SOFTWARE AS A SERVICE: A FRAMEWORK FOR ENTERPRISE E-MAIL APPLICATIONS

Komal Gupta

Master Thesis

August, 2010

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“Clouds come floating into my life, no longer to carry rain or usher storm, but to add color to my sunset sky.”

- Rabindranath Tagore

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EXECUTIVE SUMMARY

For any business be it a road-side bakery shop or a MNC conglomerate, IT Infrastructure has become an integral part of the business need today. Although the IT hardware needs of a company continue to fluctuate, with the ever-changing economic clime, it is becoming all the important for businesses to be updated in terms of the software that they use. Be it an e-mail solution or CRM system, or retail POS software, quick implementation, installation and updates to software have become all the more essential to enable the businesses to understand the business trends, especially in such economically challenging times.

Large upfront licensing costs, maintenance, operations and support issues and delayed software deployments are problems that are keeping companies from focusing on their core business and are raising IT costs sky high. Such delays not only result in increased costs, but can sometimes also impact the companies' key business growth plans.

Could Software as a Service (SaaS), a (new) way of software deployment, possibly be the solution to all the above problems?

Many seem to claim so. There are skeptics who believe SaaS is just a hype and disagree. Rather than providing clarity, the ongoing discussions on this topic across various forums are making companies even more confused. This thesis aims at taking away the confusion by providing an overview of the ins and outs of the SaaS business model.

Our research objective consists of three parts:

1. Giving the reader an understanding of SaaS
2. Creating a detailed overview of the benefits and risks of SaaS
3. Defining what considerations need to be made before deciding to implement a SaaS based e-mail application

So, what *is* SaaS? In short, SaaS is a way of software deployment where companies 'rent' software, infrastructure and support rather than buying it. SaaS is basically an alternative to the traditional software deployment model in which clients buy software that is located on their premises. There are several definitions of SaaS, but all come down to five characteristics:

- *Hosted software.* SaaS is a software distribution model in which applications are delivered, maintained and upgraded (i.e., hosted) by a vendor/service provider;
- *Network based delivery*. Services are delivered to customers over a network, typically the Internet;
- *Pay-per-use*. SaaS is a subscription-based service model;
- *Multi-tenant*. A SaaS application typically has a multi-tenant architecture;
- *Customization through configuration*. A SaaS application is typically configurable, but not customizable. In other words, SaaS applications are generally not tailor-made.

We focus on enterprise e-mail applications as we are seeing major changes in the SaaS e-mail market: Google and Microsoft are bringing their SaaS offerings into the market and on the client side large companies are moving their e-mail data to these providers.

The benefits and risk of SaaS are derived from desk research and five case studies. The case studies are done by means of interviews with companies who implemented SaaS based e-mail applications and companies who chose not to implement it. Being able to focus on core business, decreasing implementation time, decreasing initial investments and increasing global accessibility are some of the well known benefits of SaaS. On the flip side, SaaS could also increase the risk of losing business critical data, SaaS applications are less tailor-made and with SaaS availability, reliability and performance issues are to be expected, depending on the technological solution of the SaaS provider.

After analyzing the case studies, desk research and interviewing SaaS experts we determined that companies need to focus on eight areas in order to assess whether SaaS will create business value for them or not. These eight areas, presented in our SaaS Decision Making Framework, are:

- Motivations for SaaS
- Legal, security & ethical issues
- Tailor-made versus off-the-shelf
- Integration
- Migration
- End-user awareness & acceptance
- Evaluation of benefits & risks
- Cost analysis

We conclude that SaaS will create more business value than any other software deployment model if the two criteria below are met:

- SaaS provides superior quality and improved implementation compared to premise based enterprise e-mail.
- Solutions are found for legal, security & ethical issues, the requirements for tailor-made versus off-the-shelf software, integration, migration, end-user awareness and acceptance issues.

The first criterion is met if end users are positive about the SaaS application and if the level of integration and migration that is required in the implementation is low. Whether SaaS meets the second criterion can be checked with our SaaS Decision Making Framework. In the framework we give step-by-step guidelines for finding solutions to the addressed risks.

Although a SaaS implementation might seem straight forward, the case studies show the need for an intermediary party to manage the implementation process. With the help of our SaaS Decision Making Framework Accenture can fulfill this role by guiding companies in their decision making process.

ACKNOWLEDGEMENTS

With this thesis I will be completing my Masters of Business Information at the University of Twente. My journey at this university has been longer than I expected, but it has also taught me so much more than I expected. I specially learnt a lot during my master's thesis assignment. Not only about Software as a Service and Cloud Computing, but also about working for a high profile company, about communicating, planning, learning, conducting a research, about life in general and moreover about myself. It has been a rocky road with ups and downs, but as I look back today at the end of this journey I can say that it's been an amazing experience.

As a student you feel protected and safe within the university walls amidst your books, co-students and professors. Working for a company like Accenture made me see the "outside" world. I realized it is quite different than what I was used to at the university. At first adjusting to this new environment seemed a bit difficult, but after some time I picked up the pace and found myself feeling at home. Much of the credit for this goes to my amazingly friendly and helpful colleagues at Accenture. You were always ready to guide me around, up for discussions or casual chit chats during lunch breaks or Friday afternoon drinks. Thank you all.

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1 INTRODUCTION

This research project is a result of the collaboration between the University of Twente and Accenture. This chapter gives a description of the organizational context, a short background of the research topic, problem statement, research questions, methodology and structure of the research.

The research aims at studying the ins and outs of the Software as a Service (SaaS) business model for enterprise e-mail and determining how this emerging technology can be used to eliminate the problems that companies currently experience with on premise e-mail systems, such as large upfront licensing costs, maintenance, operations and support issues and delayed software deployments. An example of SaaS based e-mail is Google's Gmail service.

1.1 ACCENTURE

Accenture is a global management consulting, technology services and outsourcing company. Combining unparalleled experience, comprehensive capabilities across all industries and business functions, and extensive research on the world's most successful companies, Accenture collaborates with clients to help them become high-performance businesses and governments. With more than 190,000 people serving clients in more than 120 countries, the company generated net revenues of US$21.58 billion for the fiscal year ended August 31, 2009.

