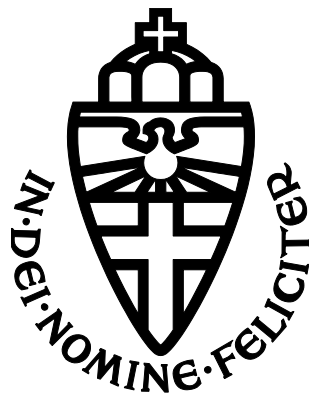Radboud University Nijmegen

Cooperation in the clouds

Cooperation with a creating focus.

Menno van Wieringen
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Abstract

Cooperation in the cloud, this thesis is about cloud, cooperation and the way to use a cloud environment by supporting a creating cooperative process. The story starts with the explanation of the concepts of cooperation and cloud, explaining what these concepts are and what researchers are researching within these areas. With these concepts defined it is time to bring them together and look at cooperation in the clouds and its possibilities, describing the possibilities on an abstract level. In the last chapters it's time to focus on the research question and see how we can support creating cooperation with cloud services.

The study is done mostly by literary review of papers on different kind of subjects and by a review of platforms there are on the market. A review of two well known cooperation platforms is done and advantages and improvement points are taken. With these platforms in mind a conceptual platform is described combining these two platforms to a cooperation platform which supports the cooperation.

As a conclusion it could be said that there is room for improvement within the existing cooperation platforms, especially those that are available through the Internet(clouds).

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1. Introduction

Companies are having different locations and partners around the world, so working with remote locations can sometimes be inefficient. With the globalisation of the world market, communication between remote locations is mostly not optimal and can be seen as inefficient. (Bradner & Mark, 2002)This is why new ideas and concepts are needed to provide and support cooperation. Within this Thesis a vision is given on cooperation and the use of clouds and cloud computing. This all around creating through cooperation.

1.1. Document structure

To give an overview how the document is build up this structure is made.

Cooperation			Cloud		
Reason why	Defining area	Examples	Risk and Security	Defining Area	Examples
Articles	Forms	Research	Articles	Forms	Research
	Creating	Sharing		platforms	
			Google Docs /Chrome	Wikipedia	
		Concept			
		Idea			
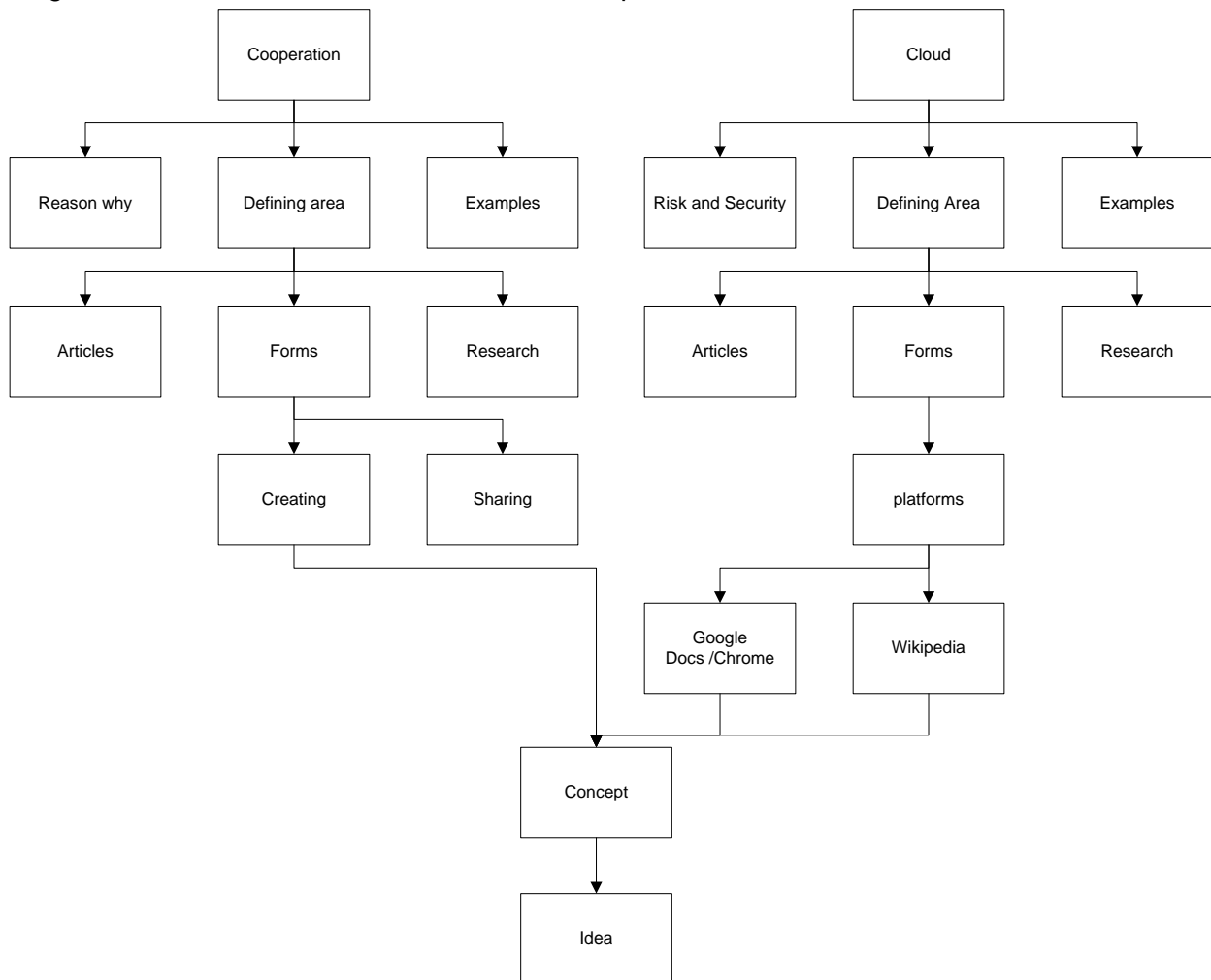
2. Problem statement

With the market changing and new solutions arising cooperation in a digital environment can be improved with the support of modern tools and cloud services. However, the problem with the solutions offered today is that they can be expensive and or do not reach all the requirements that are needed. Making all the different vendor solutions to help digital cooperation in to a jungle with many different products all having their benefits and problems.

Implementing many different vendor solutions can help to reach all requirements, but also creates a chaos and wild growth of applications. With the problem of creating an application landscape of which nobody really knows what is already provided.

New solutions and concepts are available, but since they are still in a beginning state the market is looking for answers and solutions that can make the difference.

That is why within this paper we look at cooperation, cloud and a way to use the cloud to cooperate.

2.1. Research question:

- How can cooperation to create be supported by the use of cloud computing?
  - What is cooperation?
    - Which forms of cooperation are there?
  - What is cloud, cloud computing?
    - What can cloud and cloud computing do for us?
    - Which are the developments within this area?
  - What is already available if we look to cloud and cooperation?
    - Which are important factors of this?
    - Is there room for improvement?

3. State of the art

Within this Thesis various papers and articles are used to give a quick overview of the content of these articles. A short description is given of the most important papers and articles.

In the book of L. Friedman the world is flat (Friedman, 2005). He describes the three eras of globalisation and talks about its influence on western societies. This in the combination with Erin Bradner and Gloria Mark's paper (Bradner & Mark, 2002) about cooperation versus distance gives a interesting view on Cooperation on a global market and a historical overview of scale changes.

To define cooperation J. E. Doran, S. Franklin, N. R. Jennings & T. J. Norman, (Doran, Franklin, Jennings, & Norman)came up with an interesting distinction between the various types of cooperation, giving good insights about common cooperation forms like communicative and non-communicative. Birger Sevoldson (Sevoldson)gives some more information about digital cooperation in his paper adding to define cooperation and digital cooperation.
In the paper of Sarah Gillinson, (Gillinson, 2004) she discusses various ways of cooperation and why we tend to cooperate, talking about different research conducted in the field of cooperation. Balliet describes the importance of communication during cooperating, giving a overview why we need clear communication lines. (Balliet, 2010) With these papers in place and as basis of the chapter about cooperation it is time to look to research of cloud computing.

In the search of what a cloud is Luis M. Vaquero, Luis Rodero-Merino, Juan Caceres, Maik Lindner (Vaquero, Rodero-Merino, Caceres, & Lindner, 2009) searched in their paper for a definition of what a cloud is and how we could describe this. This is interesting as a starting point the definition of a cloud. Also Brain Hayes (Hayes, 2008) wrote an article about cloud and cloud computing and adding more information to define a cloud.
With cloud and cloud computing there are many risks that should be taken in mind. In the paper of Gartner (Gartner, 2008), Gatner discussed the critical assessment areas when doing a security assessment of a cloud computing services provider. Also Thomas Ristenpart, Eran Tromer Hovav Shacham and Stefan Savage (Ristenpart, Tromer, Shacham, & Savage, 2009) show in their paper the risks of using cloud computing. Bensaou links cooperation and information technology given insights about the impact of IT in the field of cloud computing linking the two together.(Bensaou, 1993) Knode describes in his paper the aspects of trust in a digital environment showing the importance of trust when working in the "clouds" (Knode, 2009).

Al these papers form the basis of the first two chapters of this thesis, with additional papers to add fill-in gaps.

4. Cooperation

Long before the computer spread around the world and cities were formed, humans have cooperated in small groups to survive their daily lives. The humans evolved but they kept cooperating, achieving more than if they would work on their own. In the modern days cooperation is still important and we still benefit from the cooperation done by others or the cooperation we do ourselves. The basic concept of cooperation hasn't changed in time. In this chapter we will look at cooperation by giving a brief overview of what cooperation is and describe some important concepts.

4.1. What is Cooperation

We humans cooperate since we can remember starting with gathering foods and hunting to the more modern cooperation forms where we work together to realize various types of projects. When we work together we can say we cooperate, but cooperation can be defined more precise.

4.1.1. Defining cooperation

When asking what cooperation is, the answer could be as simple as saying cooperation is a group of people working together, but still within this definition we could define cooperation more specific.

When looking online for a definition of cooperation it seems that in many definitions the word benefit arises, for example: "The association of persons or businesses for common, usually economic, benefit. "(Farlex (2))

"Activity shared for mutual benefit."(Dictionary.com (1))

"The association of a number of persons for their benefit."(BookRags Media Network)

When looking at different online definitions we could conclude that when we cooperate we do this because we benefit from the end result. This is because we achieve more in working together and sharing skills and knowledge.

It is also interesting to look what research is telling us about cooperation. Sarah Gillinson came up with the following definition: "Cooperation is defined as a group of individuals acting together to a common end." (Gillinson, 2004) She also puts two notes with this definition. The first one stating that not every cooperation is a good thing. For example criminals could cooperate to get more loot at a time, but this has a more negative effect from the person who gets robbed. Also she distincts the cooperation that is coerced or voluntary.

When comparing the forced and voluntarily cooperation, we can conclude that when we cooperate voluntarily we do this for goodwill, making us more emotionally involved and more willing to participate. Also cooperation out of voluntarily could be money driven, meaning that we will be rewarded for our cooperation. When we are coerced to cooperate we are less committed to the cause then if we would cooperate out of goodwill.

J. E. Doran, S. Franklin , N. R. Jennings and T. J. Norman describe in their paper (Doran, Franklin, Jennings, & Norman) a definition of cooperation, they came up with two forms of cooperation: communicative and non-communicative. Communicative means that communication is involved. With non-communicative there is cooperation, but without any form of interaction between the co-operators, they react on each other's behaviour.

With communicative cooperation the cooperation can be with another location of a company or just with another company. With both options you need to negotiate what form of cooperation will be best suited for the situation. Important before cooperating is the gain of mutual trust between the co-operators. When cooperating with another location of one and the same company you can speak of deliberative communicative cooperation. When there is more competition involved, like another company with its own vision and strategy, you can speak of negotiating communicative cooperation.

With non communicative the co-operators can have different goals to achieve, but they are both in the same area of working and react on each other. A good example of non-communicative cooperation is: when driving on a speedway sometimes one of the cars makes way for another car driving on that speedway. this can be on-purpose, because the other car is driving fast and is in a hurry, or the car making way just needs to head to the exit and switches lanes and by doing this makes way for other cars to pass although this isn't his first intention.
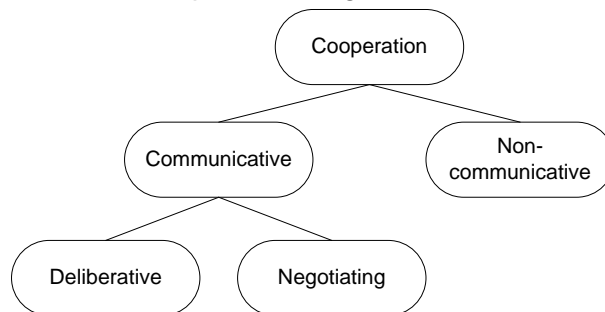
Figure 1

On the question 'what is cooperation?' we could say that cooperation is something we benefit from when we are involved, but others who are not involved may suffer from it, so cooperation is not always a good thing for everybody.

When cooperating we can be coerced to do so or do this voluntarily, but when we do it voluntarily we are more committed to cooperate and more involved than we are coerced to do so. Also we can distinct communicative and non-communicative cooperation as two important factors. Within this paper this given context will be used when cooperation is used.

When group members cooperate with each other they can achieve some goals they couldn't achieve on their own by sharing knowledge, resources and time for a common goal, resulting in the possibility of realisation of bigger projects in less time.

The research:

One well known dilemma when looking at cooperation is the Prisoner's dilemma. (Gillinson, 2004)Two persons are arrested for a crime, the police cannot prove anything and needs to have a confession to prosecute.

They want at least one person being prosecuted, so they offer both persons the following: if you tell on your partner in crime we let you run free, but if you both tell you both get lower sentences. The only thing is that when both persons refuse to talk you both walk out free. The dilemma here is that you don't know what the other persons will do. So when he talks and you don't you get the full sentence. For both it is the best to cooperate and don't tell anything. The prisoners dilemma is something that in many researches about cooperation is used and explained.

