2.3 Data extraction form**

We have written a google sheet document which we used to keep track of all our approved / disapproved references as well as using it for data extraction. The sheet was divided into several columns in which the following columns were used.

For further information what each column was used for, please see Appendix A.4.

## 3.3 Survey

### 3.3.1 Goal with the survey

The goal is to capture the user's perspective on different quality attributes and use cases

Useful statistics data categories are the following, which are based on quality attributes whose origin is written about in 3.3.3.

- How users would rank certain functionality in terms of Security
- How users would rank functionality that they have used before in terms of Learnability, which is defined in 3.3.3
- How users would rank functionality that they have used before in terms of Operability, which is defined in 3.3.3

### 3.3.2 Description

- The survey will be a web-questionnaire
- The survey link will also be shared to our friends through the means of Whatsapp, Skype, as well as on a Facebook timeline in the form of a post in which the latter has the potential to reach out to at least 122 users.
- The collected data will be organized and inserted into google sheet documents which will then be displayed as graphs
- [current functionality] refers to the current mentioned statement question in the survey

### 3.3.3 Survey design

The design is an essential part and can reflect the respondents answer, to the extent where decisions such as not wanting to complete the survey may occur[16]. A progress bar might help the respondent to complete the survey because a visual perspective of how much is actually left keeps the participant motivated[16]. Today many people are using their smart-phone and tablet for everyday Internet web-browsing, and the normal desktop computer has become more of a productivity tool. We wanted the survey to be web-based as we can reach more people but also get faster responses[16]. Therefore aspects such as chosen platform for the survey must be implemented with responsive techniques in order to meet the demand for different devices [17]. As completion time was considered we choose

to have 17 - 32 questions depending on how the respondent will answer, in which Brent C in his work writes about 16-25 questions, which should take approximately 7-9 minutes to complete, because the respondent tend to spend less time on each of the questions when there are too many of those, which can lead to a decrease in quality for the answers.[18].

To gain understanding of what qualities users value more or less in a cloud service, we use those quality attributes with their corresponding use-cases found in the systematic literature mapping. By creating questions relevant to the use-cases will help us find out what is more or less preferable.

In terms of security it's relevant to investigate if users consider the backup frequency, and being in complete control over their files important features.

In terms of learnability, it's important to have good product qualities so that users will be able to understand its features easily.

In terms of operability it is interesting how easy it is for a user to change settings for a functionality for cloud services as well as personal cloud.

### 3.3.4 Survey distribution

As the survey cannot be responded from whoever, we choose to pass the survey on a individual level, that met the criteria on our developed "personas". These following distribution channels was used: Skype, Whatsapp and Facebook.

### 3.3.5 Validity threat

We choose to use Google forms to distribute our survey, we notice that the respondent has ability to respond multiple times to the survey. Only way to avoid it is to force the respondent to have an google account in order to answer the survey. That kind of restriction we also believed would lead to loss of respondents due to the very nature of people finding it not interesting to do a survey and if they decide to do it, they would prefer a simple approach.

We also included the possibility for person participating in the survey to express him / herself further if there was one use-case that he / she has been using before. This intention wasn't to make a connection to a certain service, but instead of bringing up statistics of often used use-cases from the eyes of a user.

We choose a scale from 1 to 4 due to our belief that a 5 grade scale would yield neutral results. Now we force survey participants to either choose less or

more on the 4 grade scale. However there is still a risk of the user setting 3 as default so the result is not 100% accurate.

If a user selected that he / she had used a functionality before, then he / she was automatically asked a learnability and operability ranking question. For learnability, it's reasonable to assume the user is able to answer how easy it was to learned the mentioned functionality, however for operability we also assumed the user could determine and answer how easy it was to change settings for the current use case. This may not always be true for the participant, and may produce faulty answers.

We also preferred to have more data points, in other terms more people that responded to our survey in order to compare age as well as internet bandwidth categories. Since we didn't have any groups of atleast 2 with 30 data points in each for these categories, we decided not to do any comparisons for these parts.

If time allowed, we would have complemented the survey with an interview follow-up for 4 new people doing the survey in order to investigate if people defaulted to 3 in ranking, understood the survey properly or if they actually chose 3 as they believed certain use cases just wasn't worth a 4.

### 3.3.6 Target population

We created personas in order to find out whom the survey questionnaire is intended for. Our target population was created in such a way that many has the opportunity to respond the survey. Year differences gives a span from 25 - 49 where the user may have different knowledge about the cloud. Those who know what a cloud service is and those who actually use it. We used different working sectors, which may change their way of using the cloud, and gives a variation of what type of cloud use-cases have been utilized.

Miguel Larsson: 49 years old English speaking, working in IT sector. Miguel Uses Internet daily and does know what cloud service is.

Ruben Johansson: 35 years old, English speaking and working as a cab driver. Ruben uses his 4G wireless Internet connection in order to pload his dashcam videos to his cloud service.

Sofi Karlsson 25 years old, English speaking Student. Has multiple Internet capable devices, with different types of Internet connections 100 mbit and 3G wireless. Sofi Upload her video-logs on a cloud service to let her viewers watch her everyday life.



### 4.1 Systematic literature Mapping

For the performed SLM we found 62 papers and articles totally which were analyzed, with 43 rejected and 19 were approved. We had a later addition of 9 papers for general referencing of statements in late parts of our thesis.

Our source of information had to include both academic papers, blog-posts and journals. There are different angles on cloud service for each of the sources, which means that they focus either on a user or the business perspective of the cloud service. Essentially the perception of the cloud service remains the same, but the use-cases can differ depending on whom the target audience are. As we stated in section 3.2.2, we have limited the publication year to 2008 and above.

The use-cases were collected from the performed SLM, which gave us enough data to understand which use-cases are actually important or are relevant for the end user. We choose those use-cases that were essential as well as applicable today that can also be found on the feature list on websites of certain cloud service companies.

#### 4.1.1 Collaborative working

Collaborative working is used in todays many different cloud services such as Google and Office365[19]. One of many purposes is to store in-progress document on the cloud and to be able to work on the same data-set and automatically share and synchronize the files among the users[20]. Without a restriction of access for the rest of the collaborative users, the changes made to the data can be seen instantly.

#### 4.1.2 Password protection

Password protected files helps to protect the users data and is accessible for those who has the right key. The files or folders can be protected and be shared publicly

among users[19].

### 4.1.3 Backup

Backing up files is one of the many great features cloud services are able to provide, it can be done in regular intervals or manually by the user. The backed-up data can then be restored whenever the user deem it necessary to do so[21].

### 4.1.4 Version tracking

With the help of version control, a team or an individual user is able to track their progress and see what changes are made to the data which is being worked on. The user is able to rollback to a certain point in time, with the help of a built-in history tracking[22].

### 4.1.5 Media streaming

User is able to view and listen to their media files without having local access to the file. By loading the chosen media file(s) into the cloud-service, gives you the possibility to consume the media trough a number of devices such Tablet, smart-phone and a computer[8]. The file gets consumed on the go while playing the content, this means that only the part of the media file that is being utilized, is transfered to the user [23].

### 4.1.6 Recovery

A recovery involves storing data and recapturing it. The recovery procedure takes place whenever data fails, or when a disaster occur, which leads to not being able to get the current data back [24]. The backed-up data has the capability to be stored in many different locations[25].This enables the capability for much higher data redundancy and lesser risk of loosing your future recovery data.

### 4.1.7 Quality attributes

The following table depicts the connection of each use case found in our SLM with their corresponding quality attribute.

As can be seen, Security is linked with Recovery, Password protection and Backup use case. Learnability and Operability on the other hand applies to all of our 6 use cases which consists of Collaborative working, Version Tracking and Media streaming in addition to the three use cases first mentioned for Security.

Table 4.1: Use cases and their respective quality attribute

	Recovery	Collaborative working	Password protection	Backup	Version tracking	Media streaming
Security	X		X	X		
Learnability	X	X	X	X	X	X
Operability	X	X	X	X	X	X

Table below depicts the connection between use-cases for public and personal cloud. Six use-cases has been found for the public, only two for the personal cloud.

Table 4.2: Cloud service and Personal cloud use-cases

Cloud	Recovery	Collaborative working	Password protection	Backup	Version tracking	Media streaming
Cloud service	X	X	X	X	X	X
Personal				X		X

### 4.1.8 Public and Personal Cloud

Our research question regarding the comparison clearly shows lack of use-cases for the personal cloud compared to the public cloud. There seems to be many different alterations of what a personal cloud is and what should be included in terms of functionality. Many vendors define personal cloud different, which is more of a storage device than anything else[26]. A handful of those described can be found in an article by Geoffrey Goetz[27]. The main differences between Cloud and Personal cloud are architectural aspects on a software level[28]. There are open source projects, which allows use-cases for more than just storage, in which one of those are ownCloud. By having the right software gives potential to run application on your personal cloud and therefore getting closer to a broader range of use-cases[26].