In 2005 Accenture, being one of the first consulting firms, took the first steps towards SaaS. Along with market leader Salesforce.com, Accenture started consulting companies in their process of changing their traditional Customer Relationship Management (CRM) systems into SaaS CRM developed by Salesforce.com. In recent years, Accenture has started doing more research on several other types of applications delivered through the SaaS model. This research was initiated by the Workplace Technology and Collaboration service line, a part of the Technology Consulting group. Accenture Technology Consulting translates the client's strategic agenda into IT initiatives that measurably improve performance. Combining a solid understanding of business processes with deep industry knowledge and implementation rigor, Accenture Technology Consulting gives IT leaders practical solutions tailored to address the most crucial business challenges. Technology Consulting helps companies leverage technology to drive high performance. Accenture's Workplace Technology and Collaboration solutions help organizations use information technology to automate common workplace activities. Accenture teams closely with clients to help them shape a next-generation workplace and implement the work processes and IT infrastructure required to deliver high performance. Accenture's vision of the next-generation workplace redefines the workplace as being wherever and whenever your employees need or want to work-from any device, anywhere, anytime.

Accenture Workplace Technology and Collaboration is interested in finding out how clients can leverage from this young technology named SaaS and what role Accenture can play in a SaaS implementation scenario. Our research is a result of this recent development.

1.2 A BRIEF REVIEW OF SOFTWARE AS A SERVICE

In short, SaaS is a software deployment model in which an external provider hosts an application on a subscription basis to companies (further indicated as clients) over the Internet. Clients usually pay a monthly fee to the provider and in return clients can use the application 24x7 from any location. SaaS, currently one of the hottest topics in the computer software industry, is basically an alternative solution to the traditional software deployment model in which clients buy software that is located on hardware on their premises and is also owned by them (Dubey and Wagle, 2007). Although many sources describe SaaS to be new and innovative, the concept of SaaS has already

been around for a while. According to McDonough (2009) and Linthicum (2010) the concept was already used during the time of the mainframes. People didn't have desktops back then, but signed in through a terminal in order to access software running on the mainframe. Now with the wide acceptance of personal computers and easy and cheap access to a broadband connection, the concept is gaining momentum. The delivery of software through the Internet in the form of a service first started with simple applications provided by Applications Service Providers (ASP). What makes the SaaS model new compared to software provided by ASPs is that SaaS applications are based on Rich Internet Applications (RIA). RIAs are interactive internet applications that give the user the look and feel of using a desktop application.

The difference between SaaS and traditional software (sold with licensing and often with a maintenance contract) can be explained by the example of a water tap. Using a software application is comparable to tapping water. If you want water running from your tap at home, you can chose out of two scenarios. The first one is that you drill a hole in your back yard and keep drilling until you hit a water source, then you buy and install a water pump and start pumping water out of the ground. In order to have clean water, you will also need to buy a filter and connect the pipes correctly. In this case you own the water pump, you control it and maintaining it is your responsibility. In other words, if you wish to make use of an application, one way to do it is to approach a software company and get the application developed by them and installed on premises. This is a time consuming and costly process, but all hardware and software in this case is physically present at your premises. It could give some people the feeling that everything is secure; the water you are drinking is clean. If anything happens, you will be able to see it immediately and do something about it. You have it all under control. This is what is called the on-premise solution.

The other scenario, the SaaS solution, is that you search for a water provider and the water provider plugs you into its infrastructure of pipes that run across the city. You can tap water anytime you want just by opening up the tap. The only thing you need to do is purchase a tap and subscribe with the water provider. In this case, you don't have any control over the water. You have to trust that the provider filters it correctly and that you are able to drink water at any time you wish. The provider is responsible for providing you with water and maintaining the pump, filter and infrastructure of pipes. Although things might not be under your control directly, the installing and maintaining issues that you would have with the on-premise solution are now alleviated.

This simple example shows the difference between SaaS and traditional software deployment: in a SaaS model the company whose data we are talking about doesn't own the software. The company becomes a client of the provider and takes the application as a service from the provider on the basis of a pay-as-you-go or pay-as-you-use model. Figure 1 and Figure 2 show an overview of how the IT landscape of a company changes when moving from a traditional to a SaaS deployment model.

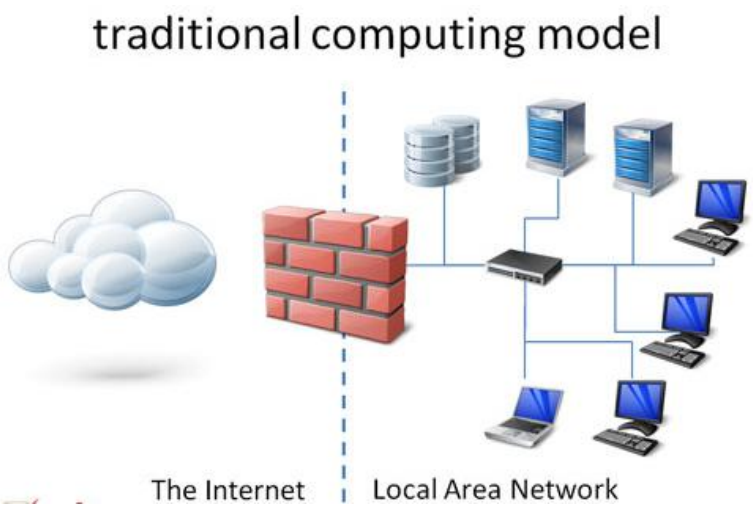

Figure 1 Traditional computing model (Clio, 2009)

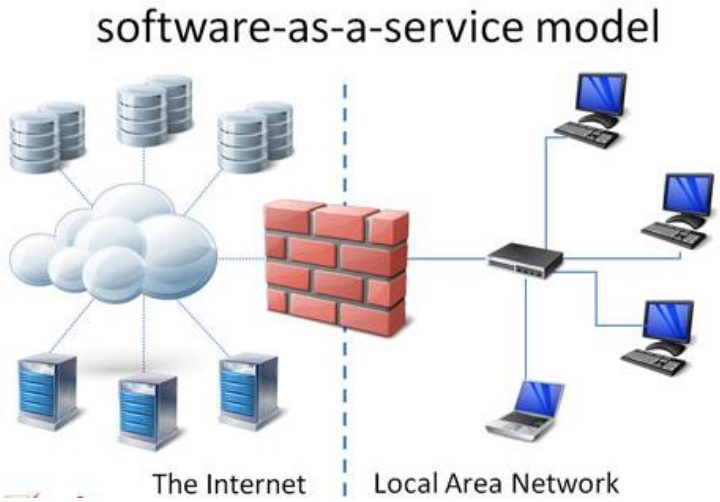

Figure 2 Software as a service model (Clio, 2009)

The monthly fee that the client pays to the provider depends on the number of users or the usage of the software. The software is owned by the provider and the data of the client is usually stored at the side of the provider, not on premises of the client. Often the client doesn't know where its data is stored. It could be on the other side of the world. Mostly there are several copies of the data spread over several locations in the world. According to this model, not only is the responsibility of purchasing and installing hardware shifted to the provider, but also maintenance, operations and support issues become the provider's responsibility.