4.2. Why do we cooperate

When asking what is cooperation it is also important to know what you can achieve with cooperation. When working alone the person working isn't tied to somebody else's schedule, but he can work whenever and wherever he wants. When that same person is however working together, he needs to be on the same level of understanding with his partner. He and his cooperating partner both need to know where they are going and what they want to achieve. This costs extra time and sometimes it is faster and easier to do things without a partner, like writing a paper.

Imagine there is a big fire. A person on his own has to transport the buckets of water between the fire and the well. In this case the fire will probably grow, but when he cooperates, a chain of people can be made to transport the buckets full of water, saving time on transportation and having a higher chance to extinct the fire on time.

This can also be said about projects, by combining forces you are able to achieve more. Especially if you combine various specialist together, all having their own field of expertise. With cooperation you can benefit from each other's knowledge and/ or save time by executing a task quicker than working alone.

Sarah Gillinson discusses in her paper why we cooperate (Gillinson, 2004). The conclusion here is that all those who cooperate benefit from each other. Even if a person is more advanced in a certain task he can benefit from others, although chances are there that the persons that are less advanced are benefiting more. However, the more advanced cannot always work on their own, because of scale and/ or difficulty. This means that everybody benefits from cooperating, which is one of the main reasons why we cooperate. A good example is a politician who has the power to solve problems, but needs to talk local people to find-out what their difficulties so that he can represent these people in the. By solving the problems of the local people the politician may gain votes ensuring his position in parliament. Also there are free-riders, the local people who benefit, but don't vote for that politician.So the local people benefit, because their problems are solved and the politician benefits, because he may gain more votes. Simply said the powerful politician helps the weaker local people to solve their problems. Both are benefiting in their own way.

The example of the politician is an example of loose cooperation. There are also forms of cooperation in which the cooperating part is more strict and both parties work together to gain a common goal.

4.2.1. Achieving more

When cooperating we can achieve more. All around us cooperations are conducted. People, businesses and even animals cooperate to gain a common benefit. The way in which we cooperate is different per situation, but looking at two forms of cooperation you can see common aspects returning.

When looking to cooperation ants can give us a good example of how nature cooperates. An ant colony consists of different types of ants. At the heart of an ant colony there is the queen, she produces youngsters and is responsible for the continuity of the nest. Ants grow up in two different groups; the smaller ants are workers and the larger ants within a colony become soldiers. The workers do all the work in the nest while the soldiers defend the nest when necessary. The ants are all part of the group, making the survival of the group a group effort. (Weston, 2001)

Another example of cooperation is a joint venture.

A joint venture is a way of cooperating with another party, where within this cooperation two or more persons or organizations join their forces to gain a benefit, but still keep their independence. In a joint venture all parties contribute something to joint venture, to create new and unique opportunities that weren't possible before. (The New York Times Company)

Ants have a special way of finding the shortest path to a resource, they lay a trail of pheromone. This pheromone can be detected by other ants, these ants are then attracted to this trail and will follow it. The idea behind this is that the ant that has the shortest path will arrive the soonest and by walking the path again the pheromone on this trial becomes denser, attracting more ants. When however an ant with a longer path arrives at the nest before the ant with the shorter route, you would expect that the longer trail attracts more ants because of the more dense pheromones on that trail. This problem is solved by the expiration of the trail. The pheromone trail gets less strong over time, so the shortest path will have a stronger pheromone trail then the longer one. This means that the shorter path will eventually attract all ants and creating the shortest path. This form of knowledge sharing is a unique way of how nature cooperates.

Not only ant's share knowledge. Also within a joint venture this is done. (Weston, 2001)

Within a joint venture the knowledge of two parties is combined to create unique new opportunities. The knowledge of two companies combined could make it possible to be more competitive towards the market, giving both cooperating companies a benefit that they wouldn't have realized when working on their own. (The New York Times Company)

The cornfield ant is one of the species that shows use a cooperation form in nature. The cornfield ant is very fond of honeydew; this honeydew is created by aphids or better known as plant lice. The aphid creates the honeydew and because the cornfield ant is really fond of this honeydew they protect the aphids. The aphid gains the benefit of being protected by the ants from their predators and the ants gain their beloved honeydew. The relationship goes even farther than just protecting, the ants also transport the aphids from location to location to ensure production. Also the ants protect the eggs of the aphids by harvesting the aphid's eggs in fall and securing them in their nest to protect the egg against the winter. When the winter is over and the youngsters are born the ants carry them to certain plants so that the aphids can create their honeydew.

A note should be made by this form of cooperation; it seems that the ants are the dominant party within the cooperation. This is shown by the way ants act when one of the aphids decides to take another spot to feed themselves. The ants will transport the aphids back to its original

position. Within this cooperation the aphids gain the protection of the ants and the ants gain their beloved honeydew. (Weston, 2001)

To look at a more human perspective on this we return to the joint venture.
With a joint venture two companies create a new company and use their own resources to start up the joint venture. Because both companies contribute knowledge and other resources, this newly created company has a unique structure. This form of working together makes it possible for companies to keep ownership of their own organization and still work closely together on a product via the joint venture. (The New York Times Company)

4.3. How do we cooperate

When looking how we cooperate, we could say that we cooperate in different forms, some are voluntary and others are coerced. The forms in which we cooperate may depend on what we are doing. Whenever we cooperate we have a common goal to achieve. This goal can be a shared problem that we want to resolve or can be of a more financial character with the goal to gain money.

4.3.1. Projects

What is a project when looking online for a definition? There are many different ways to describe what a project is:

"A large or major undertaking, especially one involving considerable money, personnel, and equipment."(Dictionary.com (3))

"Projects are different from 'business as usual' activities, because they have a number of distinguishing features: they bring about change projects may offer investment opportunities
They have unknown elements, therefore: they create risk" (Oxford Brookes University)

One of the things that defines a project from business as usual activities is that it brings change to an existing situation. Projects also contain unknown and uncertain elements to the existing situation, because it is not always sure what impact a change may have. This is why some projects fail, because people are sometimes not willing to change their habits. Also projects contain people that need to cooperate to realise the change desired.

"Successful IT/IS projects deliver improved financial benefits (either directly or indirectly), and/or reduced wastage from aborted projects" (Cooke-davies, 2002)

A project is one of the more business oriented ways of cooperating. Within a project a task needs to be executed. This task is mostly new within the context of execution and it is mostly a bit vague as to what it will result in. Cooperation within a project is one of the most important factors of success. The people who execute the project need to work together to finish the project and get directions from a manager who gives guidance and supervises the progress made within the project. Within larger projects this can lead to a hierarchical structure where a small group of people work together on a small part of the project. The manager of this small group has another manager above him to supervise multiple smaller parts, combined they give the end result of the project. Within a project it can be that one project team is working in Europe and another on the other side of the world. They both work on the same project and may even need to share some data to finish their specific tasks.

4.3.2. Cooperating a group effort

When cooperating you always work with one or more persons together, making a group. Sometimes the groups are small and sometimes the groups get bigger. The structure on the group may have impact on how the cooperation is done. Factors that are important here are the group itself and the way and means to cooperate.

When looking at group size and cooperation, an increase of group size has a negative effect on cooperation. (Sevoldson) This is especially true in non-communicative cooperation forms. For example: on a road that is not crowded we give each other (more) space, knowing that we don't be delayed by doing so. When however the number of cars on a road increases, we are less willing to cooperate. Also in the literary review of Daniel Balliet (Balliet, 2010) the lower perceived sense of individual and collective self-efficiency is called as a negative effect on group size and non-communicative cooperation.

Communication has a positive effect on cooperation. (Balliet, 2010) It outweighs the negative effect of the large group size, making a group more cooperative. Especially if others say they are cooperating it gives us a feeling that our contribution is critical for the rest of the group. The forms in which we cooperate also have effect on cooperation. Face to face communication is more effective than written messages, because written message are less fluent and dynamic then face to face communication. Also subtle clues, like touching, or hand gestures are not available in written communication.

4.3.3. Cooperation over large distance

In the digital world talking to somebody on a distant location can be as easy as calling up a friend who is close by. The world is changing; Internet and telephony are getting important for our social lives. Keeping in touch with friends, family, colleagues and customers all around the world is getting easier. In the digital word there is no distance.

The world is getting smaller and smaller with each era passing by like described by Thomas L. Friedman in his book 'the world is flat' (Friedman, 2005). So far there have been three eras of globalisation; the first era lasted from 1492 to 1800. In this first era America was discovered and trade between the new world and the old world began. This made the world shrink from large to medium. The second era of globalisation was from 1800 till 2000, in this era multinational companies shrunk the world from medium to small. Within the present era started in 2000 the world shrunk from small to tiny, but instead of the multinationals being the drive behind this, it was the individual who made it happen. With on the horizon the non-Western, non-white countries such as China and India, as the power behind it.

With companies getting more global, the cooperation with distant locations are getting more important. This cooperation can be between two distant locations of one company or between different companies that wish to work together. In both cases there are different forms of cooperation that can be undertaken.

Erin Bradner and Gloria Mark (Bradner & Mark, 2002), wrote in their paper about the effect of distance when cooperating. They found that distance matters when cooperating. If we cooperate with somebody in the same city we are more likely to show cooperative intentions then when somebody is more than 3000 miles away. This effect has a social aspect; we tend to be more cooperative when the chance of meeting the person in real life is bigger. This is because of the fact that the distance between them is smaller, the person is in the same city.

The will to cooperate over distance gets bigger when we can see and hear the person, but still distance matters.

Also when we cooperate we tend to sit closer to each other than normal and when we compete we get further apart from each other.

So when looking to distance we can conclude that working with people that are geographically close by we are more willing to cooperate then when the person is far away from the location we are at.

Culture has a great influence on how we think and act. (Hofstede, Hofstede, & Minkov, 2010) The country where a person is born and the culture that person has adapted may form the values and the ways of how a person communicates. A good example of this is miscommunication between western and eastern companies. The western companies are used to ask a question about the possibility to produce something., but in some eastern cultures it is considered rude to say no to a question. This may give a western cultured company the idea that it is possible, leading to miscommunication and failing cooperation.

This is why it is important to know how another country culture differs in cultural aspects. Hofstede (Hofstede, Hofstede, & Minkov, 2010) looked at these differences and gave insight in this. This information can be used to help us understand why people make certain decisions based on their cultural behaviour.

The hofsteden (Hofstede, Hofstede, & Minkov, 2010) *model distinct 5 areas of culture:*

Power Distance Index (PDI) how inequality the power is defined so a higher score means that people are used to having large distance between management and employees.

Individualism (IDV) how individual a culture is this can mean that people are suspected to look after them self or are more group oriented and do things for the group.

Masculinity (MAS) is the comparing of status between men and women. A high masculinity means that males have a high status in that culture. This means that there are greater distances between males and females compared to a low score.

Uncertainty Avoidance Index (UAI) how many risks a countries culture takes so a very uncertainty avoidance culture would first plan everything before they act and with a country with a low value on uncertainty avoidance would take more risks.

Long-Term Orientation (LTO) A culture with high long-term orientation looks more in the perspective what a choice will mean for the future planning many years ahead.

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4.4. Communication

When we cooperate communication is an important factor, it creates more willingness to cooperate between people. With communicative cooperation we are more likely to be willing to cooperate and more aware that we are cooperating. Especially when working on projects we need communicative cooperation to end a project in success. Communicating with others is not always easy, different backgrounds may lead to miscommunication. Leading in delays or failure when working in project form.

4.4.1. Communicating when cooperating

When looking to the example of a project, especially when a project is of moderate or large scale, we need to have structure to communicate with each other. When everybody is just shouting, nobody will be able to find the information that is valuable for them. This is why we use project methods to structure the communication. These methods like prince2 tell us how we can maintain an orderly way of communicative cooperation, in which everybody gets their information needed. This means that the management is kept up to date with the progress and the project teams get the information of the context and what is expected from them. (Balliet, 2010)

Group forms of cooperation always have some sort of communicative cooperation. People need to know what is being done and who is doing what. This leads to different forms of communication.

In many researches communication is described as one of the most important way to improve cooperation. (Bradner & Mark, 2002) (Gillinson, 2004) (Balliet, 2010) Communication makes us more bound to a group effort and gives us more trust in the others we cooperate with. Although non-communicative cooperation is also effective in some situations., communicative cooperation helps us to understand each other in more complex situations like projects.

4.4.2. Cooperation in a digital environment

With the arising of the computer, the possibilities to communicate with each other have expanded. With the Internet to our disposal it is possible to send messages all over the world without waiting for days before a message is delivered. The digital age we are living in is connecting everybody around the world with each other, making the world smaller and smaller.

But what do all these digital tools contribute? We could say that digital tools help us communicate over larger distances more effectively, but also on smaller distances it could spare time. Digital communication is in some cases faster than non digital means. This depends on the situation, because when we are in the same room it could just be easier to talk to each other than to send a digital message. When however we are apart or separated it could spare us some time. Digital communication can have various forms. You could just send text, but also voice- and video messages are possible.

When cooperating on a complex project together communication is important to create a shared vision and work together to achieve the same goal. When looking into communication there are many different forms of communication. The first distinction is between digital communication and non-digital communication. Digital communication mostly works via text based tools, like e-mail or instant Messaging (IM). Also Voice over IP solutions, like conferencing, is one of the ways people communicate with each other. When using tools like e-mail, instant messaging or conferencing you have various options to communicate. You could just connect to another person and communicate only with this person, but sometimes the need to connect to multiple persons in a time is required. Within this paper there is a distinction between three of those forms of digital communication:

- one to one
- one to many
- many to many

Within this communication forms the distinction lies within one communication session. So within one e-mail conversation or IM session.

During setting-up a one to one session, most communication tools can be used. When there is a connection between two persons this makes it easy to keep track of the conversation for those involved. It gets more complicated if one person tries to communicate to many persons at the same time. You could send an e-mail to all these persons, but if somebody edits content or replies the message he sends again, he will either create a a one to many situation, or a one to one situation when the message only is relevant for the initial sender. One problem with one to many communication is that when using a tool like e-mail versions of documents could be conflicting and it will become unclear what the latest version of a document is that was attached to the message. One to many is often a good tool to inform people when none or a few replies are expected.

Using many to many communication means that there will be a session with various people that can all communicate at the same time with the people involved in that session. A good example of many to many is instant messaging, where you can hold a group conversation including all person needed at the same time. This is a good option for a meeting, but when documents are involved it could be handy to use a collaboration platform that offers document sharing and allows to view and edit the document for all users at the same time.