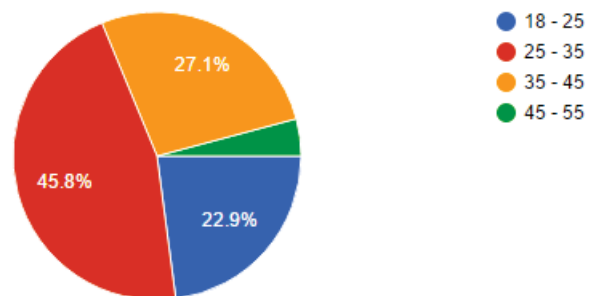
## 4.2 Survey

We have performed a Survey directed at people that are familiar with cloud services. Out of this survey we received 45 responses in which we will fetch statistics how users have ranked in terms of Operability, Learnability and Security. The ranking was done by specifying on a scale from 1 to 4 on how the current use case was for the user.

### 4.2.1 General statistics

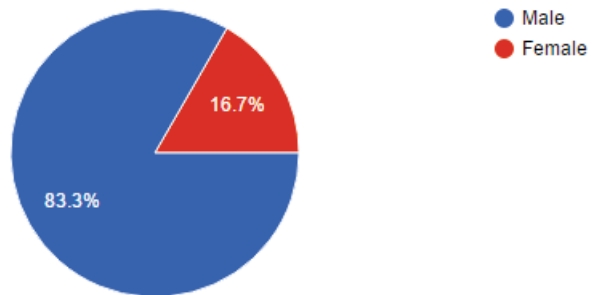
For our survey we asked entry questions in forms of age, gender, occupation , how many internet capable devices they had as well as how fast their internet connection were.

How old are you? (48 responses)



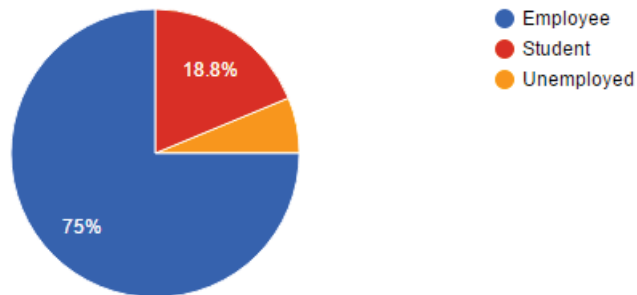
By looking at the age response in the categories offered we can see there's a clear majority of 45,8% being in the age span of 25 - 35, followed by 27,1% in the age span of 35 - 45.

What is your gender? (48 responses)



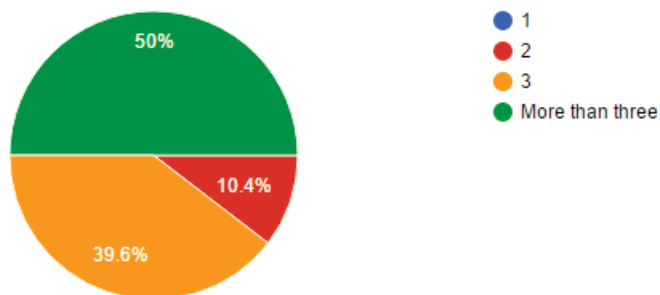
It would seem a large majority of our participants were male, which ended up at 83,3%.

Your occupation? (48 responses)



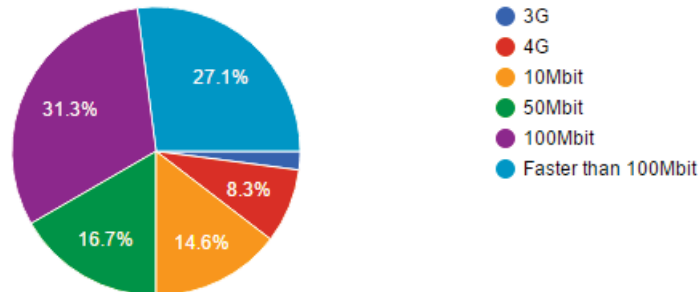
Judging by the response for this question, it would seem a clear majority are employees, and ended up at 75%.

How many internet capable devices do you use? (PC(s),Tablets, Phones. etc)  
(48 responses)



This pie chart pans out a bit more, with 50% having more than three devices, followed by 39,6% having 3 devices.

How fast is your internet connection? (Pick your closest one) (48 responses)

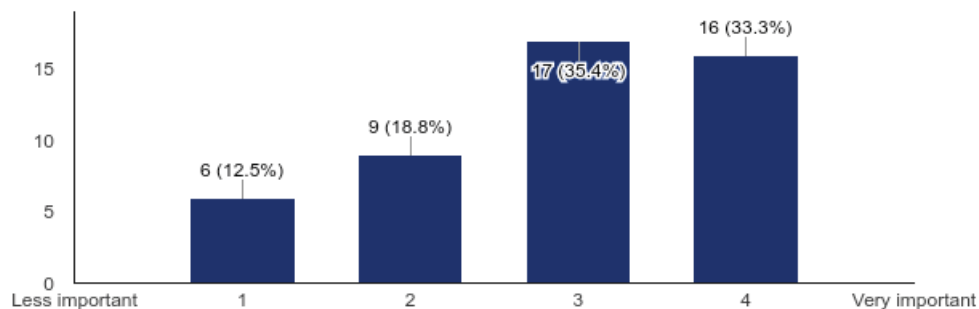


This chart is slightly more divided, but we can see 100mbit being in majority with 31,3%, followed by "Fast than 100 Mbit" with 27,1%.

#### 4.2.2 General Survey use case ranking

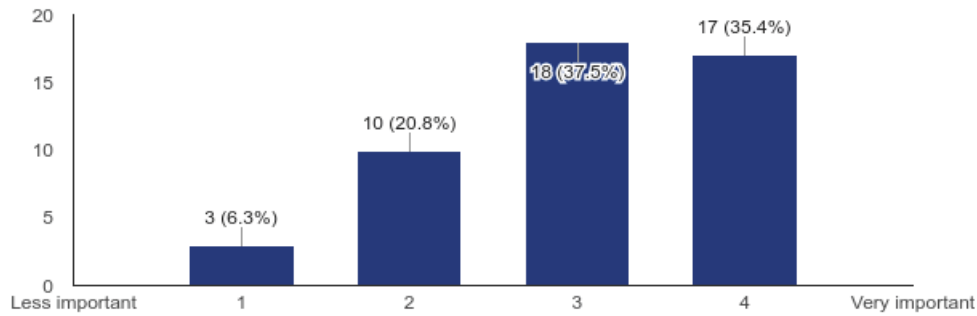
We asked the participant to rank use cases which we found from our performed SLM.

The first general survey ranking question was in regards to stream media files like images and video from cloud service to a local client, without saving any data on the local client.



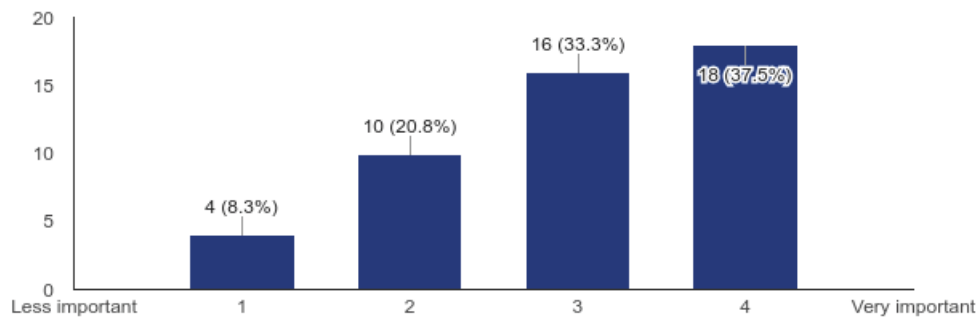
What we can observe from statistics is that the rank of 3 at 35,4% is in clear majority followed by a ranking of 4 at 33,3%.

Our second general ranking question was in regards to collaborate with files among several users and sync the ongoing progress.



What we can observe from this diagram is that the majority chose a 3 of 37,5%, tightly followed by a 4 of 35,4%.

Our third and final general ranking question was in connection to version control for a person or a team to track changes being made to files and being able to rollback to an earlier version of the file.



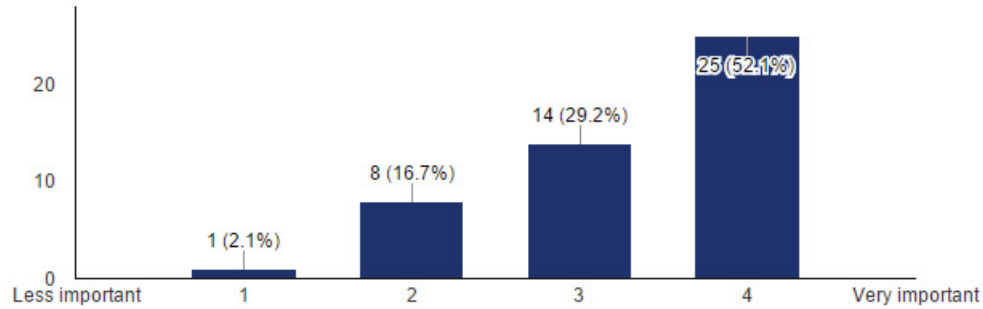
Judging from this diagram is that rank 4 is in majority with 37,5%, followed by rank 3 of 33,3%.