One of the benefits of this software delivery model is that it alleviates problems such as large upfront licensing and maintenance costs that many companies are coping with, especially in current economic times. The frustration with on premise applications and the technology maturity are also drivers for the acceptance of SaaS, as shown in Figure 3. (Kandysoftglobal, 2005)

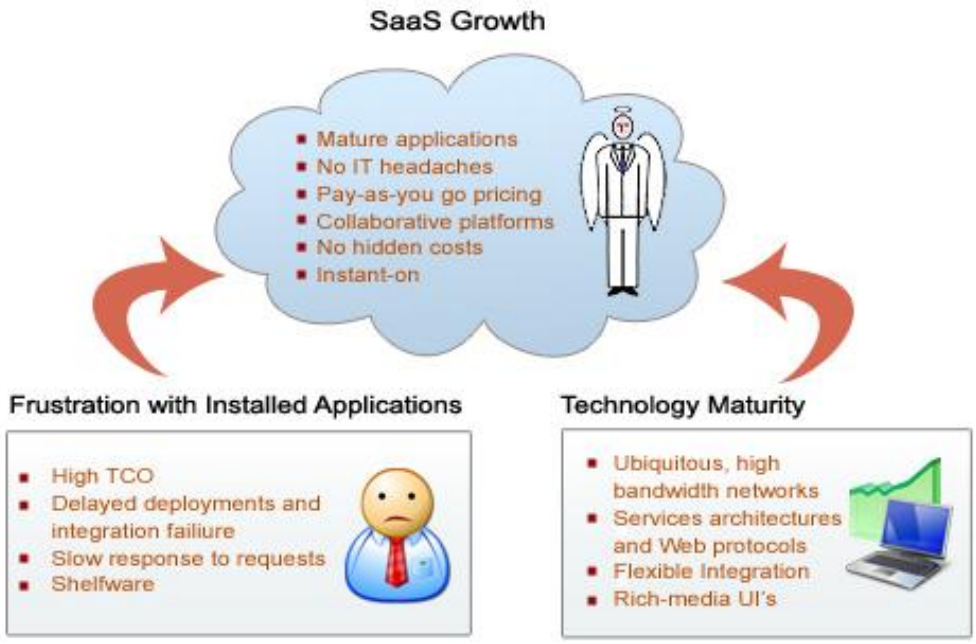

Figure 3 Drivers of SaaS Growth (Kandysoftglobal, 2005)

According to Gartner reports (Cain, 2008), we are in the middle of an explosive growth in SaaS based enterprise e-mail deployment. In 2007 only 1% of all enterprise e-mail was SaaS based. Gartner predicts that by 2012 around 20% of the enterprise e-mail market will be SaaS based; a growth of 2000% in 5 years. The maintenance, operations and support problems of traditional software deployment combined with the technology push from the SaaS vendors, catalyzed by the current economic situation, are believed to be the key drivers for the acceptance of SaaS. (Essers, 2008) The market is changing fast and although there are many blogs and discussions to be found online, little scientific literature is available on this topic.

Currently the SaaS business model is used to deliver several types of applications; Content, Communication and Collaboration applications, Customer Relationship Management systems (CRM), Human Resource Management (HRM), Enterprise Resource Planning (ERP), Office suites and Digital Content Creation (DCC), Supply Chain Management (SCM) and other applications. Figure 4 shows the growth of these applications from 2005 up to 2011 expressed in revenues in millions of Dollars. E-mail applications are part of the Content, Communication and Collaboration category.

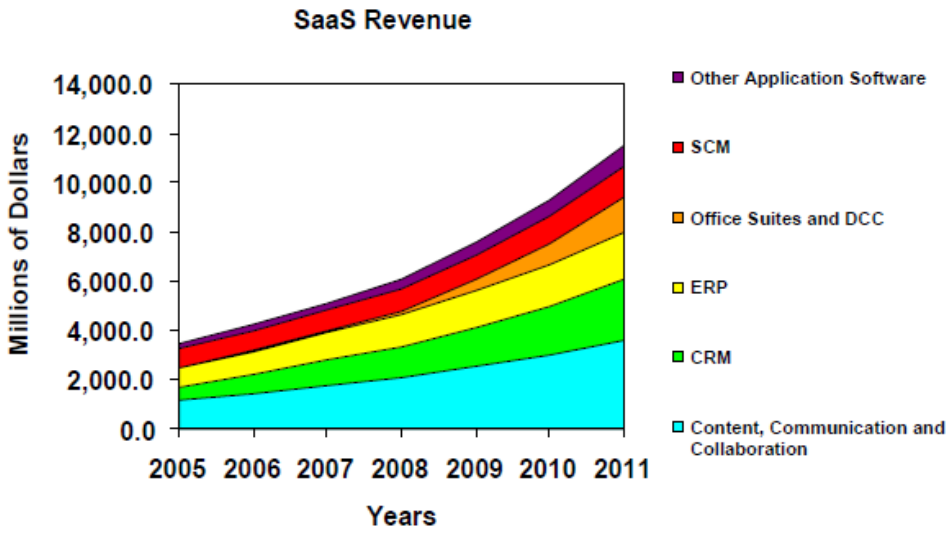

Figure 4 Software as a Service market trends (Mertz et al., 2007)

The current status of the SaaS market is unstable. Major changes are taking place. The market is growing at a high pace towards a future state in which more and more applications will be delivered through SaaS and with a high adoption rate of SaaS by customers.