4.5. Creating via cooperation

Cooperation can be done in different forms. You can cooperate by sharing data or you can cooperate by creating a new product, data or resources. When creating within a cooperation this is mostly done by a project form. A group of people comes together to work on a common goal. This goal is part of a vision, for example, someone had to reduce costs by creating a new system to automate a part of a business process.

When creating anything within a cooperation the co-operators need to be able to have the same goal in mind and share their ideas how to realize this goal.

5. Cloud

We all know clouds, when we look we can find one in the sky. We see them as a hole, but we don't see the inside of a cloud. We can predict on the type of colour of the cloud if it is going to rain or not, but this doesn't always gives us an answer. The same counts for digital clouds. We know they are there, but what they are and what they contribute is sometimes hard to tell.

5.1. What is a cloud

When using the Internet we log-in to all types of digital clouds, the information we send or request may pass several clouds before we receive it.

5.1.1. Definition

What is a cloud if we look at a cloud in its digital form? This is not easy to define, because many persons tried, but didn't succeed in their definition.

"A communications network. The word "cloud" by itself may refer to any local area network (LAN) or wide area network (WAN)." (the Computer Language Company)

Looking on the Internet for a definition it is about cloud computing, that is seems like a service provided in the form of a cloud. The definition: it's a network that is used for communication effort, like sharing data between different computers, defining a LAN or a WAN as a cloud seems to refer to not being able to see the underlying layers.

The problem of finding a good definition of cloud is that many experts tent to talk about cloud computing and not about the cloud itself. When however you draw a cloud in a network image, most of the IT people will know what you are talking about. It could be that you talk about cloud computing, but mostly you will just talk about a network of which the underlying hardware is to complex or not interesting for the context of the image. This is why a distinction has to be made about a cloud and cloud computing.

Since it is hard to tell what a cloud is, we will use the NIST definition (NIST, 2011) given to distinct different types of clouds. With defining different types of clouds the difference between a cloud and cloud computing gets clearer, since cloud computing is a type of cloud. Still NIST gives a definition that relates much to cloud computing, but this is a problem with unclear defined terms, everybody has an opinion about what it really is or should be.

5.1.1.1. Private cloud
"Private cloud. The cloud infrastructure is provisioned for exclusive use by a single organization comprising multiple consumers (e.g., business units). It may be owned, managed, and operated by the organization, a third party, or a combination, or it may exist on or off premises." (NIST, 2011)

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A private cloud is meant for a limited group of users, within an organisation these clouds are connected to public clouds to gain access to the Internet, private clouds are regularly self owned. We could say that home networks are private clouds as well.

5.1.1.2. Community cloud

"Community cloud. The cloud infrastructure is provisioned for exclusive use by a specific community of consumers from organizations that have shared concerns (e.g., mission, security requirements, policy, and compliance considerations). It may be owned, managed, and operated by one or more of the organizations in the community, a third party or some combination of them, and it may exist on or off premises." (NIST, 2011)

An example of community clouds is cloud computing services providers, they provide hardware and software so can rent their service.

5.1.1.3. Public cloud

"Public cloud. The cloud infrastructure is provisioned for open use by the general public. It may be owned, managed, and operated by a business, academic, or government organization, or some combination of them. It exists on the premises of the cloud provider." (NIST, 2011)

With public clouds we can think of the Internet, this cloud is publicly accessible and makes it possible to connect to other clouds.

Cloud/internet
One of the well known public clouds is the Internet. This is the biggest public cloud in the world and is used by billions of users all around the world. The Internet itself consists mainly of routers that direct the users to servers and other computers around the world. This is done by using an unique number called the IP address. Every computer or sometimes group of computers has an IP address, otherwise there is no access possible. The Internet itself was first called ARPAnet and was designed as a way to share information between universities, but it evolved in the what we now know as the Internet.

"The Internet, sometimes called simply "the Net," is a worldwide system of computer networks - a network of networks in which users at any one computer can, if they have permission, get information from any other computer (and sometimes talk directly to users at other computers)."(Tech Target (4), 2000)

5.1.1.4. Hybrid cloud

"Hybrid cloud. The cloud infrastructure is a composition of two or more distinct cloud infrastructures (private, community, or public) that remain unique entities, but are bound together by standardized or proprietary technology that enables data and application portability (e.g., cloud bursting for load balancing between clouds)." (NIST, 2011)

When talking of a hybrid cloud we could say that a part is in a community cloud, for example a cloud computing services provider cloud, and another part in a private cloud, for working with privacy sensitive information, because of laws and regulations.

5.1.2. Clouds recap

To make a clear distinction between cloud and cloud computing within this document, the term cloud would be used to describe a network and the definition provided by NIST will be used to distinct the different types of clouds.

5.2. Cloud computing

One type of cloud is cloud computing, Cloud computing is becoming more and more popular with companies that outsource a part or even all their information systems to a cloud computing environment. With the market growing and the demand for better and more complex services, the need for cloud computing services providers to innovate in scalability and security rises.

5.2.1. Definition

What cloud computing is, is sometimes unclear. Because cloud computing is a recent development, there is not one unambiguous definition that says this is what cloud computing is.

"Cloud computing is a general term for anything that involves delivering hosted services over the Internet. These services are broadly divided into three categories: Infrastructure-as-a-Service (IaaS), Platform-as-a-Service (PaaS) and Software-as-a-Service (SaaS). The name cloud computing was inspired by the cloud symbol that's often used to represent the Internet in flowcharts and diagrams." (Tech Target (1), 2007)

"Cloud computing refers to applications and services offered over the Internet. These services are offered from data centres all over the world, which collectively are referred to as the "cloud." This metaphor represents the intangible, yet universal nature of the Internet." (techterms.com, 2009)

"Cloud computing is a distributed architecture that centralizes server resources on a scalable platform in order to provide "on demand" computing resources." (definitioncloudcomputing.com)

When looking online to find a clear definition of cloud computing words as 'scalable' and 'on demand', but also a clear reference to the use of a cloud as the symbol of Internet is made.
Cloud computing could also be a service to outsource a part of you information systems., with different options available, like IaaS PaaS and SaaS.

Still it is interesting to look what researchers define as cloud computing.
"Clouds are a large pool of easily usable and accessible virtualized resources (such as hardware, development platforms and/or services). These resources can be dynamically reconfigured to adjust to a variable load (scale), allowing also for an optimum resource utilization. This pool of resources is typically exploited by a pay-per-use model in which guarantees are offered by the Infrastructure Provider by means of customized SLAs. " (Vaquero, Rodero-Merino, Caceres, & Lindner, 2009)

"Cloud computing is a model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction." (NIST, 2011)
When looking to the definition of Luis M. Vaquero , Luis Rodero-Merino , Juan Caceres , Maik Lindner (Vaquero, Rodero-Merino, Caceres, & Lindner, 2009) and NIST (NIST, 2011) we can

see that both talk about scalability in some form. Also if we look at all the definitions we see that cloud computing is seen as a combined group of computing resources to execute certain task, is accessible via Internet and can be scaled so that the demand is met.

Within cloud computing there are 3 different types of computing, namely IaaS, PaaS and SaaS, all providing a specific service that can be used to replace existing hardware and software or to create new platforms on.

5.2.2. IaaS

Infrastructure as a Service is a way of using a third party cloud to outsource the hardware part of a server park. This is mainly done to reduce costs of maintenance and renewal of the server park.
The control of the operation system and applications is still in control of the one outsourcing. IaaS could be seen as a next step. When a company already uses virtualization, using IaaS would be nothing more then moving the virtual servers in a IaaS environment

"Infrastructure as a Service is a provision model in which an organization outsources the equipment used to support operations, including storage, hardware, servers and networking components. The service provider owns the equipment and is responsible for housing, running and maintaining it. The client typically pays on a per-use basis." (Tech Target (3), 2009)

5.2.3. PaaS

With Platform as a Service not only hardware is rented, but also a part of the software. This is ideal when a new application is launched, especially when uncertainty exists of the capacity that will be needed when running the new application. For example, when launching the next new Internet hype it could be that scalability is needed to upscale fast and because PaaS gives the possibility to upscale the capacity of the capacity rented, it allows the new hype to keep up with the demand. PaaS is handy when launching a new application, because no investment in new servers is needed and expectations of demand can be scaled quickly.

"Platform as a Service (PaaS) is a way to rent hardware, operating systems, storage and network capacity over the Internet. The service delivery model allows the customer to rent virtualized servers and associated services for running existing applications or developing and testing new ones." (Tech Target (5), 2008)

5.2.4. SaaS

When using Software as a Service model you use everything from the service provider, the provider provides the software and hardware that is needed to run a platform. This is handy when wanting to use commodity software and you only want to configure the software in a way that is needed. The rest is being done by the service provider.

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"Software as a Service (SaaS) is a software distribution model in which applications are hosted by a vendor or service provider and made available to customers over a network, typically the Internet." (Tech Target (6), 2006)

5.2.5. IaaS PaaS SaaS versus traditional IT

Looking to IaaS, PaaS, SaaS and how traditional IT is used we see that the various aaS are interesting when we are looking to save costs and or we want scalability over the platforms we use.
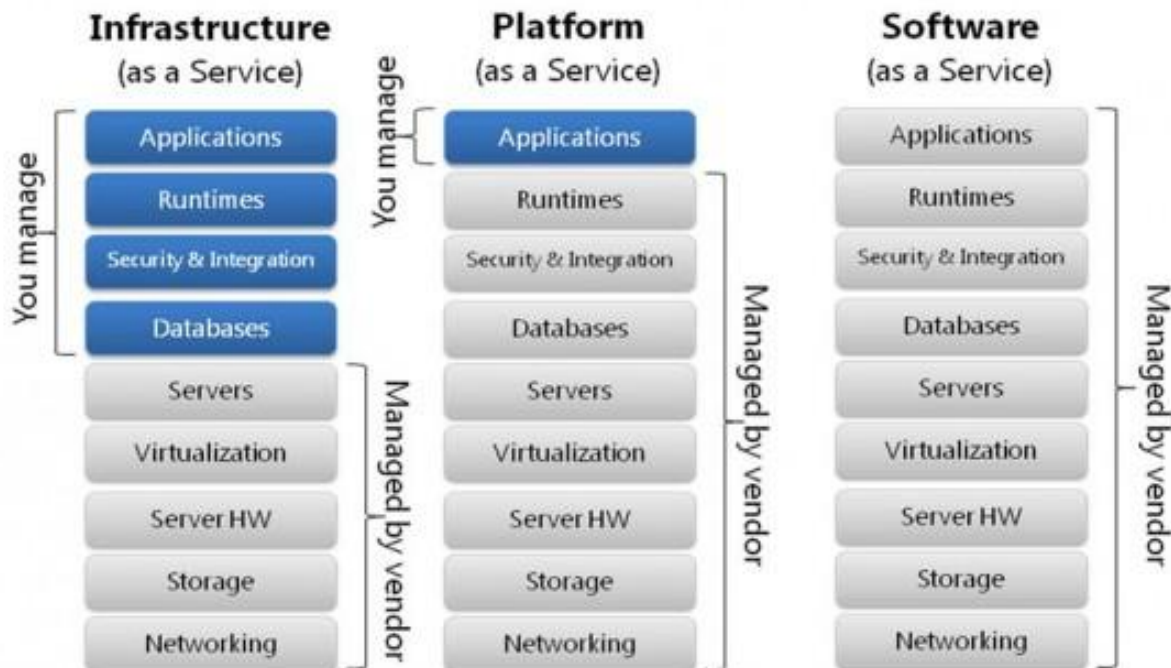
Figure 2 (CRC, 2010)

As shown in the figure above we can see the differences between IaaS PaaS SaaS and traditional IT (CRC, 2010). Although we could have an argument about the correctness of the figure, for example whether applications are indeed in the top of data or data is the top-layer. This specific argument may arise, because we may use an application, but keep the data for ourselves and only use the application to compute.

The figure gives a good illustration of the differences between traditional IT and the various aaS. We can compare how IaaS, PaaS, SaaS and traditional IT are used with the following example: when we want to renovate a house we can do all the work ourselves, meaning that we lay the floors, paint the wall, do the plumbing, the electricity and all the other stuff we can think of. This is like traditional IT, you do everything yourself, meaning that you probably have to learn some new skills as well and invest time and money in self development. When however we are too busy or too clumsy to do everything ourselves we can hire somebody to do the plumbing and the electricity for us, leaving some less difficult and expertise tasks for ourselves. This can be compared with IaaS, where we only do the software side and the hardware is managed by somebody else.

If we are really busy or really clumsy, we can hire somebody who does the electricity, the plumbing and lay the floor for us, leaving only the painting to do ourselves and maybe some finishing touches we would like to do. This can be compared with PaaS, with PaaS we only manage our application and the data involved, the rest we leave to experts to do for us.

If, at last, we are really clumsy, lazy or have no time to renovate our house we can hire somebody to do all the work for us. This has of course a price, but the only thing we have to do is tell him what we want and he will paint our walls, fix the electricity and the plumbing and lay the floors. The only thing we have to take care of ourselves is maybe some small finishing touches, like choosing new furniture.

When looking to the market we mostly see a Traditional IT and SaaS solution, we want to deliver a letter so we post it on the mail using a service to deliver it for us. The person posting the letter is a sort of SaaS service and the company delivering the letter is more of the traditional structure, he has everything in place to make the delivery.

This we can also see with cloud computing, in which we outsource a part or everything to a service provider, we use the service, but the traditional IT management is still done. Only not everything is done by the one outsourcing, but the service provider takes care of it.

5.2.6. Cooperation and cloud computing

Cloud computing offers many ways to cooperate, most of them are already known and exist in many companies, but still it is interesting what cloud computing can offer when cooperating. One of the benefits is that by using a cloud computing environment no investment in hardware or software needs to be made, you just rent what's needed. Also the basis is provided, so setting up everything from scratch is not needed, which can save money and time.   So using a cloud computing environment could be interesting when cooperating and no existing structure is present.   It could also save money for companies already owning an own application environment, because when they move their applications in a cloud computing environment they can save costs on maintenance and renewal of hardware en software licences. (Hayes, 2008)

It depends on the provider of the cloud computing service which software and tools are available to use., but still, when looking into an environment that offers a collaboration platform, a cloud computing environment could offer a good solution for those who want to work together, but don't want to invest in hardware and software, to do so. Cloud computing is one of the best cooperating ones if the nature of the cooperation has a limited running time and needs investment in hardware and software. Also for longer periods a cloud computing environment could be interesting to save costs and provide the ability to grow.