### 4.2.3 Security

We had asked the participant in the survey to do a ranking for three Security related use cases.

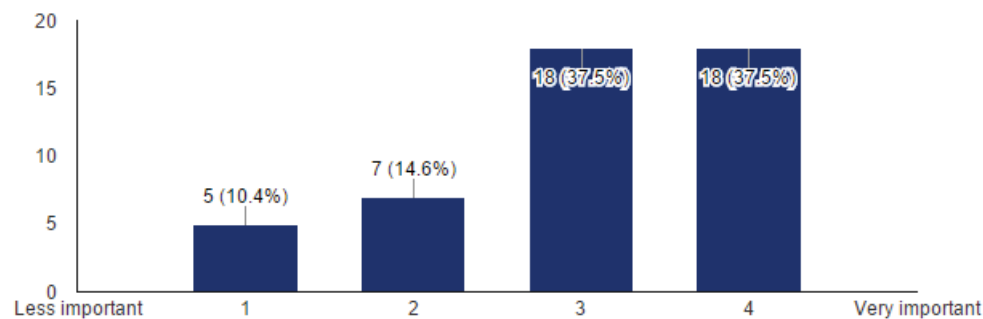


The first question was regarding a recovery feature in case of data storage failure.



As is depicted by the diagram, a clear majority of 51,1% considers this use case to be of utter most importance and ranking it as a 4.

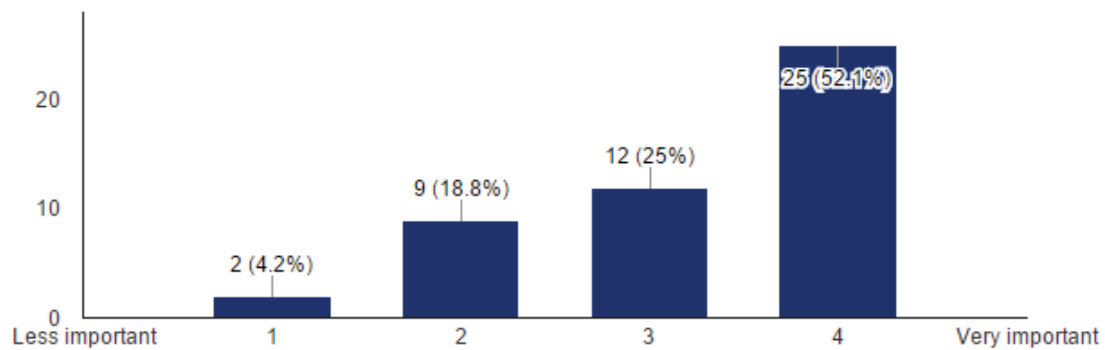
The second question was regarding being able to backup selected files in a set interval or doing it manually.



It would seem even this use case would ranked more to the important side with 37,5% ranking it as a 4 and respectively 37,5% ranking it as a 3.

The third question was how users would rank the possibility to setting a password protection on certain files in order to protect data as well as offering a public key in order to access the data which can be shared publicly among users.

It would seem the participants of this survey have taken security into consideration and ranks this use case very high in clear majority as well, with a total of 52,1% ranking it as a 4.



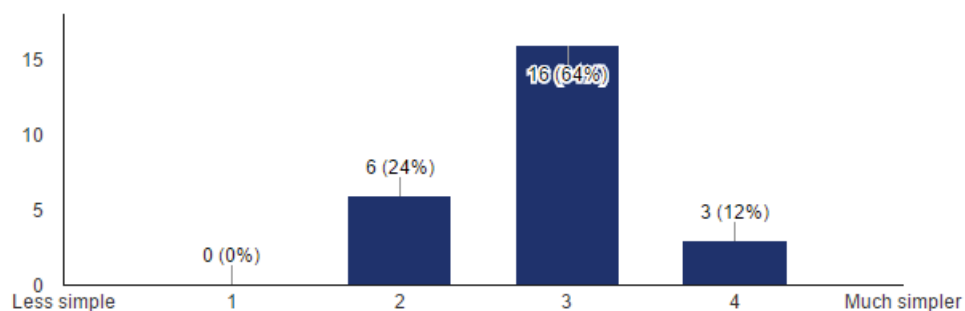
#### 4.2.4 Learnability

We asked the survey participant to rank each of our found use cases from the SLM. We also asked a follow-up question whether they had used this functionality or not. For those that answered yes, we had two follow-up questions for each use case, in which one of them was based on Learnability that asked the user how simple it was to learn.

We did our ranking in the same fashion as we did with the use cases, which was a scale from 1 to 4.

Our first learnability question was how simple it was to learn a recovery feature in which the user had tried before.

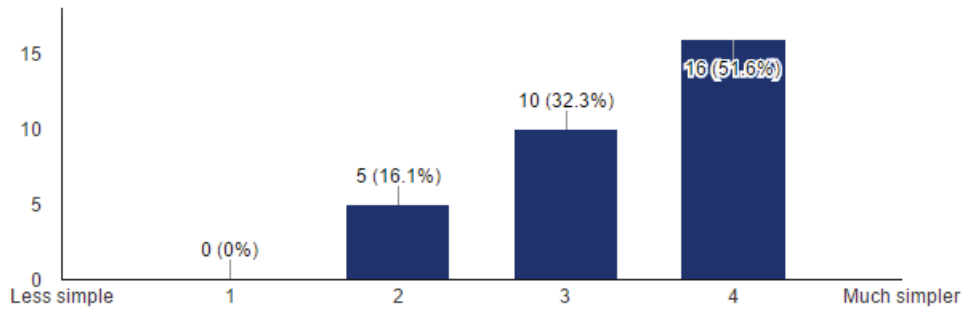
##### How simple was it to learn ? (25 responses)



It would seem it was leaning against the much simpler direction where a majority of 64% chose a ranking of 3 with a total of 24 out of 48 was familiar with this functionality and had used it before.

Our second question was stated in the regard to how simple it learn to stream media files from a cloud service.

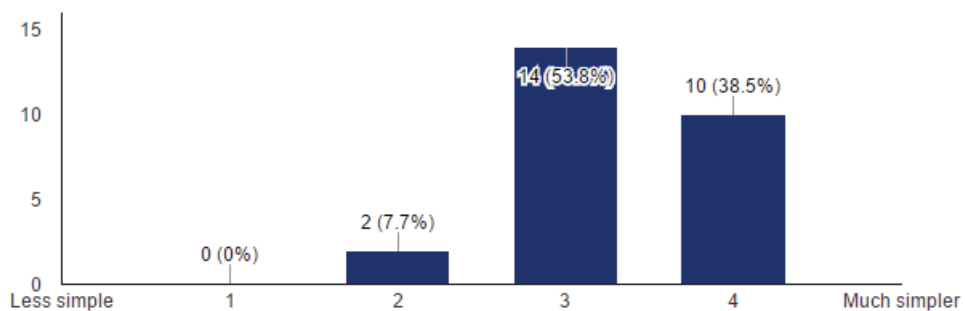
**How simple was it to learn ? (31 responses)**



They ranked the learnability for this functionality quite high as well with 51,6% ranked it a 4, with a total of 31 out of 48 people that had used this functionality before.

Our third question was asked for how simple it was to learn how to backup manually or for an automated set interval.

**How simple was it to learn ? (26 responses)**

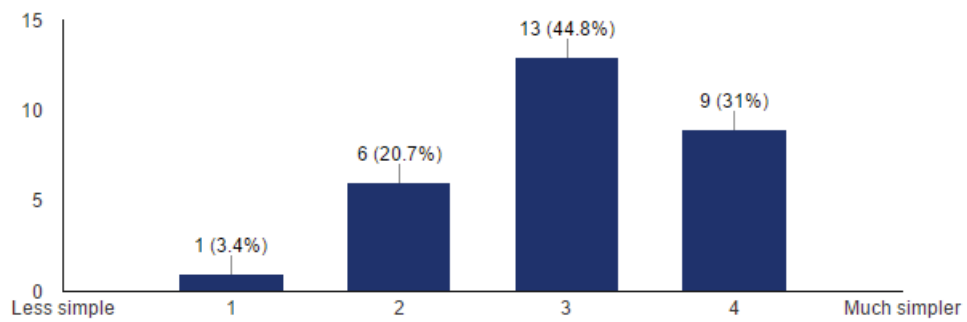


It would seem it was leaning in the simpler direction here, as 53,8% ranked it a 3 for this question, with a total of 26 out of 48 people that has used this function-

ality before

Our fourth question was asked about how simple it was to learn how to set password protection on certain files and offering a public key in order to access it, (in simpler terms a public link).