1.3 Problem Description

If we study the market more closely we see that in the past two years there have been major activities going on in the e-mail market on the vendor side; Google entered the enterprise e-mail market by acquiring e-mail hygiene supplier Postini; Microsoft launched its Exchange Online services; Yahoo bought Zimbra; Dell acquired SaaS provider MessageOne. These developments show that the vendor side of the SaaS market has been highly active. However, the pool of customers that the vendors have been chasing is a small one. The 1% of the market is estimated at 1.5 million users of a total user base of 150 million e-mail users (Cain, 2008). The other 99% has the enterprise e-mail systems deployed on premises. According to the Gartner research the barriers to market growth have been price and brand. Until now only small businesses (with up to 1000 users) find SaaS solutions economically interesting. Larger businesses have been hesitant because they are reluctant in handing over business-critical data.

One might think that if SaaS is eliminating maintenance, operations and support problems, then why is the SaaS e-mail user base still so small? Although the benefits of SaaS are being understood by companies, these companies are also concerned about the risks involved with SaaS. The debates on the benefits and risks involved with SaaS solutions compared to traditional solutions are ongoing. Implementing and maintaining an e-mail system within the walls of your office is not an easy job. Such projects are accompanied by hardware costs, large upfront licensing costs, support costs, upgrades, a backup and recovery architecture, and a security architecture to name but a few. Others say that by opting for a SaaS solution, a company is no longer burdened with these problems and can focus on its core business. One major concern of the companies is security of the company's data. According to the SaaS model, the company's data is physically present at the datacenters of the provider. Therefore, companies are concerned about losing control over the data and introducing security, vulnerability and integration headaches (Fonseca, 2008). End-users are concerned that the SaaS application will not be as functional and as fast as premise based applications. The recent failure stories of high profile hosting providers (Miller, 2009) add up to this and make the growth of the market more difficult.

As the success stories of enterprise e-mail SaaS projects are slowly growing, more and more companies are showing interest in this emerging technology. The decision of transforming their IT landscape into a SaaS based deployment model requires thorough assessment of the pros and cons of SaaS. Also, it is not clear what considerations the companies need to address in order to assess whether to implement SaaS or not.

Thus, the problem identified here is defined as:

The pros versus cons of Software as a Service and the considerations to successfully implement Software as a Service based e-mail are not sufficiently studied for potential users to make a well balanced adoption decision.

The proposed research aims at addressing these two uncertainties. The research is partly an analytical and partly a design research. The analytic part of the research will comprehensively discuss the benefits and drawbacks of SaaS based e-mail applications. Based on these findings, a framework will be designed that companies can use to assess whether SaaS is suitable for them.

1.4 Research Objective & Scope

The objective of this research is to clarify the pros versus cons and to design a framework that incorporates the technical and business side aspects that a company needs to consider and deal with when transforming their IT landscape into a SaaS based delivery model. If SaaS seems to be a promising technology for a company, the designed framework can be used as a guideline to achieve business development by SaaS.

In order to determine whether SaaS is a promising technology or not, we investigate two different aspects of the technology; the product aspect and the implementation aspect. We define that SaaS is perceived as being promising when it provides superior quality (product aspect) and when it improves the implementation process in comparison to a premise based solution (implementation aspect).

We have defined the scope of our study by selecting the enterprise e-mail application from all these applications that can be delivered through SaaS, because the enterprise e-mail SaaS market is still young yet promising. In recent years e-mail has become a crucial part of the modern business.

Although e-mail SaaS applications are popular with individuals (Gmail, Hotmail, YahooMail), enterprises are still reluctant in moving their company's mail data to an external party. Clients have shown interest in e-mail SaaS after seeing the popularity of SaaS on other fronts such as CRM and SCM. Accenture has identified the need for further studies on the area of SaaS in order to provide a fitted solution to their clients. Some of the areas to be researched are: understanding the SaaS based e-mail delivery model, how SaaS based e-mail can increase business value for the client and what role Accenture can play in the SaaS ecosystem.

1.5 Research Questions

The main research question that defines this research is stated below.

Does Software as a Service enterprise e-mail provide superior quality and improved implementation compared to premise-based enterprise e-mail and what considerations do companies need to make before implementing a Software as a Service based e-mail application?

The research exists of three main parts. This structure is seen in the sub questions below.

1. What is Software as a Service?

2. What are the benefits and drawbacks of Software as a Service, both quality of product and implementation wise?
3. What considerations do companies need to make before implementing a Software as a Service based e-mail application?

The answer to the first sub question will be a State of the art of SaaS. The answer to the second question will be given by means of the pros versus cons analysis. At this step we will investigate in detail what the benefits and drawbacks of SaaS based enterprise e-mail applications are. As discussed earlier, this will be done on two levels: product and implementation level. Finally the third question is asked to identify the considerations that need to be made before implementing SaaS.

1.6 METHODOLOGY

Our research consists of three main sections structured by the three sub questions; 1) the state of the art of SaaS, 2) the pros versus cons analysis and 3) the framework that defines the considerations to be made before implementing SaaS. Each sub question or section has a distinct research method.

Table 1 Research Methods

Sub Question	Research Method
1. What is Software as a Service?	Desk Research
2. What are the benefits and drawbacks of Software as a Service, both quality of product and implementation wise?	Desk Research, Case Studies
3. What consideration do companies need to make before implementing a Software as a Service based e-mail application?	Design Research

The goal of the state of the art is to gain a deeper understanding of the latest developments on SaaS. Thus, this phase of the research is conducted by means of desk research. All the material is collected through a literature review. The next step is to identify the benefits and drawbacks of SaaS based enterprise e-mail. From an initial investigation we have learnt benefits and drawbacks of SaaS can be found through literature review, but in order to perform a thorough analysis a case study is conducted to add to the results of the literature review and to validate these results. Finally, a design research approach is used to design the transformation framework. The gathered data from the first and second sections form the basis of the design of the transformation framework.

The next two sections elaborate further upon the case study and design research approaches and describe how they are conducted.

1.6.1 CASE STUDY

The reason why we choose to perform case studies for this research is that case studies are performed in order to understand the dynamics present within a single setting (Eisenhardt, 1989). The setting here being the case in which a company is using SaaS based enterprise e-mail. The other reason for doing a case study is that case studies are used to perform qualitative research. By doing a qualitative research we aim at getting more in depth data of what people perceive as benefits and risks of SaaS. Case studies have some characteristics; small number of cases, perception of a few people, strategic sampling, in depth investigation and conducting the interview in the interviewee's natural habitat (Verschuren & Doorewaard, 2002).

Number of cases

The number of cases can vary from one up to ten cases. With regard to the time frame of the thesis project and the willingness and availability of companies to participate, we will perform five case studies.