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5.3. Security in the clouds

The last few years security breaches of IT systems were in the news regularly. From Iran's nuclear facility that was struck by stoxnet (Telegraph Media Group Limited, 2010) to Playstation network being hacked (Thomas, 2011). Security of systems is breached, information is stolen or, even worse, systems are sabotaged. The news of systems being breached can deliver bad reputation upon a company so securing an information system can be important for a company's reputation. But how do you secure a system that is in the clouds?

5.3.1. Securing the clouds

The last few years usage of cloud services and connecting from one cloud to another has grown extensively. Large networks have been breached, leaking privacy sensitive information on the Internet. It is always unsure who gets the data and whether every breach where data are gained by hackers is reported. This is why security between clouds and within cloud computing environments is an important subject. As a customer you want to be sure your data are not leaked on the Internet.

With clouds and cloud computing trust is hardly gained. As in the paper of Ronald B. Knode (Knode, 2009) we see that transparency is important when using digital trust, but when we are working with clouds and cloud computing this transparency is not always available. This is due to the fact that we don't know what lies behind the mist of the cloud and providers are not always eager to share a glimpse of what's behind the mist.

A few of the risks with clouds and cloud computing lie within different subjects, like Jansen & Grance (Jansen & Grance, 2011) point out in their paper.

The complexity of environments makes it hard to secure every asset within a cloud, leaving exploit unprotected and making it able to breach security. This is not always solvable by system complexity increasing. Another risk might be the connection to the Internet, by connecting to another cloud environment. This mainly goes through the Internet, data are also becoming accessible via the Internet. Loss of control over an account can therefore have catastrophic effects on an organisation.

Also when using a cloud environment it is possible that you lose control, because third parties are involved, managing a part or even everything of a cloud and its connection. A company can find itself losing more and more control over their data and security measurements.

There are several risks to consider, but the first step is trusting the partners, present and then analyse the risks. (Das & Teng, 2001)

When working within a cooperate private cloud, the system managers of this cloud are known with the structure of the network and the security in place. The IT department hopefully knows what they're doing and they know which measures are taken and can adapt to occurring risks. You could say that your own network environment is known within the organisation. Metaphorically speaking you are within the cloud and can see what's within this cloud if you want to.

It is even possible to conduct an audit on security to check if everything is protected as it should, but by connecting to another cloud or cloud computing service you aren't able to see what lies behind the mist. We don't really know what lies behind this mist and need to trust our partner who knows that the cloud is secure enough by corporate standards. We could do an audit on the security of this cloud, but then we would need permission of our partner. Gartner (Gartner, 2008)says that it is the most practical way to do an audit is to let an external party do this audit for you. The plus point of an external party doing the audit is that they already have experience and know what things to look at, probably finding more attention points. After the audit is done you know what the status is of the security of this cloud or cloud service, but when it comes to sharing information with another cloud or cloud computing service it is all about trust. (Jansen & Grance, 2011)

Knowing that the cloud or cloud computing service and the trust relationship is established it is important to make sure that transferring data happens in a secure way. You don't bring diamonds to a bank in a plastic bag, but transport them with adequate protection. The same counts for corporate data, you don't want others to gain access to your data without authorisation. It is smart to make agreements with trusted partners about how and with what security policies that data is transferred. (Jansen & Grance, 2011)

non-repudiation
When you want to prove a paper letter is sent by you, you sign the letter with your signature. But with digital communication forms this is not really possible with a handwritten signature. But to prove that a message send is really from the person who said he is, he can sign the message with his private key. This private key is only known by him and when using his public key you have a validation of the sender. Two of the algorithms that makes digital signing possible are RSA and elgamal. The public keys are stored on a public accessible server and a trusted third party guarantees the authenticity of the public key. (Herda, 1995)

5.3.2. Security between clouds

What if two companies want to start working together? At first some agreements are made by the big bosses and after that a process is started and new thing and ideas are created. Working with a newly gained partner however probably means that there are two environments that have information that may benefit the new cooperation. This information can be shared in different ways, but to prevent a wild growth of solutions it is best to come up with one solid and secure way for sharing this information. This is because of the fact that you don't want that hackers to gain access to your network and data via the newly created cooperation.

The security of your own organisation may be at risk when sharing data with a cooperation partner. The security of your environment is manageable and if problems arise you are able to intervene, but when it comes to somebody else's cloud you don't have any control. That cooperation may bring security risk.

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It is important to over think and plan security between local environments and the cooperation partner before engaging them (Jansen & Grance, 2011). In the first place this has everything to do with trust (Knode, 2009). If you don't trust your cooperation partner and are unsure if this partner is able to be compliant with security standards of a local environment, it could be smart to over think the cooperation carefully before engaging it.

When trust between the two parties is build up it is time to make agreements about security. First there should be considered how the data will be exchanged, via which channels, and how to secure them. This to prevent information to be intercepted and read by others when they are transferred. Also very important is whether your partner gets access to the local network resources. This has everything to do with the nature of the share. Maybe e-mail is sufficient, but when large amounts of data are transferred regularly other solutions may be needed.

When sending data to a cooperation partner it is important to make sure the data transmission is done in a secure way. For example, when sending data the received should be the same as the data that was initially send. Also it could be of importance that the data is not intercepted or readable to others. To make sure that data is not tempered with or intercepted by others it is important to make a security plan that defines the policy for transmission.

When using third party cloud services it is hard to tell which security measures have been taken. When working with these services a company needs to trust the service provider to deliver a solid system that is secure enough for a company to store its data and or compute data with this service. One of the things that is always a bit unclear in a cloud computing environment is where the data are stored and especially with which other data they are stored. Surely there are cases where this is of no importance, but sometimes it is needed to know the exact location of you data, for example because regulation demands this.

"Carefully plan the security and privacy aspects of cloud computing solutions before engaging them." (Jansen & Grance, 2011)

As pointed out before it is always advisable when using third party cloud services to make good agreements about security and privacy of data with the cloud service provider. When looking for good guidelines on this the paper, guidelines on security and privacy in public cloud computing may help (Jansen & Grance, 2011).

5.3.3. Trust

Trust is a vague term that researchers tried to define. The trust definition may differ between research fields, for example a person with an economic background may define trust in another way than a person with a physiologic background.

"On-line System: On-line trust is an attitude of confident expectation in an online situation of risk that one's vulnerabilities will not be exploited." (Corritore, Kracher, & Wiedenbeck, 2003)

We can define trust as a relationship that involves at least two parties: a trustor and a trustee, they rely on each other for mutual benefit that involves uncertainty and risk. (Yan & Holtmanns, 2007)

Also when we are talking of trust we need to consider the importance of cloud and cloud computing. If we have two partners that are cooperating we could consider that the trust relationship is two ways, both having the same risk and both relying on the other party. When however we work with a cloud computing services provider we could consider this more as a one way trust relationship. This is because the party using the services takes a bigger risk and has more uncertainty then the provider. (Das & Teng, 2001)

Trevor Williams describes in his paper that mutual trust and informal agreements help the sustainability of the cooperation between cooperating partners. (Williams, 2002)

Trust within cooperation is very important, investing in trust and act predictable within the cooperation will provide stability and sustainability within the relation. (Williams, 2002) (Bensaou, 1993)

5.4. Cloud and Cooperation

With cloud and cloud computing defined it is time to look what possibilities cloud brings to cooperation. SaaS is maybe one of the most interesting forms of cloud computing when looking to cooperate in a creating way. With SaaS setting up a work environment for the co-operators can be done fast and easy without any big upfront investments, but clouds and cloud technology have many more things to offer when cooperating.

6. The clouds, a way to cooperate

With new technologies arising and the needs to cooperate, to achieve more and more, the question for good a solution to cooperate is rising. Cooperation and the clouds are briefly explained in the last two chapters, but still the question arises: is cooperation in the clouds a valid solution for the demands that organisations have today? Or do we need shift our attention to other ways of cooperating?

6.1. Sharing resources in the clouds

IT clouds are everywhere around us, containing large quantities of information. These clouds grow without outsiders noticing. This information can be valuable for some organisations. Combining the information contained within different clouds can give new and more valuable information, making cooperation in the clouds an interesting activity. A form of valuable data is profiling. This is done by many companies to make a personal profile of a person to give him ads he might be interested in. (KHaynes, 2011)

"Anything you buy out of an app, any subscription you sign up for, any new game you buy, every time you subscribe or register, Apple gathers more data about you and your preferences."(KHaynes, 2011)

6.1.1. Local/ private Resources

When sharing resources of any kind it is always a good idea to start looking at the local situation. When working in a private cloud environment this means that first it's needed to look at what is inside the local cloud. Important here is to look which vendors are used for particular software and hardware, but also to look how data is distributed right now and how the access is managed for those allowed. This calls for structured analyses of the present situation of the private cloud with the main goal to find out what is being shared, who has access to it, which rules apply to the shared resources and what software and hardware is being used.

When looking at a private cloud environment from the inside, the structure of a cloud is visible and shows which data are stored and which applications are being used. At first it seems somewhat chaotic with all the different structures in-place, but still it is important to look and find out which resources are available within this cloud. It is especially important to find out which resources are shared among the different segments of the cloud. When looking at a specific part of the cloud it is probably visible that an application or group of users have access to a certain amount of resources, allowing them to use these resources and create more and new resources with it. This selected group of users and or applications is probably limited in some forms. They have some rules they are bound to. More important is that this group is probably predefined, meaning that it is known who may and who may not use and or access these resources. (Sandhu & Park, 2003) (Seal, 2005)

Within the present environment the accessibility of all the resources is already regulated, making all the data available to those employees who need it, and limit access for others. The data within the private cloud are made in a certain format. Maybe this is done by the software that saves the data in a certain way, or maybe employees need to follow regulations about the format to create and save data. These regulations are important when creating and sharing information within the organisation and also with the outside world. The only problem when cooperating is that partners may have other regulations and policies in place, creating the need to convert the data before exchanging.

The most important with resources and their accessibility is to know who can access what with which limitation attached. When we know this we can start looking at how we are going to allow cooperating partners to access and share resources. (Sandhu & Park, 2003) (Seal, 2005)

When we look at the private cloud and see the resources throughout the environment, we can see that certain rules and policies are used to regulated access, storage, format and other things to make the resources act in a way it is manageable. These rules and policies are very important to keep the cloud functioning properly. With those rules in place it is possible to regulate the usage of resources by users and applications within and out of the cloud. Especially when cooperating the rules and policies regarding usage from outside the private cloud are important.

With the proper rules and policies in place, the risks regarding to usage of resources can be reduced and the risks remaining become more manageable. This makes it important to know which rules and policies are in place and have effect on external and internal use. (Stoneburner, Gonguen, & Feringa, 2002) (Das & Teng, 2001)

Within a private cloud decisions about vendors are made, specific vendors of hardware and software are selected depending on the needs of a company. The selection of a vendor made in the past may influence the compatibility with cooperating partners in the present. Switching vendors is mostly not possible when starting a cooperation, hardware and software are embedded in the daily use and changing this may create resistance with the employees. When cooperating the resources that are present, are those which the local employees are used to. These employees probably also prefer the current resources over another tool which they have to learn how to use. This means that switching to other applications or vendors can lead to resistance. A good analysis of the software and hardware that are used can help in the future when cooperation is wanted. When it is known which vendors are used, a compatibility check can be undertaken to review which hard-software can cooperate with others, and which don't.

When finished analysing the resources of a local cloud it is time to look forward and look outside of the local cloud, in the hope to get a peek at what lies behind the mist of the cloud of a cooperating partner.

6.1.2. Foreign/ shared resources

With a cooperating partner and the private cloud in sight, the need for information about available resources within the cloud grows. If cooperation is wanted, the need to have insight in what can be expected is present. Especially when opening up private resources to the partner, knowing where data is going to, who has access to it and which data is usable for the partners is vital information.

The same question counts for foreign resources as it does for local/private resources: what is being shared, who has access to it, which rules apply to the shared resources and what software and hardware is being used?

When cooperating, a certain goal to reach is present for both co-operators. This goal can be reached in different ways, but it is for sure that resources are needed and used in the processes of doing so. The resources in a self owned local cloud are accessible, but resources stored in a partners` private cloud are probably not yet accessible. It depends on what the cooperation partner is willing to give and how he is making it available to know which resources are usable for the local process. This means that a similar goal is needed to identify that these resources are needed to achieve this. This can be for example the processes of fabricating a part, where one private cloud represents the car manufacturer and the other private cloud represents one of the suppliers. The supplier needs to know what quantities are needed with which specific specifications. The car manufacturer may be interested in the price and delivery time of the supplier. If they want up to date data about the needs and delivery times of parts, they need to allow some information is being exchanged. (Bensaou, 1993)

When working with a cooperation partner the need to know which data are needed or wanted, and which data are irrelevant, is present. For example, when receiving information from a supplier we are probably not interested in the supplier of the supplier. This may depend on the business of cooperation, but with the example of the car manufacturer it seems reasonable that this information is not needed.

When it is certain what resources are needed to provide a good environment for the cooperation, the need to look at how the resources are accessed is present. The resources that are wanted need to be shared between two ore more clouds, which means a solid way of sharing resources is needed. This can be done in different ways, but more important is the agreement of how to share these resources. In this agreement there should at least be discussed which resources are going to be shared, who has access to this resources, which measurements will be taken to provide the security of this resources and what will be done with this resources.

The accessing of the resources itself can be organized depending on the situation. If only information needs to be exchanged, like in the car manufacturer example, setting up a dedicated connection to exchange this information is the most convenient solution. When

however resources are needed in the cooperation where the form of the cooperation is to create new product or data, using resources from two different private clouds is probably not be the most preferable solution. In this case a dedicated environment is needed to create and share information.

Knowing which resources are accessible, there will probably be some kind of limitation attached to the shared data and or resources. This limitation can consist of access rights, time of accessing and time validity. This may give some problems when the data that you get has limitation, this will result in less effective processing of this data. This is why it is important to know what is and what isn't possible.