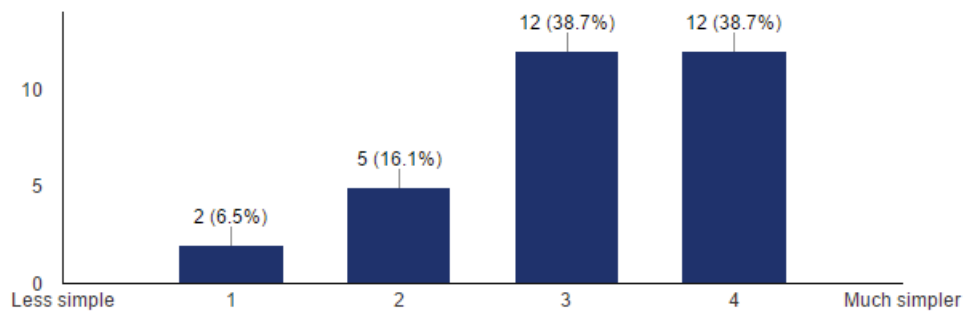
How simple was it to learn ? (29 responses)



Also this question leaned to the simpler direction where as much as 44,8% ranked it a 3, with a total of 29 out of 48 people having used this functionality before.

Our fifth question was in regards to how simple it was to learn the Collaboration functionality which spoke about collaborating with files among users and sync the ongoing progress.

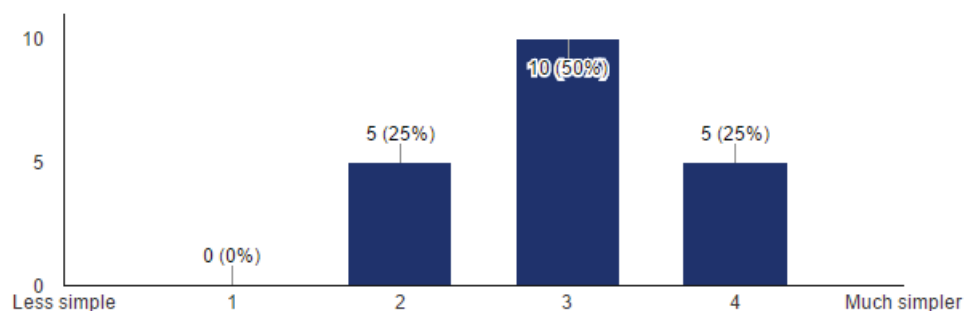
#### How simple was it to learn ? (31 responses)



After looking at the diagram you see a trend leaning in the simpler direction, but people seem unsure whether it's worth a 4 or a 3, in which the former lines up at 38,7% and the latter at 38,7%. We also recorded 31 people out of 48 having used this functionality before

Our fifth and final question in the learnability department was in regards to how simple it was to learn version control for yourself or a team, as well as track changes made to files and be able to rollback to an earlier version.

#### How simple was it to learn ? (20 responses)



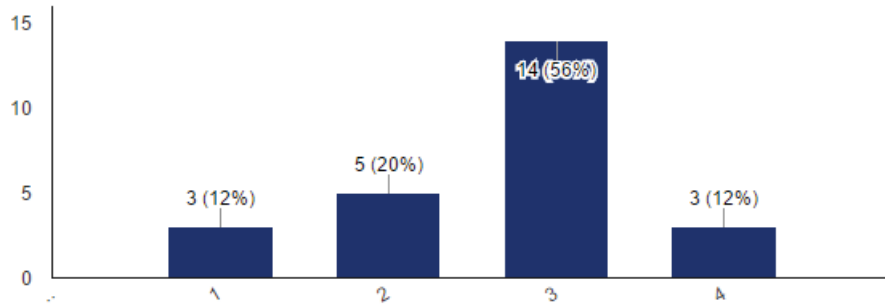
The rank of 3 at 50% is in the clear majority, and there were a total of 20 out of 48 respondents that had used this functionality before.

### **4.2.5 Operability**

For each functionality ranking statement in our survey we also asked the user if they had used this functionality before, and if they had, then they were asked an operability question regarding how they would rank the possibility to change settings for the mentioned functionality.

Our first operability question was in regards to the recovery in case of data failure functionality, in which we received the following results.

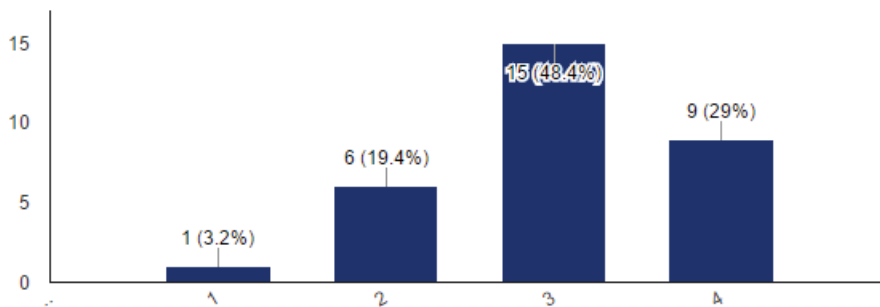
**How would you deem the possibility to change settings for recovery**  
(25 responses)



It would seem it's leaning against the simpler side with a ranking of 3 with a clear majority of 56%, with a total of 25 respondents out of 48.

Our second question was in regards to being able to change settings for the streaming media functionality.

**How would you deem the possibility to change settings for streaming media**  
(31 responses)

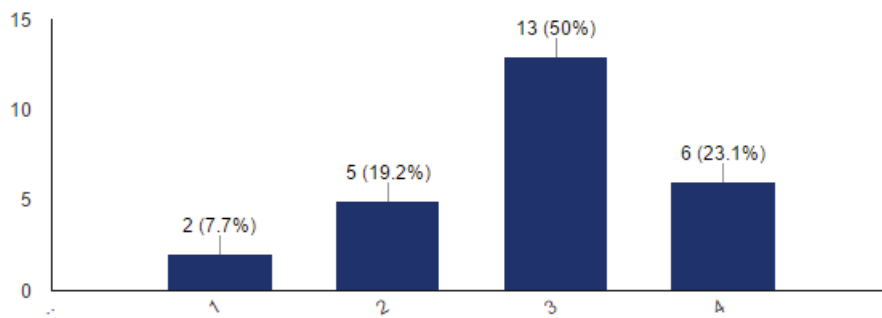


Also for this question the ranking 3 is in clear majority for a total of 48,4%, with 31 responses out of 48.

Our third question was in regards to backup and the possibility to change settings when to perform a backup.

### How would you deem the possibility to change settings when to perform a backup?

(26 responses)

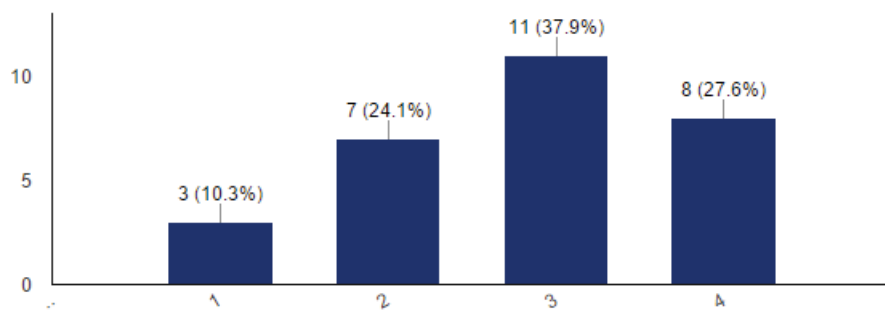


As can be observed in the diagram above, this as well has a clear majority of ranking 3 with a total of 50%. 26 out of 48 respondents were participating in this question.

Our fourth question was in regards to password protection and how the possibility to change its settings would be ranked.

### How would you deem the possibility to change settings for password protection?

(29 responses)



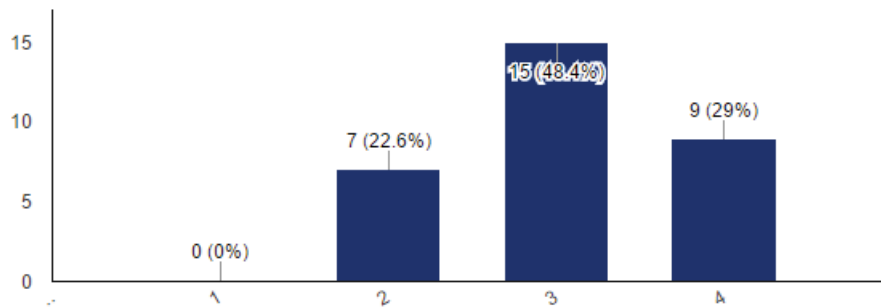


This question as well is expressing its statistics with a rank of 3 in a somewhat lower majority of 37,9% where rank 4 with 27,9% is just 10% below it. 29 out of 48 respondents answered this question.

Our fifth question was about the possibility to change settings for collaboration functionality.

#### How would you deem the possibility to change settings for collaboration?

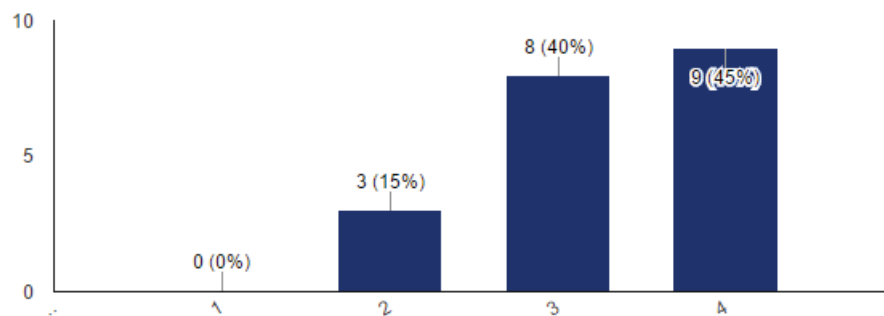
(31 responses)



We can observe here that rank 3 is in clear majority with a total of 48,4% that chose it. We had 31 out of 48 respondents answering this question.