Sampling

Because the number of cases is small, the selection of the cases is not done randomly but with strategic sampling. According to the case building theory of Eisenhardt (1989) if the number of case studies to be performed is small, it is advisable to select cases that are extremes of each other. Therefore, we choose the companies to be studied based on the extent to which they are willing to transform their premise based applications to SaaS based applications. One extreme is a company that has already transformed its premise based applications to SaaS based applications. We will study three companies that fall under this extreme. The other extreme is a company that is still using premise based applications and is not willing to take the transformation step. We will study two companies in this category.

Instrumentation

Our goal is to investigate in depth the benefits and risks of the SaaS business model. Therefore, the case study will be conducted by means of face to face interviews with open questions. In case face to face interviews are not possible, the interviewees will be taken over the phone. The interviews will be conducted with people within the company who were in some way involved with the decision making process of implementing SaaS. The interviews will be combined with literature review findings in order to achieve triangulation.

Location

The interviews will be conducted in the natural surroundings of the interviewee. This is because the interviewee is likely to feel more at home there, which will lead to more objective data. This means that the researcher will visit the interviewees on location and conduct the interview.

Analysis of the case studies

The data gathered from the case studies is analyzed in this chapter using the case building theory of Eisenhardt (1989). The results of the case studies are analyzed using the with-in case analysis and the cross-case pattern search described by Eisenhardt. With-in case analysis involves detailed case study descriptions. It helps researchers to gain a better overview of the often large amount of data gathered during the interviews. Overall, the aim of this part of the analysis is to get intimately familiar with the cases. The with-in case analysis is given in chapter 0. The next step which completes the analysis is the cross-case pattern search which "*forces researchers to look beyond initial impressions and see evidence through multiple lenses*" (Eisenhardt, 1989). The cross-case pattern search is described in chapter 0. In this article Eisenhardt also says that "*in reality people are poor processors of data and that they leap to conclusions based on limited data*". In order to reduce the risk of drawing the wrong conclusions, Eisenhardt describes three tactics. The first tactic is to select dimensions and search for with-in group similarities that are coupled with inter-group differences. The second tactic is to list pairs of cases and list similarities and differences between the pairs. The third tactic is to analyze each data per data source. For example, analyze the interview data separately from the questionnaire data. In our research we follow tactic one and tactic two. We use the first tactic for the with-in case analysis. The second tactic is used to the cross-case pattern search, because this tactic forces researchers to "*look for the subtle similarities and differences between the cases*." (Eisenhardt, 1989) This is exactly what we are looking for; the subtle similarities and differences between the cases. We don't use the third tactic, because we only have one data source.

1.6.2 DESIGN RESEARCH

The design research approach seeks to create new and innovative artifacts. One of the end deliverables of our research is a framework that will show the considerations that need to be made when deciding whether or not a SaaS based e-mail deployment model is a suitable solution for a company. This artifact, the framework, will be developed based on the guidelines discussed by Hevner et al. (2004). The guidelines are seen in Table 2.

Table 2 Design-Science Research Guidelines (Hevner et al., 2004)

Guideline	Description
Guideline 1: Design as an Artifact	Design-science research must produce a viable artifact in the form of a construct, a model, a method, or an instantiation.
Guideline 2: Problem Relevance	The objective of design-science research is to develop technology-based solutions to important and relevant business problems.
Guideline 3: Design Evaluation	The utility, quality, and efficacy of a design artifact must be rigorously demonstrated via well-executed evaluation methods.
Guideline 4: Research Contributions	Effective design-science research must provide clear and verifiable contributions in the areas of the design artifact, design foundations, and/or design methodologies.
Guideline 5: Research Rigor	Design-science research relies upon the application of rigorous methods in both the construction and evaluation of the design artifact.
Guideline 6: Design as a Research Process	The search for an effective artifact requires utilizing available means to reach desired ends while satisfying laws in the problem environment.
Guideline 7: Communication of Research	Design-science research must be presented effectively both to technology-oriented as well as management-oriented audiences.

The data to be used for the structured decision process will be collected through literature review, expert interviews and case studies. Several approaches to designing the framework can be identified:

- Design from scratch
- Extend an existing framework
- Combine two or more frameworks
- Use existing frameworks to solve the problem

During the initial desk research no framework was found that discussed the consideration steps. Therefore we will use the first approach and design from scratch.

2 SOFTWARE AS A SERVICE: STATE-OF-THE-ART

This chapter describes the state-of-the-art of SaaS: the past, definitions, terminology, benefits and risks of SaaS.

2.1 THE PAST OF SOFTWARE AS A SERVICE

In their article, Bennett et al (2000) talk about the need for a radical shift in software development; shifting the focus from a supply-side led structuring, developing and deploying of software, driven by technological advance, to a more demand-centric way. By definition the supply oriented approach works well for systems with rigid boundaries, such as embedded systems, but when it concerns systems without strict boundaries software development driven by supply-side will not work efficiently. In order to achieve the levels of functionality, flexibility and time to market required by users, the focus needs to be more demand-centric. In 1995 British Telecom recognized this need and formed a group named the Distributed Centre of Excellence in Software Engineering (DiCE) to research different and radical ways of software development. The software engineering experts developed a new approach to structuring, developing and deploying software, leading to a paradigm shift in the field of software engineering. This was the foundation of software delivered as a service. The shift first resulted in Application Service Providers (ASP) and later evolved into Software as a Service (Hoch et al., 2001; Jalonen, 2008; Luit Infotech, 2008).

There are many definitions of ASPs (Coorevits, 2002). According to Hoch et al. (2001) IDC (International Data Centre) was the one to coin the term ASP, therefore IDC's definition of ASP will be used in this thesis:

"An ASP deploys, hosts and manages access to a packaged application to multiple parties from a centrally managed facility. The applications are delivered over networks on a subscription basis. This delivery model speeds implementation, minimizes the expenses and risks incurred across the application life cycle, and overcomes the chronic shortage of qualified technical personnel available in-house."

ASPs gained popularity in the early 2000's mainly in the United States, but because of the lack of technological advance ASP did not become very popular. The applications that were hosted according to the ASP model were often delivered through a Virtual Private Network (VPN). This was perceived as being slow and frustrating to the end users (Flynn, 2008). The unexpected high cost of customizing, maintaining applications, bandwidth and infrastructure costs were some reasons why the ASP model was perceived as being inefficient (Luit Infotech, 2008). Papazoglu (2003) reports that applications provided by these ASPs were considered as having monolithic architectures, highly fragile, customer-specific, non-reusable integration of applications based on tight coupling principles.