When accessing data it is firstly important to know who may access it. It is possible that the data that is being shared is only accessible for a limited group or may only be used by a limited group, because of confidentiality of the data. This means that only parts of an organisation may handle the data acquired via the cooperation partner. An example of such a situation can be found with manufacturers of electronics, where the organisation makes a product that looks like the one of the comparator and also has a contract with that comparator to make parts for that product.

When knowing who may access the data it is important to know what can be done with the data or whether there are any limitations, for example that the original data may not be edited. When editing data is not allowed this will probably affect the way the data is being processed and used. Surely parts that are interesting can be used to gain information, but if they may not be separated from the main source, it could be inconvenient to use. When however it's allowed to edit the data, the question arises whether is it also allowed to share the edited form with other departments within the organisation or external parties. This has everything to do with the confidentiality of the data.

Clear agreements can help solve problems of editing, sharing and distribution of data gained via cooperating partners.

The slogan: 'time is money' can also be linked to cooperation. Why should you cooperate when it only costs money? Making a profit is also an important task for most companies. When having a cooperation partner that shares data, time is important. Not only the duration of the cooperation, but also validity of the received data may play a role.

When depending on data and or resources of cooperation partners it is important to know when these resources are available for accessing. It is possible that these resources are not available on certain moment of the day. This can be because the resources are being used for other tasks, or maybe the data needs to be made every day, but this is only done at the end of the day or when all information is available. All of this information can be important to know when depending on these resources.

When the resources and data are being used it is also important to keep track of which data are valid. Data validity can expire, for example the number of supplies at a supplier can decrease.

This is why it is important to keep track of what data is expiring and when and what data is still valid, when the data have an expiration date. This especially to keep the known information as acquired as possible.

When using resources and or receiving data from a cooperating partner these data are not always compatible with the current ones. This may be due to different vendors or different version of applications used. It is important to agree on a certain format of sharing resources and or data before sharing anything, to prevent incompatibility between the two different private clouds.

To make sure that compatibility is ensured a list of supported products and protocols should be compared between the cooperating partners. Using a format that is supported by both will benefit the cooperation.

6.1.3. Connecting local and foreign resources

When different parties want to cooperate, there are various solutions available to share resources with each other, but every situation has its own specific needs which depend on the scale and type of cooperation. In a cooperation where only data is exchanged another solution is needed as in a situation where experts from both organisations are working together in a project.

The distinction is therefore made between two options of cooperating. One of the options is coupling the two private clouds, creating a connection between them to provide the possibility of resources sharing and exchanging data. The other option is creating an environment where documents can be created and resources are being shared. Both solutions make it possible to cooperate and depending on the needs of the cooperating partners the best solution can be chosen

When data exchange is needed, coupling clouds or parts of these clouds to each other can be a solution. The concept of coupling is that a connection is made between two clouds where the data are being transferred directly from one cloud to another. Connecting the different clouds to each other can be a complex manner, due to different software and policies. In some cases it is however the most confidant solution to share the data between cooperating partners. This because both have their own environment which they are used to and have the abilities to allow or prohibit certain access to their cloud.

Coupling is the most convenient solution when data sharing is needed on a regular basis. To refer back to the car manufacturer, this means information about supplies and needs will be exchanged between the cooperating partners. By coupling the clouds together the data can be sent to the other cloud in a controlled manner.

The benefits of using a coupling to exchange information is that both parties can use their own environment, and software may only need small modifications, but there are also some risks attached. When setting up a connection with a cooperating partner the cloud is also open for

information to be extracted or to be sent, information that is not wanted or tempered with. For example the cloud of the cooperating partner is infected by a virus or security is breached by a hacker, creating a risk to the cooperating partners that are connected to this cloud.

When using a dedicated environment to facilitate the needs of the people involved in the cooperation there are different options available. It is possible to make space within an existing environment by making resources available to facilitate the cooperation, or choose to use a third party service provider that offers a cloud computing environment. Both solutions are in the essence the same; you use a dedicated environment to facilitate the needs of the co-operators. By facilitating dedicated resources for the people cooperating you are able to work together on each others' projects.

When we look at the implementation differences of using a cloud computing environment versus using an existing environment we see that both have their benefits, but also their downsides.

The usage of a dedicated environment can be handy in a situation where not only information is exchanged, but also new data is created. This can be in a situation where two cooperating partners combine their knowledge to create new innovative products by combining the expertises of both parties.

When you are cooperating and need to share information, a possibility is to open up one of the clouds to the cooperating partners. Opening up a network to others always brings some risks. This is why good policies and analysis need to be undertaken, making this an easy, but time consuming solution. This solution of sharing in an already existing environment with each other can be handy, because one of the co-operators is already known to the environment and is able to manage the system and its data easily.

With a shared environment there is always the question whether all cooperating partners will agree on the policies in place, because when one environment is opened to an external party this always brings some risks. Can you really trust each other with the information created and, of course, already present in the cloud? To what extent should be the access rights? Do we give the same access rights to the external parties as to our own employees, or do we limit them? When opening up a private cloud you should consider the impact on and the risks for your internal network.

When in need of an environment to cooperate with each other, and usage of a part of a private cloud is not an option, the usage of a third party provider can be a solution. By using third party cloud services it is possible to hire an environment that is ready for usage with a predefined set of application and hardware. Depending on the needs a solution like IaaS PaaS or SaaS can be chosen.

Agreed benefits of using a cloud services are that it's fast to setup and the cooperating partners can easily start with a fresh environment to work with, without having to deal with any policies or rules that were made in the past. One of the downsides of using a third party is that it affects the

work of the cooperating partners when problems arise with the third party. This is why both parties need to trust the third party to provide a stable and secure environment.

A dedicated environment is the best way to cooperate in a creating manner. This is because the group working together has their own resources and therefore does not depend on data exchange between the companies. A dedicated environment may need more management, but mostly there needs to be a solid trust relationship between the parties involved, especially when using resources and data outside one of the partner's private cloud are being used.

When cooperating, the scale of the cooperation may affect the solution chosen by the cooperating partners. This is why a solid analysis of the quantity of resources used within the cooperation and the duration of the cooperation needs to be calculated.

When cooperating with a partner, and both having different private cloud environments in place, it is wise to first look at the scale and time of the cooperation. If for example only small amount of data needs to be transferred between a small selected group it is illogical to invest large amounts of money and time to create a dedicated connection between the two clouds. In this example e-mail can be sufficient, but when the scale gets bigger e-mail is not always the best option. In that case dedicated cooperation/ collaboration tools could be required to provide the best possible solution.

We can divide the scale of cooperation into small, medium and large scale. When you look at small scale cooperation you could say that a small dedicated group consisting of two or more organisations is working together. In this case simple tools like e-mail, instant messaging and online text editing tools could be sufficient to setup a good creating cooperation even for a longer time. When however the scale of the cooperation becomes bigger and therefore the data output grows, it would be wise to invest in a more dedicated solution. Let's say that with a medium scale cooperation simple tools like e-mail and instant messaging are handy, but aren't sufficient for all the tasks that need to be executed. In this case it would be wise to implement a more dedicated solution that allows different types of communication and easy sharing of documents. When the scale of the cooperation grows to a large stage and many different people are involved, it is wise to set up a solid solution, especially when it is expected that the cooperation will last for a longer time. (Goyal, 2010)

The duration of a cooperation can also affect the selected solution. When it is expected that the cooperation will last a short time, or it is still unsure whether the cooperation is really going to last, it is not wise to invest large amounts of money in solutions that aren't going to be used. When the duration of a cooperation is stable, and the period of cooperation is agreed upon, the selection of a valid solution can be made.

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6.2. Digital cooperation a way of working with the clouds

Cooperation is something that we see around us every day. When people work together to complete a task it will be solved more easily in a group. Cooperation has many different forms, but in the context of this research digital cooperation is the most interesting. Within this paper we define two ways of digital cooperation by sharing resources and creating them.

6.2.1. Sharing a vision

When you want to cooperate and use a digital environment it is important to make decisions about which vendors are going to be used, which policies will be placed and what rules will be agreed on. All of this will create a shared vision wherein the involved partners agree upon what they want to reach and with what resources are available. This vision can help to choose vendors and rules that need to be agreed upon. For example if in the vision is stated that open sources should be used, the choice of vendors will be limited for software. A shared vision can help to reach goals more easily.

6.2.2. Trusting each other

When agreements are being made it is important to be able to trust the cooperating partner and the agreements made with them. This is why trust is important. Trust can be shown by committing to a cooperation, for example by allowing access to certain resources, but also trust has to do with good agreements. If you know what to expect from your cooperating partners trust comes more easily. (Yan & Holtmanns, 2007) (Gartner, 2008) (Belassi & Tukel, 1996)

6.2.3. Sharing resources

When sharing resources with cooperating partners, the partners may gain benefits from them such as reducing costs and gaining information. Sharing data is probably the most common way of sharing resources. These data are mostly used to support business processes such as the car manufacturer example. This way of sharing resources benefits both parties and helps them to gain important information for their business processes.

6.2.4. Creating

When two or more cooperation partners want to create new products, or combine forces for a project, it seems logical to combine forces and give this group of people the resources they need to help them achieve their goals. When they have the option to come together, exchange ideas and especially be creative, the processes of executing a project will have a higher chance of success. (Belassi & Tukel, 1996)
The important resources here are the ones that help the co-operators to work and get together, share information, ideas & vision amongst each other in such a way that they are not bound to a physical location. This can be done by setting up a special environment that allows people with different backgrounds to work on one platform they all have access to. (Cooke-davies, 2002)

''When it comes to project management, it's the people that count.'' (Cooke-davies, 2002)

An example could be that a group of cooperating people work on a platform that helps them to communicate with all the group members and gives them the tools they need to work together, like tools that help with sharing and creating data.

Providing a solution, so that the cooperating partners can work with each other, can be done by setting up a server, installing all the needed software and providing access for both partners. Another solution could be that the cooperating partners use a third party cloud service to host an environment for them.

6.3. Securing

When you are cooperating it is important to secure the resources that are being used. You should do this in such a way that only allowed access is possible. This is mainly to prevent competitors to be able to see the development and use ideas created within the cooperation. One of the success factors of projects is proper risk management, as stated by Walid Belassi and Oya Icmeli Tukel in their paper (Belassi & Tukel, 1996).

6.3.1. The risk of sharing

When using a third party cloud, or opening up a private cloud, one should always look at their security before doing so. This is mainly because of new risks that are bound to cooperating with external parties. The network itself isn't the only weak point anymore and also the other parties involved can bring risks to a self owned private cloud. (Stoneburner, Gonguen, & Feringa, 2002)

For example breach of security, if only one private cloud needs to be secured its easier then when multiple cloud environments are involved, all bringing a risk to the private environment. How can one be sure that a partner has his security in order and has an airtight access management system in place?

One of the risks is theft of data. This is not only done by outside hackers, but theft of data is mostly an inside job. This makes it important to have strict regulations about accessing data for external people as well as internal employees.
Second is the risk of data manipulation, almost the same count here as with the fact that theft it is mostly an inside job. With data you want to be sure of integration and be able to rely on data available from both internal as external resources.
The third risk we define is social engineering. When the system is airtight and good regulation and security policies are in place, an unwatchful employee can be the victim of social engineering, allowing a hacker to access data via internal personnel. (Sullivan, 2004)(Hackernews.com)(Wagley)

6.3.2. Managing risks

A project success goes with good risk management, making sure that all areas are covered and secure. This allows the co-operators to work on their project without worrying about risks. Of course they need to be aware of the risks and especially be aware of social engineering and suspicious behaviour by others, but making everybody scared with security risk doesn't add to the results of the project. It is better to give all co-operators a training explaining the risk and how they can prevent them, then making everybody scared and letting them think nobody can be trusted. (Stoneburner, Gonguen, & Feringa, 2002) (Belassi & Tukel, 1996) (Cooke-davies, 2002)

Especially when working with multiple environments the security of data should be well arranged. The ISO 27001 and ISO 27002 standard can be used as a guideline to check security measurements. These two standards describe a set of requirements that help to secure an IT environment.

The ISO standards "provide a model for establishing, implementing, operating, monitoring, reviewing, maintaining, and improving an Information Security Management System"(ISO 27000 Directory)

Another important factor is trust risk management and trusting the cooperating partners helps to reach a secure and safe environment to create and share resources. (Corritore, Kracher, & Wiedenbeck, 2003)

6.4. Cooperation and communication

One of the ways to share resources between different clouds is to exchange information with each other via different means. The scale (people involved and information output) and time of a cooperation may affect the chosen solution.

When people are working on a project together there are many different platforms and tools they can use to interact and exchange data with each other. One of the most adopted platforms is e-mail, but also Instant Messaging or complete collaboration platforms are available on the market. It depends on the situation which tool suits best.

6.4.1. E-mail

E-mail, or electronic mail, is a popular way to exchange message and data. It has the benefits that all people with an e-mail address can be reached with one e-mail address, meaning that with its open structure you are not bound to a selected group that must have a specific account on a server.

"A system for sending and receiving messages electronically over a computer network, as between personal computers."(Farlex (3))

When sending an e-mail there is one sender that sends the message to one or more receivers. These receivers can then reply to the sender, reply the message to all people that are involved in the message or forward to just anybody that could have interest in the message. When you however send a message to five people with an attachment about a project that you are working on, and some of the people working on the document notice that there are some mistakes and things missing, and all individually they reply everybody involved with their updated version it could get hard to track what changes have been made to the attachment. In this case it's possible that instead of one version at the initial start of the message, you end up with five different improved versions. This is one of the downfalls of e-mail; it can get chaotic when many people are involved. We can say that e-mail is one to one or one to many communication.

6.4.2. Instant messaging

Instant Messaging, or shortened IM, is a way of direct communication. When you want to communicate via IM you need an account on a platform and within this platform you can communicate with people that you added to your contact list.