Our sixth and final question was about the possibility to change the settings for version control functionality, in which we received the following result.

#### How would you deem the possibility to change settings for version control? (20 responses)



The results for this question is somewhat even, with a rank of 3 reaching 40%, and rank 4 reaching 45%. 20 out of 48 respondents answered this question.

#### 4.2.6 Submitted use cases by participants in our survey

In our survey we also gave the participant the ability to specify use cases that wasn't mentioned in the survey.

We received quite a few responses, and some less serious. The use cases mentioned by our survey participants were the following:

- Choose geographical location of a cloud storage
- Synchronizing media file playback progress on several devices
- Sharing folders
- Visible folder hierarchy of a public link
- Syncing data between devices
- Perform a malware / virus check on local device before communicating with a cloud service
- An option to choose between distributed / clustered or another file system

- Account termination and complete removal of files from the cloud service

They were indeed some interesting suggestions, which of some are already upcoming but not quite there for cloud services yet, such as synchronizing media file playback progress. This functionality can be found in streaming media center programs like Kodi and Plex for example.

We did however not mention any synchronization of data between devices as we believed it was self-understood and which we also found plentifully written about in our SLM, but it was a good catch anyways which we naturally believe would be a founding stone for a cloud service.

Choosing a geographical location of a cloud storage is also a very present use case as people around the world are getting faster internet connections and prefers faster as well as closer (geographically) access to their data.

There was also someone who submitted a use case about account termination as well as removal of files on cloud, which would sound like an excellent idea of a use case as it would improve personal integrity and the user would feel more in control of his/her data when not desiring the cloud service anymore.

### 5.1 Research Question 1 - What are the use cases of utilizing a cloud service?

We conducted the systematic mapping review in order to find the current use-cases that exist for the public and personal cloud.

Our findings gave us six use-cases for the public cloud and two for the personal cloud, which can be found in 4.2. Those are the major and well known ones, there might be more use-cases which we did not find during our SLM, which could have to do with start set of papers.

### 5.2 Research Question 2 - What qualities are important?

We answered this research questions with the help of a survey we constructed, where participants had the ability to rank use cases found in our SLM.

The questions asked in the survey has been split into categories of Learnability, Security and Operability which were found in the performed study in Research Question 1.

#### 5.2.1 Learnability

These questions about Learnability required the participant to have actually used the functionality before even being able to answer how simple it was to learn.

In regards to the number of respondents being able to answer Learnability questions was in the following amount of respondents for learnability questions 1 - 6:

- 25 - recovery
- 31 - stream media files

- 26 - backup
- 29 - password protection
- 31 - collaboration
- 20 - version control

If we compare the learnability ranking for being able to stream media files from a cloud service, and the ranking for being able to Collaborate with files among users and sync ongoing progress (which both have 31 participants each) which can be seen at 4.2.4, we see a clear trend of that it's quite simple to learn how to stream media files with a rank of 4 with 51,6%.

Collaboration however is cutting it very close with a rank of 3 and 4 with a shared place of both containing 38,7% for each ranking.

This may also indicate a trend that half the participants for the collaboration question considers it easy, while the other half considers it a bit simple, but still room for improvement.

We can also see from this ranking that people considers it much easier in terms of how simple it was to learn, for the media streaming functionality.

## 5.2.2 Security

These questions about Security are based on the ranking of the connected functionality in regards to Recovery, Backup and Password protection.

All 48 participants could answer these questions.

Judging by the diagrams found in 4.2.3, you can see a trend that our participants have taken security into consideration, in which the only functionality ranking there was some bit of doubt and not getting a clear 4 was for the ranking statement of backing up selected files in a set interval or doing it manually.

People seem to prefer both the functionalities of having a recovery feature, which delivers a clear 4 in rank with a majority of 52,1%, as well as the functionality of having password protection (public link), which also was a clear 4 in rank and this one also containing 52,1%.

### 5.2.3 Operability

These questions about Operability required the participant to have actually used the functionality before even being able to answer how simple it was to learn.

In regards to the number of respondents being able to answer Operability questions was in the following amount of respondents for Operability questions 1 - 6:

- 25 - recovery
- 31 - stream media files
- 26 - backup
- 29 - password protection
- 31 - collaboration
- 20 - version control

If we compare the Operability ranking for being able to stream media files from a cloud service, and the ranking for being able to Collaborate with files among users and sync ongoing progress (which both have 31 participants each) which can be seen at 4.2.5, we see a clear trend of that it's leaning against the simpler side to learn how to stream media files with a rank of 3 with 48,4% in clear majority.

Collaboration however is in clear majority with a rank of 3 at 48,4%.

Both of these functionalities seems to express statistics that's leaning against the simpler side with a rank of 3 of equal percentage result for both, making them equally as preferable in terms of ranking.

It could also indicate that people are not sure what to rank, and may default to a 3 in ranking due to our scale which only has 1 to 4 and doesn't have a neutral position. This was also a feedback concern one of our test pilots had for the survey.

### 5.2.4 Statistical analysis

We performed a Shapiro-Wilk test for our survey which was done to ensure that the data being used has a normal distribution among respondents. We choose to use this test because our data-set is less than 2000. The significance level is set to 0.05 (5-percent), which means that if  $p < 0.05$  the null-hypothesis will be

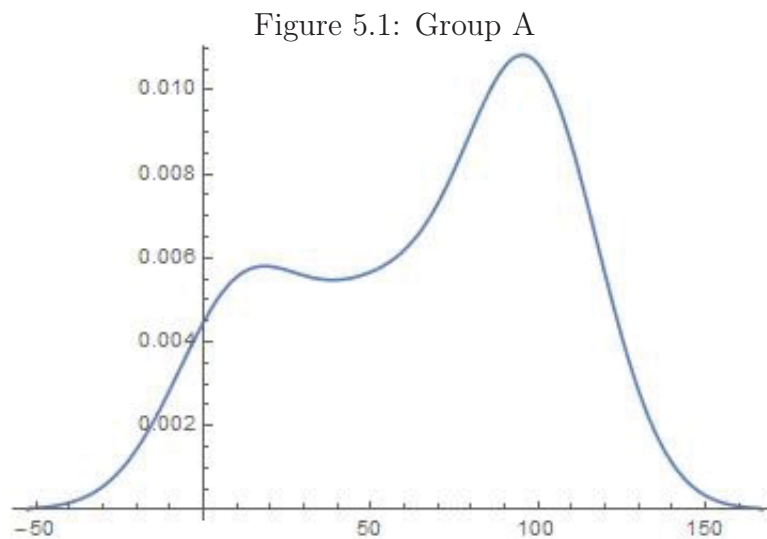
rejected. If that is the case a conclusion could be drawn that there is a relation between the values in the set. As we did not have any other sets that could be used for this we chose to use age and bandwidth. We have two different groups, range (25-35) and (35-45).

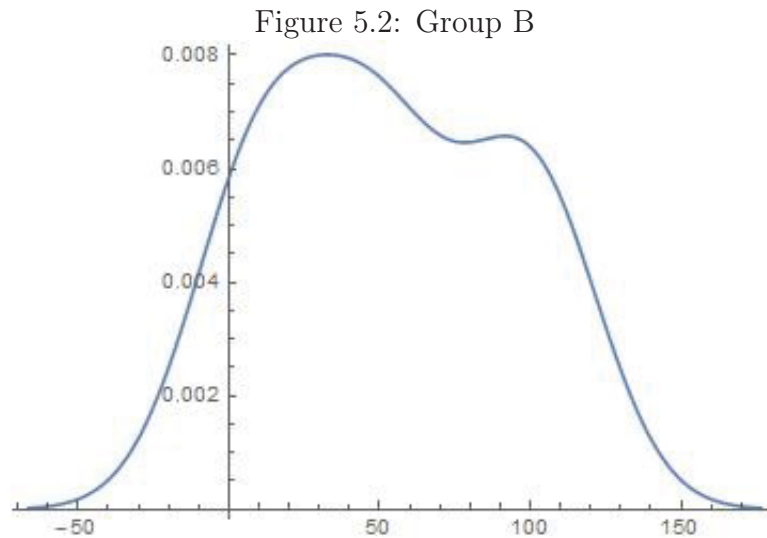
From here on we will call the groups A and B. Group A corresponds to range (25-35) and B (35-45). We want to know how each of their respective Internet speed differ from each other. Group (25-35) consist of 22 people while group (35-45) consists of 13 people. Six respondents in group A and four in group B have a connection higher than 100 mbit, as we don't know how much higher than 100 mbit, we will have to exclude them from the test.