The rapid developments in the field of web applications and standards boosted the development of on-demand applications. A new era of on-demand applications was indicated with introduction of the term Software as a Service.

2.2 DEFINITIONS AND TERMINOLOGY

This section contains definitions of SaaS and a description of the relationship between SaaS and related terms such as Cloud Computing, other "as a service" terms and SOA (Service Oriented Architecture).

2.2.1 SAAS DEFINITIONS

So far we have discussed that SaaS is an on-demand software deployment model where an application is hosted as a service, provided to customers over the Internet. Though much is written on and spoken about this topic, there is

no universally accepted definition of SaaS. (Hoch et al., 2001) The definitions below are taken from the market leaders in SaaS CRM Salesforce.com (SFDC), Gartner, Microsoft, IBM, Thinkstrategies and Accenture.

“Software as a Service (or SaaS) is a way of delivering applications over the Internet—as a service. Instead of installing and maintaining software, you simply access it via the Internet, freeing yourself from complex software and hardware management.” (Salesforce.com, 2009)

“SaaS is software owned, delivered and managed remotely by one or more providers. If the vendor requires user organizations to install software on-premises using their infrastructures, then the application isn't SaaS. SaaS delivery requires a vendor to provide remote, outsourced access to the application, as well as maintenance and upgrade services for it. The infrastructure and IT operations supporting the applications must also be outsourced to the vendor or another provider.” (Gartner: Desisto, 2008)

"Software deployed as a hosted service and accessed over the Internet." (Microsoft, 2009)

“In this model, application functionality is delivered through a subscription model over the Internet. The customer does not take ownership of the software, but instead rents a total solution that is delivered remotely.” (IBM, 2008)

“Software as a Service is a software deployment model in which an enterprise application is delivered and managed as a service by the vendor to meet the needs of multiple customers simultaneously.” (Thinkstrategies, 2008)

“Software as a Service (SaaS) is a software application delivery model where a software vendor develops a web-native software application and hosts and operates (either independently or through a third-party) the application for use by its customers over the Internet. Customers pay not for owning the software itself but for using it.” (Accenture, 2008)

Although each definition differs from the others, the idea behind the definitions of SaaS is the same. From various definitions the following key characteristics of SaaS can be extracted:

- *Hosted*. SaaS is a software distribution model in which applications are delivered, maintained and upgraded (i.e., hosted) by a vendor/service provider;
- *Network based delivery*. Services are delivered to customers over a network, typically the Internet;
- *Pay-per-use*. SaaS is a subscription-based service model;
- *Multi-tenant*. A SaaS application typically has a multi-tenant architecture;
- *Customization through configuration*. A SaaS application is typically configurable, but not customizable

Hosted

The defining characteristic of the SaaS model is that the applications that are used are hosted by an external party (the software provider or vendor). This means that the software runs on the provider’s premises. This is different from traditional on-premise software deployment where the software runs on the premises of the customer.

The term “hosted” might be confusing, because there is a difference between “software hosting” and SaaS. There’s an architectural difference between the two. “Hosted software” is the same to an application you might have on premises, but then running on a server in a third-party data center. Jainschigg (2008) states in his article how SaaS differs from “hosted software”:

"*True SaaS applications, in contrast, are multitenant at core, serving many customers on a single software instance and database infrastructure. Applications designed this way are far easier to scale on more robust platforms, far easier to manage by the host, and easier to make self-configurable by customers. All other things being equal, this combination should make SaaS applications more affordable and, ultimately, higher margin*."

Network based delivery

Typically SaaS applications are provided to clients over the Internet. The data of the client is stored somewhere on the Internet on one or more of the datacenters of the SaaS provider, usually an unknown location to the client. The only thing the client needs to access the application is a web browser and an internet connection.

Pay-per-use

The SaaS business model has a pay-as-you-go pricing strategy. In traditional software deployment the customer pays a large amount to the providers up front and in most cases has to wait for months before being able to use it. The pricing is according to the number of users or in some cases the number of transactions.

Multi-tenant

Multi-tenancy is a software architectural principle where a server runs a single instance of a software application that is shared by multiple clients (tenants) (Figure 5).

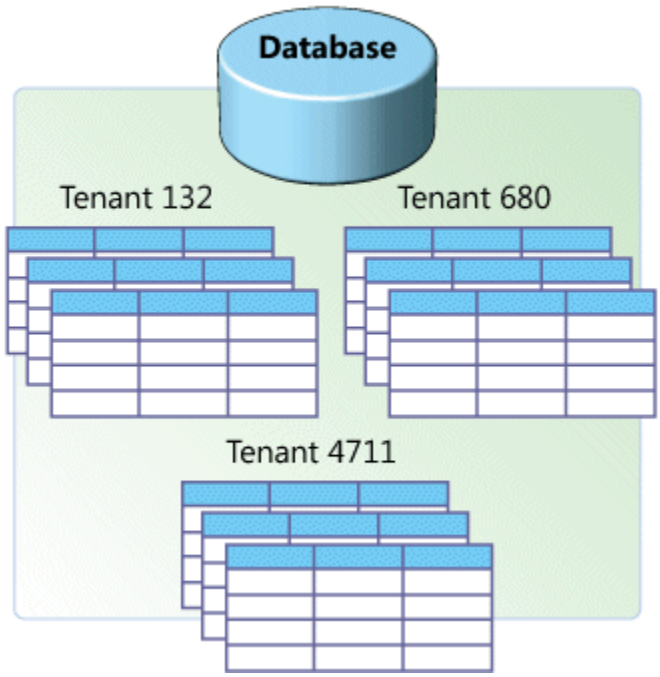

Figure 5 Multi-tenant architecture: a separate set of tables for each tenant in a common database (Chong & Carraro, 2006)

Thus the application runs on the same operating system, on the same hardware and with the same data storage mechanism for all clients. This architecture is profitable for SaaS providers because they can let several clients use one data storage instead of having a database for each client separately. On the other hand, it is also a reason why many companies don't chose for SaaS. They are worried about the safety and security of their data.

The opposite of a multi-tenant architecture is a single-tenant architecture in which client data is isolated (Figure 6).