"A system for exchanging typed electronic messages instantly via the Internet or a cellular network, using a shared software application on a personal computer or mobile device. Abbreviation: IM" (Dictionary.com (2))

When starting a conversation with one of your online contacts, a connection will be setup and messages sent will be displayed to the receiver, which can directly reply the message and send an attachment when needed. Also it possible to add multiple people to a conversation. IM is a more direct way to send messages than e-mail and also works with a presence system, giving you information about the reach ability of a contact in your contact list. IM is more closed then e-

mail. Not everybody with an IM account is directly reachable. They need to be able to connect to the IM platform and if it is possible they need to add you as a contact before a message can be send. Also when a group is involved in a conversation the sent files can get somewhat chaotic when different versions are send by various people. IM can be seen as one to one or many to many communication.

6.4.3. Conferencing

Digital conferencing is mostly done by voice and sometimes video.

"The holding of or participation in a conference, often through computer or telecommunications technology."(Farlex (1))

The persons who are conferencing all can hear and talk to each other, making it a more direct way of communicating. When adding video it is also possible to see each other, this can make communicating with each other more personal. The only downfall with this is that everyone involved needs the appropriate hardware to be able to join the conference. In most IM software the ability to setup a conference is included in the platform. Conferencing can be seen as one to one or many to many communication.

6.4.4. Collaboration platforms

Collaboration platforms are platforms designed for cooperation with other people. They offer various sets of abilities depending on the platform.

"A collaboration platform is a category of business software that adds broad social networking capabilities to work processes."(Tech Target (2), 2011)

Most of the collaboration platforms will offer some sort of IM capability and a more advanced way of sharing data. When sharing a file the platform keeps track of changes to that file and makes sure that the latest version is available for those who are working on this file. When looking to the basic function e-mail, conferencing, IM with presence system and web log/wiki are included in some form in most collaboration platforms, making it an ideal combination of ability when working together on a project. For most collaboration platforms an account to that platform is needed. Collaboration platforms can be seen as one to one or many to many communication.

7. Creating with digital cloud cooperation

With cooperation we have many different forms. One of them is creating. Creating is something that needs some creativity and of course resources to help the creating process. The internet is full of places where things are created and shared amongst each other. That is why looking for a creating and cooperating environment on the Internet is a good place to start and find answers on the research questions defined within this thesis.

7.1. Creating resources

When talking about creating resources of any form using the internet, it is smart to look what is already on the market. Two good examples of creating tools are a wiki and online office environments. Wikipedia and Google docs are probably two of the most well known online cooperation platforms available for the public. This is why it's interesting to look what defines these products.

7.1.1. Wikipedia

Wikipedia is one of the best known internet encyclopaedias that brings information to people in over 270 different languages with more than 19 million articles, containing information from historic events to details about mathematical formulas and from famous people to company descriptions.(Wikipedia (6)) Although some people were sceptical about Wikipedia, a comparison between Wikipedia and Encyclopædia Britannica showed that the fault rate did not differ that much at all.(Wikipedia (3)) This comparison shows that Wikipedia and its community is almost as reliable as some well known and established encyclopaedias, making Wikipedia a success.

The success of Wikipedia is mostly because of the philosophy behind the website. The slogan describes a bit of their vision and ideas behind Wikipedia, "Wikipedia the free encyclopaedia that anyone can edit" (Wikipedia (5)). We could say that Wikipedia is structured in such a way that anyone that is willing to share knowledge about a certain topic can create an article, sharing their knowledge with others. This can be edited by others to correct mistakes or add additional information. The main functionality that Wikipedia offers is the ability to create content together and correct each other's mistakes.

"On the surface, the success of Wikipedia makes no sense--how could (and why would) a team of volunteers possibly complete such a massive undertaking?
The answer has repercussions for leaders and business owners in every industry: Money isn't everything. In fact, a sense of purpose is more important than the size of a salary when it comes to inspiring top performance from employees and team members."(Moreland, 2012)

When we want to look at the idea, we need to look at the history of Wikipedia. The initial project Nupedia was a free encyclopaedia that was available for everybody, but because articles

needed to be run trough a peer review process, the number of articles after one year was only 12. This made the founders of Nupedia seek for new ways of developing articles more rapidly. Jimmy Wales and Larry Sanger thought of the idea of using a wiki to create content for Nupedia in a more rapid way. Not long after that Jimmy Wales and Larry Sanger choose to start the project called Wikipedia, Wikipedia allowed people to create and edit all the information inspired by an idea by Hayek's. Hayek's idea was "to share and synchronize local and personal knowledge, allowing society's members to achieve diverse, complicated ends through a principle of spontaneous self-organization." (Wikipedia (2))(Mangu-Ward, 2007) (Hayek, 1945) This self-organization is one of the important drives behind Wikipedia. There is no real hierarchy and the rules of Wikipedia even differ per language. Wikipedia chooses to let the people create the content also organize the way the content is maintained, created and controlled. Wikipedia is just providing them with the tools to do so.

Wikipedia uses wiki technology to provide the ability to create content, using a mark-up language via the web browser. The wiki technology allows multiple people to work on a page. When changes are being made, the editor opens that piece of the wiki that is being edit and saves the changes. When this is done it is shown on the wiki. This means that if two people are working on the same spot, the last one saving is creating the latest version of a page. Because wikis consist of web pages, it is easy to link wiki pages to each other. (Wikipedia (4))(O'Reilly Media)

The factor that made Wikipedia a success is not the technology, but the way they organized the site. They gave everybody the opportunity to contribute to the encyclopaedia. This is a big step, and asks for a strong control of content to prevent inadequate information appearing on the website, or even censured information. Because everybody could edit information also persons that wanted certain articles removed or edited in such a way that was more in their benefits could do this. The community controls the actions taken on a wiki and can restore this action. The community behind Wikipedia makes sure that data is adequate and not tampered with. (Gillinson, 2004)

7.1.2. Google

One of the most successful search engines of the last few years is the one from Google, which is now available in 130 languages. With the success of the search engine they developed different types of web services, ranging from photo gallery software to operating systems for smartphone and laptop. Two interesting products are Google Docs and Google Chrome operating system, that offer cloud based solutions. (Tuazon) (Malik, 2011) (Google (4))

Google had a vision of working only in the clouds and with their launch of Google Chrome OS they showed their vision on the future of computing: an operating system that wasn't much more than a web browser, using web services to provide functionality, like office suite, photo editing and storage. Google has as clear mission: "to facilitate access to information for the entire world and in every language." They also believe that "You don't need to be at your desk to need an answer."(Google (6)) (Google (7))

Google Docs and Google Chrome OS are two examples of how the Internet can be used. The idea behind Google Docs is simply offering an online office suite. The technology behind Google docs is one that comes from various projects within Google, within an experimental project, named Google Wave, there were many functionalities present that are now used within Google Docs. The concept of offering a total office solution from your browser seems to be working. Especially features like simultaneously working on one document and the ability to discuss the document with chat functions change the way of cooperating. Things like version management are a big plus point of Google Docs, because versions are saved within the Google cloud and are editable via Google Docs, therefore the latest version is always available to all co-operators. As the newsletter example that Google uses, instead of different versions being e-mailed to each other, the versions are now centrally stored without the chaos of different versions wondering around. Also the API that Google provides with their platform offers others unique solutions to use Google Docs in new ways. (Kiss, 2012)(Google (5))(Google (1), 2009)(Google (3))

Google Chrome OS can best be described as a web browser operating system. The concept behind this operating system is that everything you do is done via the internet in a cloud service environment. The idea is that the user doesn't need anything more than the Google environment to work. The concept isn't such a bad idea, because what does the majority of people do on their computer? Maybe they will send an e-mail, check their social networks or play a game. For business users however the functions of editing and creating data may be important, but this all is available on the web. Google Chrome OS is not widely adopted yet, but who knows what the future may bring. (Scott Dobson)(Google (2))

7.1.3. Cooperating

Cooperating and creating new data on the Internet is done in many ways, all have their good points and points that can somehow be improved. Within this research two technologies and visions are reviewed to see what they offer.

With Wikipedia on one hand and Google Doc on the other we can compare two popular and successful online cooperation platforms. First we see that both are able to create, edit and remove new data. Both have a search function to help find data, both have a revision system to manage versions of the data and many more similarities can be found.

When we look at how data is made we can see a clear difference. Where Google Docs gives a basic office suite that has the most important functions built in and auto saves, Wikipedia uses wiki technology. With this wiki technology the users need special codes to do lay-out and need some learning curve to be able to create content in a more structured and visible attractive way. With Wikipedia the saving is also done by the user. This can be seen as a advantage only finished work is published, but can also be seen as a risk. What if the browser crashes when an edit is done? In that case the editor probably needs to do his work all over again.

Also the way of communication is different. Google Docs offers the ability to place comments on certain parts and has a chat function that enables users to chat with everybody currently

working in that document. Wikipedia on the other hand offers a discussion board where people who cooperate on an article have their discussion. This in the concept of Wikipedia is of course sufficient, but for a more corporate solution where projects are done this may not be that handy and direct.

One of the most import things when having data is the structure. Google Docs gives a sort of e-mail look, where all documents are structured in maps and can be shown on a home page. With large amounts of data the use of the search function is vital here. Wikipedia on the other hand has a linking system to all their pages, so if within an article some interesting information is available about another and or relating subject, you can just click a link and open this information. (Wikipedia (5)) (Tuazon) (Google (8), 2010)

With the comparison of the different systems it is important to look how they manage their different versions. Within Google Docs with almost every change a save is initiated. This is of course a very safe way to make sure no data is lost when a browser crashes, but also takes a lot of overhead, especially when working with multiple people on one document.
With Wikipedia the article is only saved when the users tell the wiki to do so. This gives less revision of the document, but also has its risks. (Wikipedia (3))

When looking at both revision systems, we see that with Wikipedia we have every change that is submitted, but with Google docs this is done automatically. In a simple view the revisions of every session are shown and if wanted a list of almost every revision can be shown leading to a large list of revisions. The problem here is that the revision has no description, meaning that it is not certain from which point an edit has been made when many revisions are saved. Of Course it would be inconvenient to give comments every time Google saves the document, but it could be handy to see in short what has changed. (Google (5))

7.1.4. Operational transformation

To look how Google Docs provides their revision history, understanding of operational transformation is needed. This method is used to compare change, and merge them to one document so that everyone working on one document has the same version.

The concept of operational transformation is simple but effective: every change made is given a unique label, containing the information range that is being edit, the type of edit and the person who is making the edit. This information is send to a server which distributes the edit to all other users working on the document. The three basic changes are inserting text, deleting text and apply style to a range of text.

When two persons work together on the same piece of data, operational transformation provides the means to merge this edits. For example when person A edits a piece of text by making it bold and person B edits the same text by adding a word, the result will be that the whole text is bold including the added word.
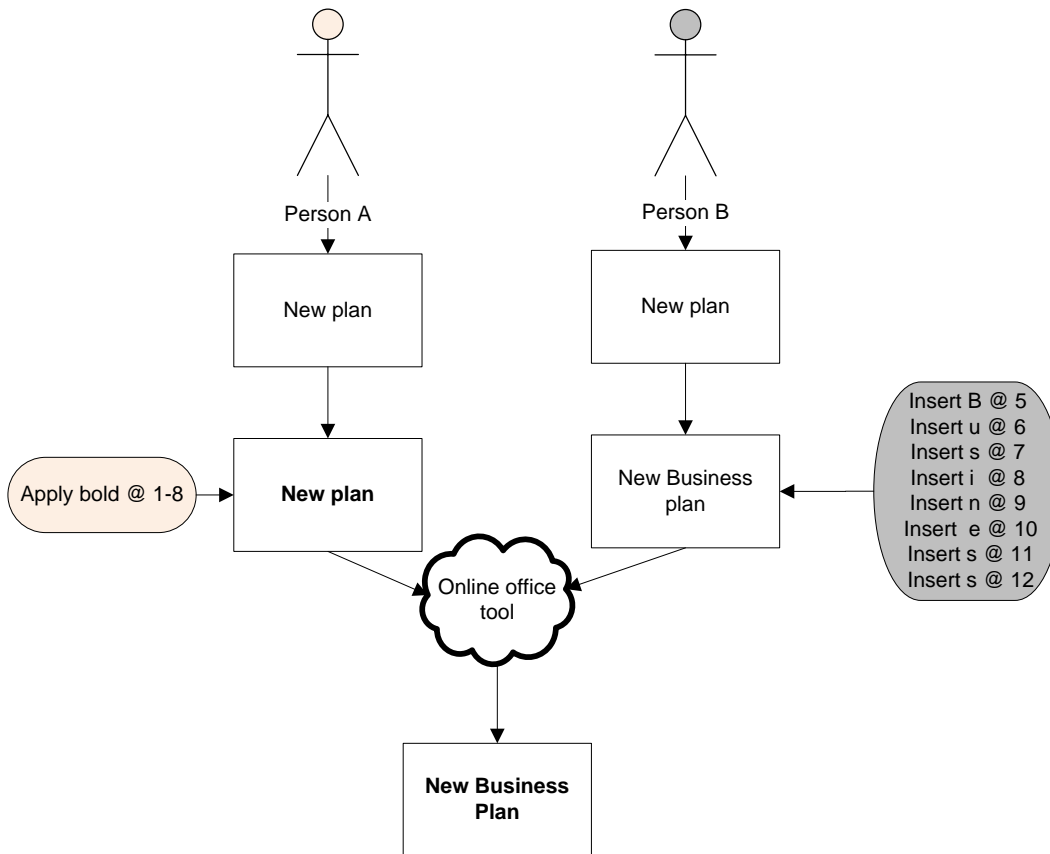
Like shown in the example in figure 3, by using operational transformation it is possible to cooperate on a document at the same time with all the edits merge (Google (8), 2010) (Ellis & Gibbs, 1989) (Sun & Ellis, 1998)

7.2. Digital cooperation a new solution

With all the information of the last chapters it is now time to look at what new solution would be advisable when we want to cooperate, and within this cooperation create new products. This calls for an environment that allows people to interact and express their creativity.

7.2.1. Concepts

Technological developments are often created by putting a technical solution in place which sometimes changes the manner of working for people, leading to undesired situations. Many products are made and have a function, but do those products really do what is wanted or is it simply accepted because people do not know better?

What would happen if we let people think of a solution and not some engineer that thinks in technology? Will we get the same solution or do we get a solution that involves process change instead of technology change?

The idea of finding a peoples solution first and then find and or create technology to work with is not a bad idea. With this idea the technical solution that is offered should feel naturally and instinctively.