Group A {100, 100, 100, 100, 100, 100, 100, 80, 80, 50, 50, 50, 14.7, 10, 10, 10}

Group B {100, 100, 100, 50, 50, 50, 10, 10, 10}

The null hypotheses that the data is distributed according to the normal distribution was rejected for both groups at 5-percent.





Mann Whitney test tell us that the median differences is 0, not rejected at the 5-percent level. The p-value is less than 0.05 which means that there's not a statistical difference between group A and B.

### 5.2.5 Category ranking conclusion

When it comes to Learnability, our survey participants have expressed themselves clearly and ranked the use case of streaming media files as the easiest functionality to learn with a rank of 4.

Security on the other hand has a split preferred use cases of Password protection and Recovery feature functionalities that both received the same percentage and a rank of 4.

Speaking in Operability terms, then the Collaboration and Streaming media files use cases stood out, which in this case as well had the same percentage and both a rank of 3.

## 5.3 Research Question 3 - How does public and personal cloud use cases compare?

We wanted to investigate with our research question how the public and personal cloud use-cases compare, and the answer to that is; only two out of six use-cases are implemented for the personal cloud. This is only true for the pre-built solutions, as the open-source software can increase the use-cases. As many personal cloud systems leans towards more of a storage device, the few use-cases



can make an potential consumer avoid these kinds of systems. The software is where the problem exists, and an alternative is to use open-source software with your own hardware. Custom solution with own hardware and open-source software will probably not be very cost effective, but you will be able to benefit from the more advanced use-cases which provides a public cloud. Hopefully in the future there will be guidelines and standards for both software as well as vendors that sells complete solutions, including functionalities that are according to the standard, which creates more consistency among the cloud solutions.

## Chapter 6

---

# Conclusions and Future Work

In this thesis we investigate several cloud service use-cases such as password protection, collaboration, recovery among a few others. Those found in our investigation are probably the most used and well known ones. They also seem to be in high demand by the users as they were highly ranked in our survey even if some of them may never have been used before by the survey participant.

We came up with a few personas to help us targetting our audience when it came to collecting survey responses. However as we later noticed this group of participants were biased, and it didn't turn out to be a normal distribution according to the statistical analysis we conducted with the help of the Shapiro test in 5.2.4.

Our chosen quality attributes from the ISO 9126 standard were successfully mapped with the found use-cases, which showed the necessity to have the quality attributes of security, operability and learnability as part of a cloud service. However there are some questions regarding the quality attributes as it would seem natural to rank security use cases very high. This is also indicated by the ranking results in our survey.

As for operability we had collaboration and streaming media use cases as the most highly ranked, but most of the rankings consisted of threes, this could indicate that the participant wasn't sure what to answer and just ranked them as a 3 by default. Or that he / she believed most of the use cases needed improvement and didn't quite reach up to a 4 in ranking. This could be solved by conducting an interview for a couple of participants and let them redo the survey and make sure they really understood the questions.

There are many different user groups for the cloud, where the majority are obviously not for the super-user who cares about having all the different use-cases. Personal cloud is mostly sold as a complete unit with included software. Vendors have excluded the use-cases that perhaps are not an essential part of their consumer products. Lacking most of the public cloud use-cases, while making it

easier for the end user to choose the right path in their search for the right cloud solution.

Results of this study could be useful for practitioners to evaluate a product quality from different perspectives. Cloud services can be niched in order to satisfy a certain target consumer, it could be helpful to know how too compromise between users and quality attributes, for example setting up an Owncloud server to share your files externally which applies to the password protection use case for a personal cloud. This solution however is not easy to setup and would not cater to the casual user.

Open-source software exists based on clouds that are well customizable and is an excellent starting point for a user that is interested in having a personal cloud.

# Appendices

# Appendix A

---

## A.1 Survey questions

### Survey questions

- How old are you?
- What is your gender?
- Your occupation?
- How many internet capable devices do you use? (PC(s),Tablets, Phones. etc)
- How fast is your internet connection? (Pick your closest one)

If the user chooses "employed" as occupation, he/she will then be asked an optional question of what sector he/she is working in.

The following statements will be rated from 1 - 4 in the survey, and they are based on found use cases in our SLR where the use cases will be from here on be referred to as a functionality in this survey.

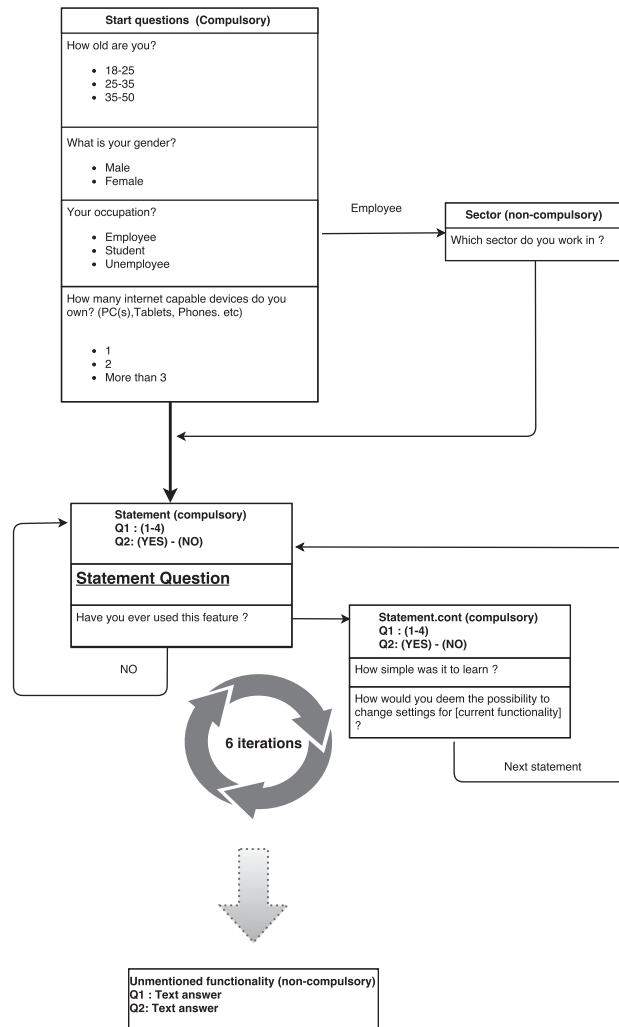
- Have a form of recovery feature in case of data storage failure?
- Being able to stream media files like images and video from your cloud service to your local client, without actually saving the data on your current device after finish watching?
- Being able to backup your selected files in a set interval or manually?
- Setting a password protection on certain files in order to protect data as well as offering a public key in order to access the data which can be shared publicly among users (public link) ?
- Be able to collaborate with files among several users and sync the ongoing progress?
- Be able to have a form of version control for yourself or a team to be able to track changes being made to files and to be able to rollback to an earlier version of the file?

For each above mentioned statements the following question will be asked

- Have you ever used this feature ?