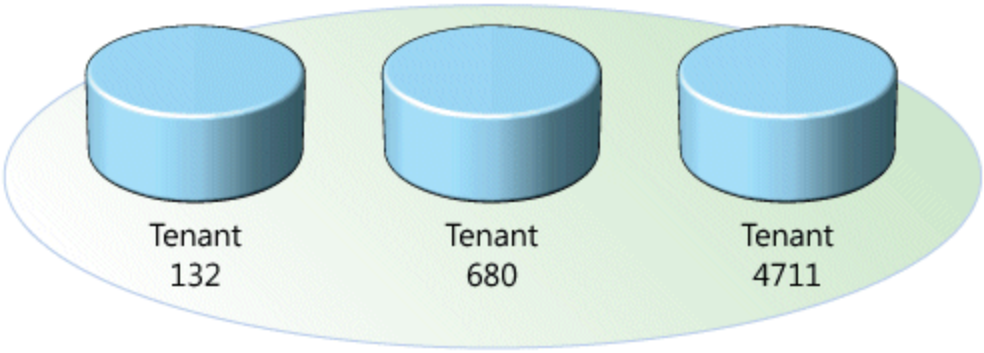

Figure 6 Single-tenant architecture: a separate database for each tenant (Chong & Carraro, 2006)

In this architecture each tenant has its own set of data that remains logically isolated from data of other tenants. Generally computing resources and application code are shared between all tenants. Single-tenant architecture assures the clients' need for data privacy and security. It also makes it easier for the SaaS provider to alter or extend the application's data model individually for each tenant. However, this architecture is more costly for SaaS providers.

Customization through configuration

A good SaaS application should be customizable through configuration. (Wainewright, 2006; Carraro, 2006) The difference between the terms configurable and customizable in this context is explained by Chong and Carraro (2006). Each customer will have its own set of demands for the software they want to use that differs from other customers. Traditional software that is usually tailor-made is customized to meet the requirements of the customer. This means that the application code is altered to fit the needs of the customer. In the case of a SaaS model it becomes unviable to customize the application for each customer if you grow upto say 1000 customers. The basic idea of SaaS is to increase economy of scale from the point of view of the SaaS provider. Economy of scale can only be achieved by designing the application in such a way that it can be *configured* to customize it to the needs of the customer.

The level of configuration options can differ per application. There is no criterion for SaaS application vendors to make their application configurable to a certain extent. Microsoft developed a SaaS Maturity Model that categorizes the different levels of configurability. It also takes into account multi-tenancy and scalability. This model is depicted in Figure 7 and can be used to get a better understanding of the concept of customization through configuration.

The maturity model shows that there are four levels:

1. Ad Hoc/Custom
2. Configurable
3. Configurable, Multi-Tenant-Efficient
4. Scalable, Configurable, Multi-Tenant-Efficient

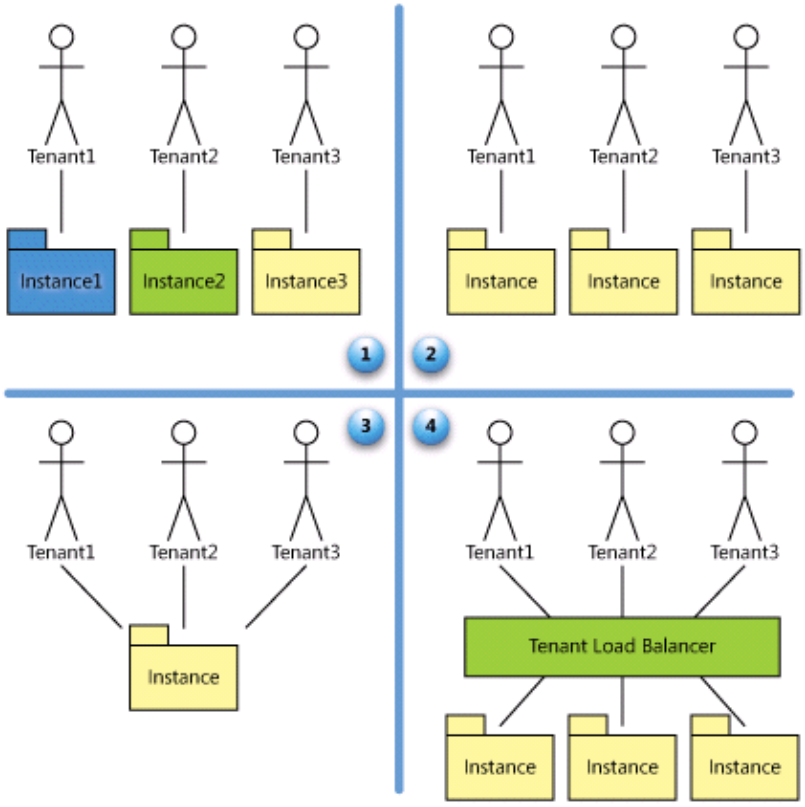

Figure 7 Software as a Service Maturity Model (Chong & Carraro, 2006)

The meaning of these levels is explained below.

- *Level 1: Ad Hoc/Custom*. A provider that rents applications at this level develops highly customizable software. The application is customized for each customer separately. According to Chong and Carraro (2006) this level is similar to the traditional ASP model of software delivery, where a separate instance of the software runs for each customer. Companies who make customized software can easily move to becoming SaaS providers renting software of this level. Although software of this level is delivered as SaaS, economy of scale cannot be achieved. Carraro (2006) In order to achieve economy of scale, the providers will need to alter their software in such a way that it is possible to configure the software to the needs of their clients instead of customizing the software on application code level. From the customer's perspective, a provider who rents custom made software will be attractive because the customer will be able to use software that confirms to its needs. On the other hand, it is likely that this kind of software will be more expensive, because more labor and hours will be needed to customize the software.
- *Level 2: Configurable*. At level 2 of the maturity model, for each customer a separate instance of the application is hosted by the provider. In level 1 each instance is individually customized for the tenant, but at this level the same code implementation is used for each instance. The provider makes the application more configurable allowing the customer to change how the application looks and behaves to its users. Thus, at code level the applications for each customer are identical, but each instance is run isolated from the others.
- *Level 3: Configurable, Multi-Tenant-Efficient*. Providers in the third level of maturity run a single instance that serves all customers, enabling multi-tenancy. The providers offer configuration options to customers

through metadata making it possible to change the appearance and behavior of the application according to the wishes of the users of the application. In order to keep the data of each customer separated from that of other customers, authorization and security policies are used. As an end user, the customer won't notice that the same instance of the application is shared by other customers.