When looking at Wikipedia and its structure there are many things that they do in a good manner. Nevertheless there are also things that could be improved, like the mark-up language used to create articles.

One of the strong points of Wikipedia is the version management system, also known as revision history. The use of comments to describe the made changes makes it easy to keep track of the progress and, when needed, restore a version that is known to be correct. Also because users initiate these revisions it is easy to keep track who changed what and when.
Another strong point of Wikipedia is the use of links within an article, making it possible to get additional information when reading about a certain topic. With this function it is made easy to find information that you may need, but probably the most important drive behind Wikipedia is the community behind it. The community is responsible for creating content and as quoted before "a sense of purpose is more important than a high salary". (Moreland, 2012)

When looking how this may all relate to cooperating with creating as a goal, we can see that a good version management helps to keep track of changes made and allows version management. Also linking of all documents within documents allows easy access to data that may be needed. Most important a sense of purpose to a well defined goal within the cooperation may lead to a bigger success as stated by Terry Cooke-Davies in his paper (Cooke-davies, 2002).

With Google, and especially Google Docs and Chrome OS, Google shows us a vision. These two products are products that use cloud computing to do the work. They show that no more than a web browser is needed for the most common task done on a computer.

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When looking to Google Docs we see that one of the most noticeable functions is the real-time editing of a document by different persons. This allows co-operators to work with each other without them having to merge changes themselves. Also this allows co-operators to correct mistakes on the spot without having to wait for a new version to be submitted. Also with this function we are sure that we are working in the latest version of a document, preventing confusion about versions and the need to manually merge. At last the communication function allows co-operator to easily discuss changes being made.

When looking how this may all relate to cooperating and creating we see that everything is done from one single location, being the cloud. Using one location to store and manage the process can help to work in a more structured manner. Also the real time editing function allows for a good way of working on the same document. Communication may contribute in making decisions.

7.2.2. Conceptual idea

With both the ideas of Wikipedia and Google in mind, it is time to make a structure that allows digital cooperation and creation of new resources. First we need to mark some important factors.

A good digital cooperation platform must provide a structure in such a way that navigation is easy, even when the quantities of the data are extensive. A good solution for communication is needed, which provides the means for discussion. Also the platform should be able to host a community and be compatible with different formats of data.

The solution needs to be able to adopt new futures which add to support the needs of its users, but, most important, the solution needs to feel instinctive. This so that the users have a small learning curve and can handle the solution without extensive training.

This leads to the concept of a cooperation platform that allows users to cooperate in a creative manner where the most important thing is that the technology helps the persons working with the tools.

The ideas of this solution need to be connected. All parts of the system need to work together to create one solution that support all the needs of the users. This is why a conceptual model is made, showing the relations of all different parts of the conceptual platform described later in this chapter. Within this model five main areas are defined: community, data linking, version management and communication. These five area's connect the various parts of the solution, together making the system one combined solution.

- The community stands for the users that define the culture within the solution and need to be able to manage their needs when cooperating;
- Data linking stands for the data structure and possibility to integrate data;
- Version management stands for managing progress and allowing the community to define goals;

- Communication stands for allowing interaction between the different users without the dependence of location;
- Control and responsibility stands for what changes are made and by whom.

The solution needs to provide a many to many environment allowing exchange of data and communication between each other. The conceptual model is shown in figure 4 and is drawn with ORM.
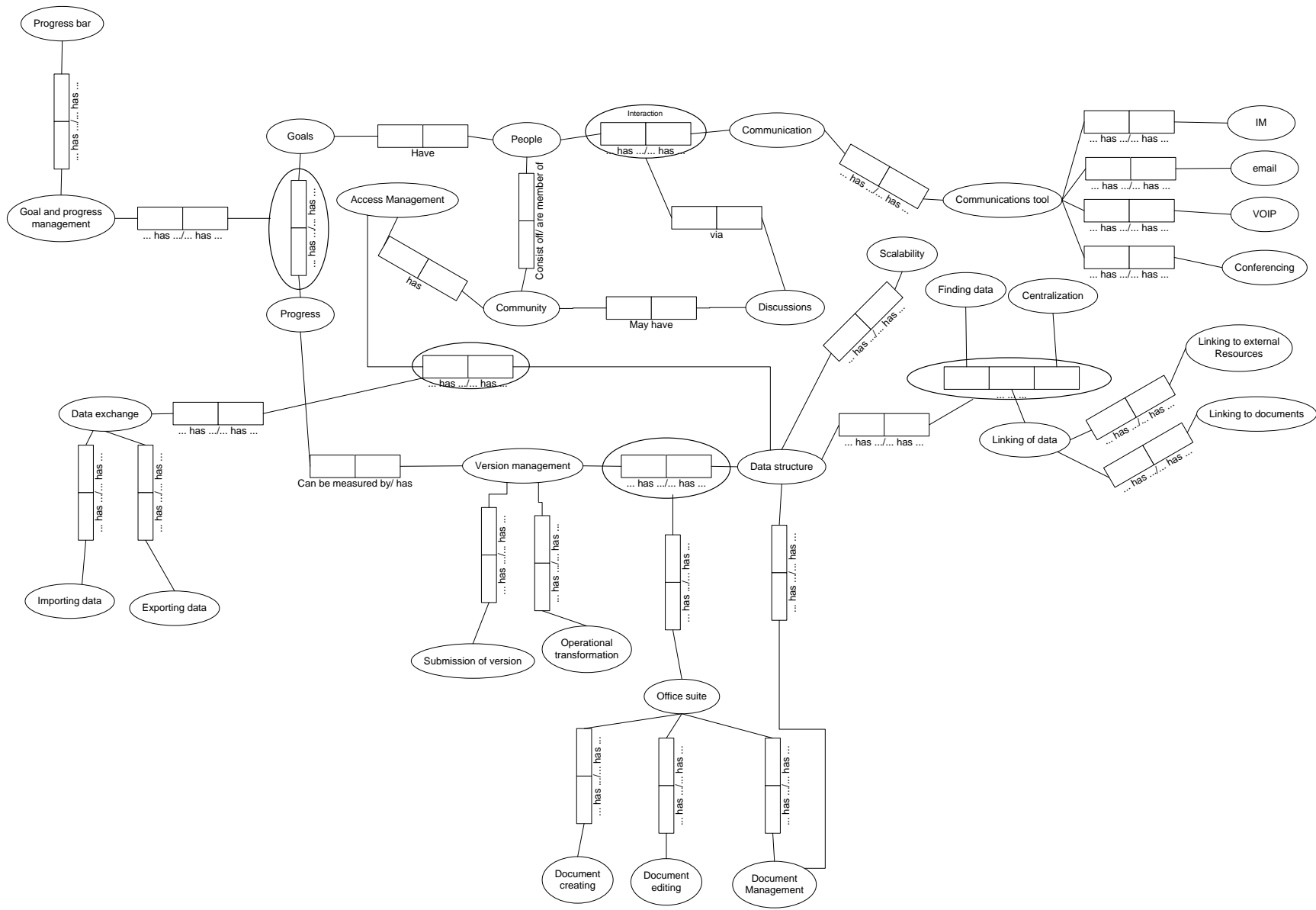
Figure 4

7.3. Framework

With the ideas of Google and Wikipedia in mind it is time to compose a framework that combines some of the characteristics that divine their products. Beginning with the platform itself, at this point we are not looking at the underlying technology, but more in an abstract way. The question is of course what the important factors are. When cooperating, a structure that everyone can understand will help the success of the cooperation. This structure means that within the project, roles are defined and also there is a vision on the end goal. (Pinto, Pinto, & Prescott, 1993) (Ford & Randolph, 1992). With the structure defined, communication is the next point to look at, because cooperation and communication lie closely together. Without communication project cooperation will not work properly, because no one knows which direction to go, meaning that there are many different visions on the end goal. (Balliet, 2010) Communication allows interaction and discussion, making the users share their ideas and create a shared goal. With a structure and communication in place it is time to setup a sort of group, that will be named a community. This community is the place where people define their goals for within the cooperation. The community idea comes from Wikipedia where it seems to provide a solid group that contributes to the project. (Moreland, 2012) At last the platform should do something with version management, so that everyone is able to work with the latest version of any document at any time. This all leads to the model as shown in figure 5.
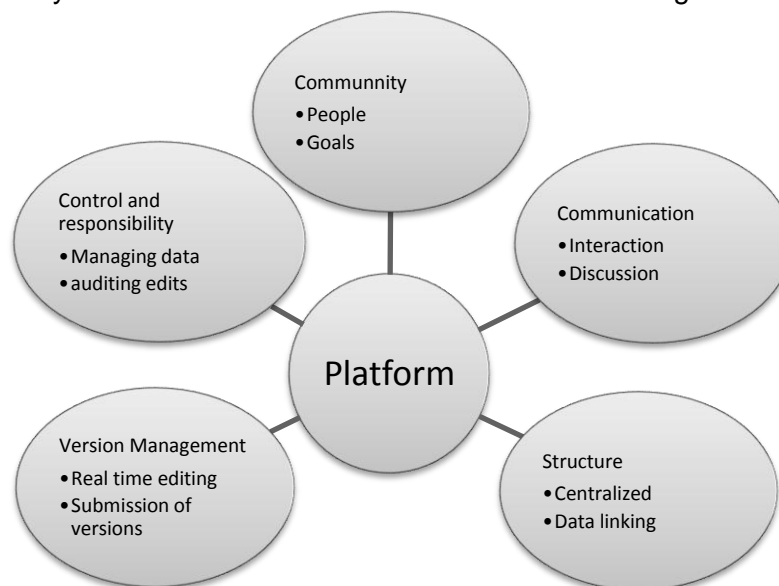

Figure 5

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7.3.1. Structure

With the framework roughly drawn it is time to zoom in on the specific pillars, starting with structure. Structure provides the basics for a work environment; this structure can be made by making agreements on how the work is going to be done. When looking to the platform, the structure mainly relies on technology. With technology you can bring a structured way of working in place. The first point is that the platform should provide a centralized place to store all data and work from. This will help keeping track of progress and benefit the cooperation. (Pinto, Pinto, & Prescott, 1993) With the centralization of data and work capacity it is also important that data can be found when needed. This is why data linking is a handy solution. With data linking the idea is that within documents, that use data from external sources or other documents, links within this document are being placed, making it possible to open the sources of data from a document without searching for it. This option also gives the opportunity to link background information within a document, making it easy to access for people involved within the cooperation.

Structure also has everything to do with how a group of users is arranged and can be linked back to the community. With structure there should also be groups defined, all having their own roles, so that goals of different groups can differ from each other, but still contribute to the main goal.

7.3.2. Communication

Communication helps people that cooperate with each other, understand one another and discuss the way to reach their goals. This is why the platform should support different ways of communicating, keeping the communication centralized and running through the platform. This doesn't mean that established software cannot be used, in the contrary, it is better to integrate available communication tools/platforms that reinvent them. The platform should offer space to interact with each other and have discussions. This can of course be done with the same tools, but offering different options lets the users of the platform decide which tools suit their needs the best.

To make the communication tools more concrete, we can define multiple ways of communicating. Integration of e-mail within the platform is probably one of the most simple solutions, because of the wide adoption of e-mail and people being used to the functionality of it. To provide more direct means of communication, IM, voice and conferencing solutions can be offered. This variety is needed mainly because sometimes IM doesn't show the emotion behind the words when making important decisions, making misinterpretation possible (Sánchez, Hernández, Penagos, & Ostróvskaya, 2006). IM however could be handy to just quickly discuss a part of a project and discuss the options available within other co-operators. With voice there is more direct communication, it shows more emotion and has less room for misinterpretation, but it is not always possible to talk. This may be due to the fact that the area where one person works is too noisy or to public. Conferencing is also an option to allow important decisions to be made. Because people can see and hear each other, they will experience a more natural way of communication (Rourke & Anderson, 2002).

At last a discussion page can be offered. This could be handy when multiple people are involved but aren't available in the same time slots. This could also be done with e-mail, but the possibility occurs that data get mixed up and e-mails get lost within their mailbox when using e-mail for discussion.

7.3.3. Community

A community consists of members that are represented by people. These people cooperate together to reach their goal. The goal can differ slightly per member or group of members, but they all contribute to the main goal as a community. The people in the community arrange a working structure, for example dividing all the members in smaller groups that work on specific tasks. Within this community the structure to work is defined by first defining a goal. This goal is important and will help the members understand what they are doing and what needs to be reached at the end. Within the platform the goal should be well defined and the progress of the goal should be visible to all the members, helping them to see the progress and motivating them to work on the goal. (Belassi & Tukel, 1996) The community and its members use the platform to reach their goal and define the structure of working. They define the rules and policies of working. This could be done by a group of members that are hierarchically higher within the community or by self regulation, depending on the cooperation.

7.3.4. Version management

A more technical aspect of the framework is version management. Version management is needed to help the co-operators to find the latest version of a document. Many people that have used e-mail to cooperate with one or more other people will probably know the problem with different versions. One version is being send to everybody, a second version is made by two different persons, both correcting mistakes and adding new parts, resulting in at least two new corrected versions of a document and in worst case ending up with many different versions, where nobody exactly knows anymore which version was the correct one. Surely this can be prevented by good communication, but still it seems confined to let the platform also handle version management when all data is already centralized within the platform.

Real time editing of data with the use of operational transformation provides a way to make sure that the newest version is always available to everybody. This is handy when you are working with more than one version, and is a preferable solution above the e-mail problems described earlier. Another option must also exist to submit versions of a document, because when we are changing things, and merging of edited data is done as is done by Google docs, we end up with many subversions of a document. In this case it usually is unclear what changed except when you open the subversions of a document and compare them with the latest version. This is why it could be handy to make a function that allows the people, that edit the version, to create a version of a document and add notes of what has been changed and done. All of this is handy so that it is clear what has been changed over time by whom, when an older version needs to be restored. These two functions will help to manage the different versions of documents,

creating also the submission of a version and allows management to only review new finished versions of a document. This can later on be used to define the progress of a goal.

7.3.5. Control and responsibility

When the platform is being used it is important to define the responsibility of certain parts of the system. This makes managing the system more easy and reliable. Auditing the system on changes being made allows control over the created data. Important here is that a controlling mechanism gives insight in who access what and whether this access is prohibited or not. This allows security issues to be noticed and properly deled with.