If the user answers yes, then the following two questions will be asked

## A.2 Survey flow diagram



# A.3 SLM snowball sheet data

number	link title	link to reference	Authors	date	short summary	peer review	inclusion	sub reference number	comments	mentioned use-cases	use case found on page
1	Abstract Cloud IX	http://www.sciencedirect.com/science/article/pii/S0167636912000148	Q Wang, Q Lu, J Wu	Proceedings of the 17th	Abstract Cloud IX				Nothing about use-cases		
2	Abstract Personal X	http://www.sciencedirect.com/science/article/pii/S0167636912000149	Q Wang, Q Lu, J Wu	Proceedings of the 17th	Abstract Personal X				Nothing about use-cases		
3	Chapter 6 Hard X	http://www.sciencedirect.com/science/article/pii/S0167636912000150	T Valle, A Valle, R Elvebacker	2009	Chapter 6 Hard X				This article is about cloud from companies perspective.		
4	Chapter 6 Hard X	http://www.sciencedirect.com/science/article/pii/S0167636912000151	S Yamana, K Luder	Financial Cryptology and Data Security	Chapter 6 Hard X				From the companies perspective, not actually about use-cases.		
5	Abstract Cloud IX	http://www.sciencedirect.com/science/article/pii/S0167636912000152	C Wang, K Ren, W Liu, J Li	IEEE Network	Abstract Cloud IX				Nothing about use-cases		
6	Abstract-Cloud IX	http://www.sciencedirect.com/science/article/pii/S0167636912000153	C Wang, Q Wang, X Ren, N Cao	Services Co	Abstract-Cloud IX				Good introduction, but paper does not focus on use-cases.		
7	The demand for digital storage	http://www.sciencedirect.com/science/article/pii/S0167636912000154	H Chung, J Park, S Lee, C Kang	Digital Storage	The demand for digital storage				The demand for digital storage		
8	The architecture of X	http://www.sciencedirect.com/science/article/pii/S0167636912000155	D Harris, B Pinkas	Security & Privacy	The architecture of X				The architecture of X		
9	Cloud storage services	http://www.sciencedirect.com/science/article/pii/S0167636912000156	Q Lu, Q Wang, J Wu	Journal of network and computer applications	Cloud storage services				Cloud storage services		
10	Abstract Windows X	http://www.sciencedirect.com/science/article/pii/S0167636912000157	B Canber, J Wang, A Gupta, N Misra	Proc 2011	Abstract Windows X				Abstract Windows X		
11	Cloud storage pA	http://www.sciencedirect.com/science/article/pii/S0167636912000158	KS Bowers, A Juels, A Ogata	Proceedings of the 2009	Cloud storage pA				Cloud storage pA		
12	A network attacks	http://www.sciencedirect.com/science/article/pii/S0167636912000159	A Brand - US Patent App. 12581589 - Google	2009	A network attacks				A network attacks		
13	Cloud storage IX	http://www.sciencedirect.com/science/article/pii/S0167636912000160	W Zhang, T Zhan, X Gu, W Song	of the 2nd	Cloud storage IX				Cloud storage IX		
14	Cloud storage IX	http://www.sciencedirect.com/science/article/pii/S0167636912000161	J Wu, L Ping, X Gu, Y Wang, J Fu	Intelligent Co	Cloud storage IX				Cloud storage IX		
15	Faculty writings edus	http://www.sciencedirect.com/science/article/pii/S0167636912000162	P Maki, T Oranoo	Faculty writings edus	Faculty writings edus				Faculty writings edus		
16	Other scenarios X	http://www.sciencedirect.com/science/article/pii/S0167636912000163	H Kobayashi, T Furukawa	ACM SIGMETRICS	Other scenarios X				Other scenarios X		
17	Cloud storage IX	http://www.sciencedirect.com/science/article/pii/S0167636912000164	C Wang, SSM Choo, Q Wang, K Ren	2012	Cloud storage IX				Cloud storage IX		
18	Abstract-With B IX	http://www.sciencedirect.com/science/article/pii/S0167636912000165	N Cao, S Yu, Z Yang, W Liu	2012	Abstract-With B IX				Abstract-With B IX		
19	Cloud storage IX	http://www.sciencedirect.com/science/article/pii/S0167636912000166	M Armitage, A Fox, R Griffin, M Sjogren	Ca	Cloud storage IX				Cloud storage IX		
20	SYSTEM DES X	http://www.sciencedirect.com/science/article/pii/S0167636912000167	W Iani, A Karyali, A Chhab	Energy Aware Co	SYSTEM DES X				SYSTEM DES X		
21	Cloud data storage X	http://www.sciencedirect.com/science/article/pii/S0167636912000168	POCATU Pauri pauri@seu.edu.cn	2013	Cloud data storage X				mentions cloud services, and use cases	collaborative working, synchronization over different devices, encrypting files, backup, archive (version)	4
22	Storage clouds IX	http://www.sciencedirect.com/science/article/pii/S0167636912000169	Edward Hulse, Walter Braken and Jonathan N	2010	Storage clouds IX				Storage clouds IX		
23	The Personal Clo	http://www.sciencedirect.com/science/article/pii/S0167636912000170	R. Gracia-Trinidad, Lihua, Roushi Vinigal, Tarunraj	2013	The Personal Clo				The Personal Clo		
24	the article presents X	http://www.sciencedirect.com/science/article/pii/S0167636912000171	L.L.V. PAUL	2012	the article presents X		X		In this paper, the author is comparing a handful of riched cloud services	Control over who can view your photos, Control over who can download your photos and control image	70, 71, 75
25	no use cases found	http://www.sciencedirect.com/science/article/pii/S0167636912000172	Ella Hershberger	2012	no use cases found				no use cases found		
26	Version tracking, Folder syncing, media streaming, password protected files, encryption, Lack in depth	http://www.sciencedirect.com/science/article/pii/S0167636912000173	Jon Finlay	2013	Version tracking, Folder syncing, media streaming, password protected files, encryption, Lack in depth		X		In this paper, the author makes a comparison against a handful of cloud	Version tracking, Folder syncing, media streaming, password protected files, encryption, Lack in depth	page count
27	no use cases found	http://www.sciencedirect.com/science/article/pii/S0167636912000174	Jon Finlay	2013	no use cases found				no use cases found		
28	no use cases found	http://www.sciencedirect.com/science/article/pii/S0167636912000175	Kai Ren, Dong Wang, and Dan Wang	2012	no use cases found				no use cases found		
29	no use cases found	http://www.sciencedirect.com/science/article/pii/S0167636912000176	Hao Di, Abdallah Gatt	2009	no use cases found				no use cases found		
30	no use cases found	http://www.sciencedirect.com/science/article/pii/S0167636912000177	Loretta Mastromiro, Maurizio Naldi	2013	no use cases found				no use cases found		
31	no use cases found	http://www.sciencedirect.com/science/article/pii/S0167636912000178	Diego Drago, Marco Mellia, Maurizio W	2012	no use cases found				no use cases found		
32	no use cases found	http://www.sciencedirect.com/science/article/pii/S0167636912000179	Tom Taylor	2014	no use cases found				no use cases found		
33	no use cases found	http://www.sciencedirect.com/science/article/pii/S0167636912000180	YK-Fann Robin Chan	2015	no use cases found				no use cases found		
34	no use cases found	http://www.sciencedirect.com/science/article/pii/S0167636912000181	Chunyu Pottery, Lawrence Gossett	2012	no use cases found				no use cases found		
35	no use cases found	http://www.sciencedirect.com/science/article/pii/S0167636912000182	Ericson Snelo	2012	no use cases found				no use cases found		
36	nothing about use cases or files	http://www.sciencedirect.com/science/article/pii/S0167636912000183	Enrico Bocchi, Mido Drago, Marco Mellia	2015	nothing about use cases or files				nothing about use cases or files		
37	about use cases and cloud services	http://www.sciencedirect.com/science/article/pii/S0167636912000184	Pujer Cheng	2015	about use cases and cloud services		X		about use cases and cloud services		
38	nothing about use cases or files	http://www.sciencedirect.com/science/article/pii/S0167636912000185	Chao, Kim-Daeng Raymond	2014	nothing about use cases or files				nothing about use cases or files		
39	talks a lot about security, then high use cases	http://www.sciencedirect.com/science/article/pii/S0167636912000186	Jaee Yoo Lee, Jung Woo Lee, Du Wan Chun, an	2009	talks a lot about security, then high use cases		X		talks a lot about security, then high use cases		
40	talks a lot about security, then high use cases	http://www.sciencedirect.com/science/article/pii/S0167636912000187	S. Rochwarger, IBM Research Division, H	2009	talks a lot about security, then high use cases		X		talks a lot about security, then high use cases		
41	no mentioning of use-cases	http://www.sciencedirect.com/science/article/pii/S0167636912000188	Does not mention anything about use-cases	2015	no mentioning of use-cases				no mentioning of use-cases		
42	Does not mention anything about use-cases	http://www.sciencedirect.com/science/article/pii/S0167636912000189	Does not mention anything about use-cases	2015	Does not mention anything about use-cases				Does not mention anything about use-cases		
43	Cloud-based serv X	http://www.sciencedirect.com/science/article/pii/S0167636912000190	Maurizio Naldi	2013	Cloud-based serv X				Cloud-based serv X		
44	no use cases found	http://www.sciencedirect.com/science/article/pii/S0167636912000191	Michael Sheahan	2013	no use cases found				no use cases found		
45	no use cases found	http://www.sciencedirect.com/science/article/pii/S0167636912000192	Quany F. Heilan	2009	no use cases found				no use cases found		
46	Cloud computing X	http://www.sciencedirect.com/science/article/pii/S0167636912000193	Wan-Mei	2009	Cloud computing X				Cloud computing X		
47	Cloud computing X	http://www.sciencedirect.com/science/article/pii/S0167636912000194	Prashant Gupta, A. Satharmaniam, John Rudon	2013	Cloud computing X				Cloud computing X		
48	Cloud computing X	http://www.sciencedirect.com/science/article/pii/S0167636912000195	Wenjin Hu, Tao Yang, Jiamin N, Matthew	2010	Cloud computing X				Cloud computing X		
49	Cloud computing X	http://www.sciencedirect.com/science/article/pii/S0167636912000196	Margaret Rouss	2009	Cloud computing X				Cloud computing X		
50	Cloud computing X	http://www.sciencedirect.com/science/article/pii/S0167636912000197	Gregor Risse	2008	Cloud computing X				Cloud computing X		
51	Cloud computing X	http://www.sciencedirect.com/science/article/pii/S0167636912000198	Saman Bluff	2016	Cloud computing X				Cloud computing X		
52	Cloud computing X	http://www.sciencedirect.com/science/article/pii/S0167636912000199	Susan Nandi	2011	Cloud computing X				Cloud computing X		
53	Cloud computing X	http://www.sciencedirect.com/science/article/pii/S0167636912000200	Das, Wilkes	2013	Cloud computing X				Cloud computing X		
54	Cloud computing X	http://www.sciencedirect.com/science/article/pii/S0167636912000201	Seagate	2015	Cloud computing X				Cloud computing X		
55	Cloud computing X	http://www.sciencedirect.com/science/article/pii/S0167636912000202	Seagate	2015	Cloud computing X				Cloud computing X		
56	Cloud computing X	http://www.sciencedirect.com/science/article/pii/S0167636912000203	Seagate	2015	Cloud computing X				Cloud computing X		
57	Cloud computing X	http://www.sciencedirect.com/science/article/pii/S0167636912000204	Seagate	2015	Cloud computing X				Cloud computing X		
58	Cloud computing X	http://www.sciencedirect.com/science/article/pii/S0167636912000205	Seagate	2015	Cloud computing X				Cloud computing X		
59	Cloud computing X	http://www.sciencedirect.com/science/article/pii/S0167636912000206	Seagate	2015	Cloud computing X				Cloud computing X		
60	Cloud computing X	http://www.sciencedirect.com/science/article/pii/S0167636912000207	Seagate	2015	Cloud computing X				Cloud computing X		
61	Cloud computing X	http://www.sciencedirect.com/science/article/pii/S0167636912000208	Seagate	2015	Cloud computing X				Cloud computing X		
62	Cloud computing X	http://www.sciencedirect.com/science/article/pii/S0167636912000209	Seagate	2015	Cloud computing X				Cloud computing X		

## A.4 Data Extraction Form Table

The following two tables are connected so the total amount of columns are actually 12, but are just displayed separately for a better viewing purpose.