7.3.6. People first

A platform can be handy to use, but still people need to work with it. That is why when creating such a platform the first thing to look at is how it is going to provide support in such a way that the co-operators benefit from using the platform. They need to have the feeling that the platform supports them and not that the platform makes their work more complicated. So first look what people can do with functions, and think about the looks and feels, before implementing these functions.

The success of a platform is not only the functionality. Also the looks and feels of a product are important. Good looks and feels can make or break a product as shown by upcoming brands on the market. (Fisher Kellner, 2003)(Ireland, 2011)

7.3.7. Technological advantage

The platform should use techniques that provide a solid manner to cooperate. For example Google docs works good for editing and making simple office documents, but lacks some functionality that Wikipedia offers. More important, it should be used from a centralized place. This is why a cloud service or private cloud should be used to host the platform, providing accessibility through the internet and allowing the co-operators to work together via a web browser. The technology used should also be compatible with other programs, allowing distribution between platforms when needed.

7.4. Conceptual platform

With the framework in place it's time to draw what this platform would look like and what functionalities would be needed.

In the basis the platform needs:
1. Tools to create documents;
2. A good version management system;
3. Some way to keep track of progress being made;
4. Ways to communicate;
5. A system to manage access;
6. Document linking to other files within documents that are outside or in the system.

An online office suite should be integrated within the platform to allow the creation of documents and the ability to create and edit new documents. This system needs to be able to do operational transformation, so that multiple people can work at the same document simultaneously and the document is automatically saved with every change made. Also there should be some form of mainly saving documents to allow document version submission. This save function needs to provide space for a description and a version number and also information of persons that worked on the document should be included. With these functions in place, the creation of documents and version management is in place.

Next to an office suite, the platform should offer extendibility of the applications used. This should be done by allowing modular applications to be implemented within the platform, allowing new features to be implemented without having to change the underling platform.

The version management system can then be used to keep track of progress. This progress should be linkable to the goals that are defined within the system, allowing for a progress bar to be shown to the users of the system. Within this progress bar the idea is that people know their goals and the total goal of all co-operators, and get some feeling with the project. Within the whole platform a communication system that allows sharing data and communication of different forms should be implemented, such as IM, e-mail, voice and conferencing. These functions need to be able to be used within the online office suite, allowing co-operators to communicate with people working on, and in the same documents.

It is very important to have a system to manage access to the system. This system should provide a way of allowing people to enter certain documents, but, more important, prohibiting access to unwanted or not allowed access of documents. This also includes sharing documents via e-mail or other ways. By not allowing persons to e-mail certain content to other persons outside the platform, we get more control over what is happening with all the data within the platform.

The linking of documents together, to allow easy accessing of background or additional information within a document, should be integrated in such a way that all documents can be linked together or even get specific information from a spreadsheet to a text document, automatically update changes being made to linked documents.

The whole platform should run from one location so that everything is centralized, with easy

access from within the system and making it more manageable. It is also important that the system is able to grow in size and functionality, because offering basic functions will allow people to see new opportunities, and by letting them extend them they might create a platform that offers all functionalities that are needed for their group of co-operators. The system should also log activities that are conducted within the system, making it auditable to see what has been done by who and when. This to prevent prohibited usage of the system.

The system should allow the formation of different access groups and allow every different access group to have their own sub goals to the defined total goal. It could also be handy if the system could manage multiple projects simultaneously, allowing the platform to be operative in more than one project. Also the system should be able to grow with the demand of the users, providing scalability and extendibility of the system at any given point of a project.

The platform should allow the users to customize parts of the layout to their needs so that for example colour blindness and other handicaps can be deled with.
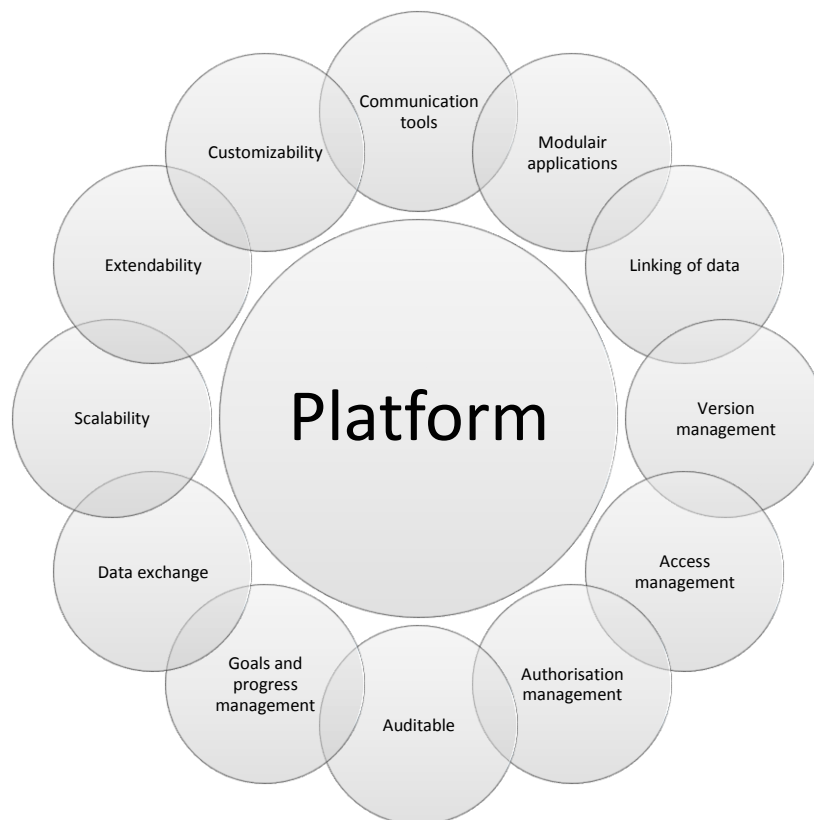This all leads to a platform as illustrated in figure 6.

Figure 6

This platform should run from within a cloud. This could be a cloud service or a private cloud, depending on the cooperation and available resources. By centralizing all resources into one

platform, users can manage their work more easily and don't have to run different applications for different tasks.

The platform should be easy extendable, but before implementation of a new function is done, a review is needed whether this function benefits the cooperation. This is because if you run all business applications from all different departments from one platform this might end up in a chaotic unmanageable system. In the vision of the platform providing exchange with other platforms is a plus, but not everything should be run from within one system. Every function should have a goal that benefits the cooperating partners to create and work on their projects.

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7.5. Vision of digital cooperation

The platform is a vision on digital cooperation, allowing everything to be done from within one centralized place. The risk here is that the platform, like many others that have a collaborative and or cooperative meaning, ends up being a big system. A consequence of ending up in a big system is that it supports the users, but you end up with changing the way the users work and restricting them by prohibiting them actions that were possible before the system was in place. This is why a new solution should always be driven to support the users and not the other way around.

Its better to have a simple solution where the goal and vision is understandable by the users, than to have a solution that is complex and allows many things, but nobody except the IT department seems to understand what it is doing.

7.5.1. My vision

Digital cooperation will move from private networks into third party clouds, helping organisations to provide an agile solution to support their business processes. Although I think that many things will move from a physical application on a desktop or laptop to a web browser used as alternative, I think that it will still take many years for people to get used to this concept and making the change of using a web browser or app to instead of a locally run application.

IT will be more of a utility, like electricity is today, making the same evolution, like electricity from every company having their own electricity generators, to power plants providing the needs of many users at once.

8.Proof of concept

As a proof of concept for this thesis an interview was held with J. Groenewegen (MSc). He has been responsible for managing the content management platform within the Radboud University Nijmegen, but now J. Groenewegen (MSc) is responsible for managing a diverse range of applications within the Radboud university Nijmegen as Coordinator student systems. This includes managing all the IT-related concern wide systems for students, like: a student portal, e-mail and Share. As manager of different student systems, J. Groenewegen (MSc) is known with the needs of users, who use different types of systems.

Within the interview J. Groenewegen (MSc) gave feedback on the concept that is described in chapter 7.
The concept was presented with explanations of cooperation, cloud and cloud computing. This was followed by an explanation of cooperation in the cloud and the concepts behind this. Finally the conceptual model and platform where explained and discussed.

At the start of the interview cooperation was discussed, here we talked about the different forms of cooperation. When we talked about voluntarily and coerced cooperation J. Groenewegen (MSc) was wondering if forced by need and forced by superior were different within this concept. This wasn't so, because of the scope of this thesis and the scope of the paper where this definition was from. After defining cooperation we spoke about things that can influence cooperation, like culture, distance and communication. Here J. Groenewegen (MSc) asked about anonymity and how this relates to power distance (PDI),. The example given here was that you may use an idea box to complain against a superior, but wouldn't do this directly in a face to face conversation. This was an interesting dilemma, but wasn't in the scope of the thesis. After we finished talking about cooperation we briefly discussed cloud, because we both were on the same line with regard to the definitions as described in this thesis.
After we finished talking about cooperation and cloud, a short explanation of the research field was given. Here the differences were given between sharing and creating in a cooperation. J. Groenewegen (MSc) asked about one way cooperation and whether this was part of the scope. Also validating creation was discussed as something that J. Groenewegen (MSc) was missing.

After we agreed on the definition and the research field, as are described within this thesis, we began talking about the conceptual model and platform.

The conceptual model was explained, using concepts of Wikipedia and Google, because every part of the conceptual model is retraceable to Wikipedia and or Google. First we talked about the community pillar, with Wikipedia as example. We also talked about how goals can help to motivate a community and we agreed on its use. After talking about the community, we talked about the need to communicate and why this is important. The separation of discussion and interaction also was discussed, and J. Groenewegen (MSc) had no comments on this part. The structure had some interesting discussion points, one of them being the managing part. J.

Groenewegen (MSc) his opinion was that this could better be split off the structure pillar and placed within a separate pillar, named control and responsibility.

We agreed upon this new pillar and discussed what fell within its range. J. Groenewegen (MSc) came with two important points: edited by and edited on. This to make it traceable what has been done by whom. Within the pillar control and responsibility, the ownership of a part of the data is important. We agreed upon the need to add this pillar, and by looking to the conceptual model you now notice that this extra pillar has been added.

At the last pillar, version management, we looked at operational transformation and agreed that this would add many benefits to the platform, also submitting of versions seemed important for the platform.

After discussing the conceptual model we looked at the conceptual platform. Here we looked to each circle and talked about its function. When we talked about the office suite circle, J. Groenewegen (MSc) asked why it wasn't called modular applications, because this seemed more fitting. We talked about the option of using the best of breed. By allowing online apps and tools to be integrated within the platform, it would easily allow the users to customize the platform to their needs. Customization is also a circle that was later on added, because of this discussion. We agreed that these two changes would benefit the overall platform.

J Groenewegen and I agreed upon most of the circles quite quick, and after we finished talking about the conceptual platform as showed, J. Groenewegen (MSc) came with some points he was missing. He said that he missed three points: authorisation, customisation and auditable. Authorisation management was needed in J. Groenewegen's (MSc) opinion to allow control over access to data. Customisation was needed to allow users to change the layout and functions to their needs, so that the platform could easily be used by them. Auditable was needed to be able to trace back the changes were made. We agreed, after talking about these topics, that they needed to be added.

Most changes J. Groenewegen (MSc) suggested were implemented within the concepts, improving the conceptual model and platform.

8.1. Workable

When looking to the workability of the platform, it seems that all aspects are covered. Surely not every area is 100% described, but this is due to different situations and requirements. The platform covers the most important areas for a cooperation platform, and because of its modular structure it is extendable to specific needs.

When looking to the cooperation capacity, this platform offers all important tools to do so. Because functionality can be added, later on the platform can grow with the needs within a cooperation. Also the option to later on change functions, by integrating other or improved versions of an application or tool, gives the system the ability to provide what the users need and want.

8.2. Desirable

Building a platform like described, within this thesis, is a large task that probably can only be undertaken by an experienced team of developers. The best way to make this platform, is using already available elements, like an online office suite and file share possibilities. This mainly because of one reason: Why should build something when other people already have a good solution? Although, when implementing, already build components can have a negative side effect when no good agreements are made with the software providers.

The platform can work, but it would be smart to develop the system in a modular structure, delivering every part separated and leaving room for adding and removing functions, when building it. This is mainly because of changing expectations of the users and the possibility to replace functions. This allows implemented functions to be improved without having to change the whole platform. Also the option to exchange information with an already present platform should be build into the platform, to allow stand alone usage of the platform and integration to an already existing environment. This is to make migration and or integration of a new platform more easy.

8.3. Limitations

Because of the complexity of platforms like described in previous chapters, we can conclude that the biggest limitation of a platform as proposed, is the money and the expertise needed to create it. This can limit the functionality provided within the platform.
This is why there should be a clear vision on what would and wouldn't fall within the scope of this project, when conducting a project, like making the suggested conceptual platform. This also includes an analysis of the downfalls when you will not implementing a function.

One of the other limitations is that the system would get to big and to complex, creating room for errors. This can make the system somewhat unstable and may require patching the platform.

Conclusion

Within this thesis the concepts of cooperation and cloud/ cloud computing are described and used to conduct a research on how an online cooperation platform should be designed and which functions should be offered.

On the question what cooperation is, the answer was given by looking at different definitions. We can conclude that cooperation is a group of persons working together on a common goal. This can be done in a communicative manner, but isn't always needed. When we however do cooperate, we deliver better results when we do this out of freewill.

When looking what cloud and cloud computing is, we can say that a cloud is a network, like a LAN or a WAN. This cloud can be of different types, like a private, community, public or hybrid cloud. Cloud computing is a service that is provided and offered in IaaS, PaaS or SaaS structures.

When combing the concepts of cooperation and cloud we can distinct two types of digital cooperation sharing and creating. Creating is when persons cooperate to create new product and idea's, sharing is the exchange of data

On the research question: How can cooperation to create be supported by the use of cloud computing? the answer is clear a solid platform is needed to allow experts of different expertises to cooperate. A solution is described in chapter 7 and build with the ideas behind Wikipedia and Google. This resulted in a conceptual platform that offers the most important functions to allow co-operators to cooperate. Important for such a platform is that it provides a stable environment to cooperate and does everything from within a cloud environment.

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Radboud University Nijmegen