Number	Link Title	Link to reference	Authors	Date	Short summary
Numbering each reference for easier handling.	Title of the paper / article, which is good for quick overview. (marked in blue, red, or green)	URL to the paper / article	Which ones' that have participated in making it.	Date of release	Usually taken from abstract or summary in the article / paper.

Peer review	Inclusion criteria	Sub reference number	Comments	Mentioned use cases	Use case found on page number
Marked with an "X" in case the paper / article is peer reviewed by others in the academic area.	Marked with an "X" if it adheres to our inclusion criteria.	A number based on the first column "number" is specified here in order to connect the current paper with its "parent".	If it's relevant or not, or useful in any other way.	Comments in regards to better identify what kind of use cases are mentioned.	Specify which page in the paper the use cases have been found for faster retrieval.



---

## References

- [1] C. Pettey and L. Goasduff, “Gartner Says That Consumers Will Store More Than a Third of Their Digital Content in the Cloud by 2016,” 2012. [Online]. Available: <http://www.gartner.com/newsroom/id/2060215>
- [2] M. Spectrum, “Data demand explained,” no. June, 2015. [Online]. Available: <http://www.gsma.com/spectrum/wp-content/uploads/2015/06/GSMA-Data-Demand-Explained-June-2015.pdf>
- [3] R. Cheng, “Forget 4G. Here’s what 5G wireless tech will look like,” 2015. [Online]. Available: <http://www.cnet.com/news/forget-4g-heres-what-5g-wireless-tech-will-look-like/>
- [4] J. Y. L. J. Y. Lee, J. W. L. J. W. Lee, D. W. C. D. W. Cheun, and S. D. K. S. D. Kim, “A Quality Model for Evaluating Software-as-a-Service in Cloud Computing,” *2009 Seventh ACIS International Conference on Software Engineering Research, Management and Applications*, pp. 261–266, 2009. [Online]. Available: <http://ieeexplore.ieee.org.miman.bib.bth.se/stamp/stamp.jsp?tp={&}arnumber=5381749>
- [5] M. Armbrust, A. Fox, R. Griffith, A. Joseph, and RH, “Above the clouds: A Berkeley view of cloud computing,” *University of California, Berkeley, Tech. Rep. UCB*, pp. 07–013, 2009. [Online]. Available: <http://scholar.google.com/scholar?q=intitle:Above+the+clouds:+A+Berkeley+view+of+cloud+computing{#}0>
- [6] J. Geelan, “Twenty one experts define cloud computing,” 2009. [Online]. Available: <http://virtualization.sys-con.com/node/612375>
- [7] PersonalCloud, “Personal Clouds Wiki.”
- [8] Seagate, “What Is a Personal Cloud?” [Online]. Available: <http://www.seagate.com/gb/en/do-more/what-is-personal-cloud-master-dm/>
- [9] A. Betts, “NAS vs the Cloud: Which Remote Storage Is Right for You?” 2015. [Online]. Available: <http://www.makeuseof.com/tag/nas-vs-the-cloud-which-remote-storage-is-right-for-you/>

- [10] Q. Requirements, “International Standard Iso / Iec,” vol. 25021, no. 121021, 2012.
- [11] W. N. Atieh Khanjani, “Saas Quality of Service Attributes.pdf,” *Journal of Applied Sciences*, vol. 14, pp. 3613–3619, 2014.
- [12] A. Samir, “Reusability Quality Attributes and Metrics of SaaS from Perspective of Business and Provider,” *International Journal of Computer Science and Information Security*, vol. 14, no. 3, pp. 295–312, 2016.
- [13] A. Ojala, “Software-as-a- Service Revenue,” *IT Professional*, vol. 15, no. June, pp. 54–59, 2013. [Online]. Available: <http://doi.ieeecomputersociety.org/10.1109/MITP.2012.73>
- [14] S. Jalali, “Systematic Literature Studies : Database Searches vs . Backward Snowballing,” 2012.
- [15] B. Rochwerger, D. Breitgand, E. Levy, A. Galis, K. Nagin, I. Llorente, R. Montero, Y. Wolfsthal, E. Elmroth, J. Caceres, M. Ben-Yehuda, W. Emmerich, and F. Galan, “The Reservoir model and architecture for open federated cloud computing,” *IBM Journal of Research and Development*, vol. 53, no. 4, pp. 4:1–4:11, 2009. [Online]. Available: [http://ieeexplore.ieee.org/search/srchabstract.jsp?tp={&}arNumber=5429058{&}queryText{&}3D{&}28{&}28ibm+journal+of+research{&}29{&}29{&}26openedRefinements{&}3D\\*{&}26sortType{&}3Ddesc{&}PublicationYear{&}26matchBoolean{&}3Dtrue{&}26pageNumber{&}3D3{&}26rowsPerPage{&}3D50{&}](http://ieeexplore.ieee.org/search/srchabstract.jsp?tp={&}arNumber=5429058{&}queryText{&}3D{&}28{&}28ibm+journal+of+research{&}29{&}29{&}26openedRefinements{&}3D*{&}26sortType{&}3Ddesc{&}PublicationYear{&}26matchBoolean{&}3Dtrue{&}26pageNumber{&}3D3{&}26rowsPerPage{&}3D50{&})
- [16] M. J. Lamias, “American Association for Public Opinion Research Web Survey Design and Administration Author ( s ): Mick P . Couper , Michael W . Traugott and Mark J . Lamias Published by : Oxford University Press on behalf of the American Association for Public Opinion,” vol. 65, no. 2, pp. 230–253, 2001.
- [17] Uberflip, “What is Responsive Web Design? [In 60 Seconds],” 2013. [Online]. Available: <https://www.youtube.com/watch?v=snQp757{&}Rr0>
- [18] Brent C, “How Much Time are Respondents Willing to Spend on Your Survey?” 2011. [Online]. Available: <https://www.surveymonkey.com/blog/2011/02/14/survey{&}completion{&}times/>
- [19] E. Hamburger, “Google Drive vs. Dropbox, SkyDrive, SugarSync, and others: a cloud sync storage face-off,” 2012. [Online]. Available: <http://www.theverge.com/2012/4/24/2954960/google-drive-dropbox-skydrive-sugarsync-cloud-storage-competition>

- [20] E. Bocchi, I. Drago, and M. Mellia, “Personal Cloud Storage Benchmarks and Comparison,” *IEEE Transactions on Cloud Computing*, vol. 7161, no. c, pp. 1–1, 2015. [Online]. Available: <http://ieeexplore.ieee.org/lpdocs/epic03/wrapper.htm?arnumber=7096995>
- [21] W. Hu, T. Yang, and J. N. Matthews, “The good, the bad and the ugly of consumer cloud storage,” *ACM SIGOPS Operating Systems Review*, vol. 44, no. 3, p. 110, 2010.
- [22] Atlassian, “What is version control.” [Online]. Available: <https://www.atlassian.com/git/tutorials/what-is-version-control>
- [23] M. Rouse, “streaming-media,” 2009.
- [24] ———, “cloud disaster recovery (cloud DR),” 2016. [Online]. Available: <http://searchcloudstorage.techtarget.com/definition/cloud-disaster-recovery-cloud-DR>
- [25] M. Ferkoun, “Top 7 most common uses of cloud computing,” 2014. [Online]. Available: <http://www.thoughtsoncloud.com/2014/02/top-7-most-common-uses-of-cloud-computing/>
- [26] J. R. Joyce, “Setting Up Your Own Personal Cloud,” 2015. [Online]. Available: <http://www.scientificcomputing.com/blogs/2015/08/setting-your-own-personal-cloud>
- [27] G. Goetz, “How to set up your own personal home cloud storage system,” 2014. [Online]. Available: <https://gigaom.com/2014/03/01/how-to-set-up-your-own-personal-home-cloud-storage-system/>
- [28] B. Posey, “Cloud storage architecture vs. local storage.” [Online]. Available: <http://searchcloudstorage.techtarget.com/feature/Cloud-storage-architecture-vs-local-storage>