- *Level 4: Scalable, Configurable, Multi-Tenant-Efficient.* The highest level of the maturity model adds scalability to the third level. This means that it is easy for the provider to scale out its applications. It is easy to add new instances of the software to the instance pool in case the load on the server increases. Appropriate data partitioning, stateless component design, shared metadata access are part of the architecture. (Carrora, 2006) By using a Load Balancer the utilization of hosting resources (CPU, storage etc.) is maximized. The total load is adequately distributed over the entire infrastructure. At the highest level, the architecture is scalable, multi-tenant and customizable via configuration.

2.2.2 RELATED TERMS

Being a hyped up term, SaaS is often used interchangeably with terms such as Cloud Computing and other as-a-Service terms such as Infrastructure-as-a-Service and Platform-as-a-Service. There is some confusion on whether Cloud Computing and SaaS can be used interchangeably or whether they are two different things. Also, the difference between SaaS and other as-a-Service terms is sometimes not clear. The relationship between these terms and SaaS will be discussed in this section in order to clarify the differences. We use the Cloud Computing definition by the National Institute of Standards and Technology (NIST), Information Technology Laboratory (Mell & Grance, 2009):

"Cloud computing is a model for enabling 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. This cloud model promotes availability and is composed of five essential characteristics, three service models, and four deployment models."

The five essential characteristics that are defined by the NIST are described as follows. (Mell & Grance, 2009)

- *On-demand self-service.* A consumer can unilaterally provision computing capabilities, such as server time and network storage, as needed automatically without requiring human interaction with each service's provider.
- *Broad network access.* Capabilities are available over the network and accessed through standard mechanisms that promote use by heterogeneous thin or thick client platforms (e.g., mobile phones, laptops, and PDAs).
- *Resource pooling.* The provider's computing resources are pooled to serve multiple consumers using a multi-tenant model, with different physical and virtual resources dynamically assigned and reassigned according to consumer demand. There is a sense of location independence in that the customer generally has no control or knowledge over the exact location of the provided resources but may be able to specify location at a higher level of abstraction (e.g., country, state, or datacenter). Examples of resources include storage, processing, memory, network bandwidth, and virtual machines.
- *Rapid elasticity.* Capabilities can be rapidly and elastically provisioned, in some cases automatically, to quickly scale out and rapidly released to quickly scale in. To the consumer, the capabilities available for provisioning often appear to be unlimited and can be purchased in any quantity at any time.

- *Measured Service.* Cloud systems automatically control and optimize resource use by leveraging a metering capability at some level of abstraction appropriate to the type of service (e.g., storage, processing, bandwidth, and active user accounts). Resource usage can be monitored, controlled, and reported providing transparency for both the provider and consumer of the utilized service.

There are several models that describe the relationship between Cloud Computing and SaaS. We compare three of these models, the NIST model, the Forrester model and the model presented by Linthicum (2009) in this section.

Linthicum (2010) defines Cloud Computing as consisting of 11 categories or patterns:

1. *Storage-as-a-service* (also known as disk space on-demand), as you may expect, is the ability to leverage storage that physically exists at a remote site but is logically a local storage resource to any application that requires storage. This is the most primitive component of cloud computing and is a component or pattern that is leveraged by most of the other cloud computing components.
2. *Database-as-a-service*. Provides the ability to leverage the services of a remotely hosted database, sharing it with other users and having it logically function as if the database were local. Different models are offered by different providers, but the power is to leverage database technology that would typically cost thousands of dollars in hardware and software licenses.
3. *Information-as-a-service* is the ability to consume any type of information, remotely hosted, through a well-defined interface such as an API. Examples include stock price information, address validation, and credit reporting.
4. *Process-as-a-service* is remote resource that can bind many resources together, such as services and data, either hosted within the same cloud computing resource or remotely, to create business processes. You can think of a business process as a meta-application that spans systems, leveraging key services and information that are combined into a sequence to form a process. These processes are typically easier to change than are applications and thus provide agility to those who leverage these process engines that are delivered on-demand.
5. *Application-as-a-service* also known as Software as a Service (SaaS), is any application that is delivered over the platform of the Web to an end user, typically leveraging the application through a browser. While many people associate application-as-a-service with enterprise applications such as Salesforce SFA, office automation applications are indeed applications as-a-service as well, including Google Docs, Gmail, and Google Calendar.
6. *Platform-as-a-service* is a complete platform, including application development, interface development, database development, storage, testing, and so on, delivered through a remotely hosted platform to subscribers. Based on the traditional time-sharing model, modern platform-as-aservice providers provide the ability to create enterprise-class applications for use locally or on-demand for a small subscription price or for free.
7. *Integration-as-a-service* is the ability to deliver a complete integration stack from the cloud, including interfacing with applications, semantic mediation, flow control, integration design, and so on. In essence, integration-as-a-service includes most of the features and functions found within traditional enterprise application integration (EAI) technology but delivered as a service.
8. *Security-as-a-service*, as you may have guessed, is the ability to deliver core security services remotely over the Internet. While the typical security services provided are rudimentary, more sophisticated services such as identity management are becoming available.

9. *Management/governance-as-a-service* is any on-demand service that provides the ability to manage one or more cloud services. These are typically simple things such topology, resource utilization, virtualization, and uptime management. Governance systems are becoming available as well, offering, for instance, the ability to enforce defined policies on data and services.
10. *Testing-as-a-service* is the ability to test local or cloud-delivered systems using testing software and services that are remotely hosted. It should be noted that while a cloud service requires testing unto itself, testing-as-a-service systems have the ability to test other cloud applications, Web sites, and internal enterprise systems, and they do not require a hardware or software footprint within the enterprise.
11. *Infrastructure-as-a-service* (IaaS) is actually data center-as-a-service, or the ability to remotely access computing resources. In essence, you lease a physical server that is yours to do with as you will and, for all practical purposes, is your data center, or at least part of a data center. The difference with this approach versus more mainstream cloud computing is that instead of using an interface and a metered service, you have access to the entire machine and the software on that machine. In short, it is less packaged.

These 11 categories or patterns are depicted in Figure 8 The categories or patterns of Cloud Computing defined by Linthicum (2010).

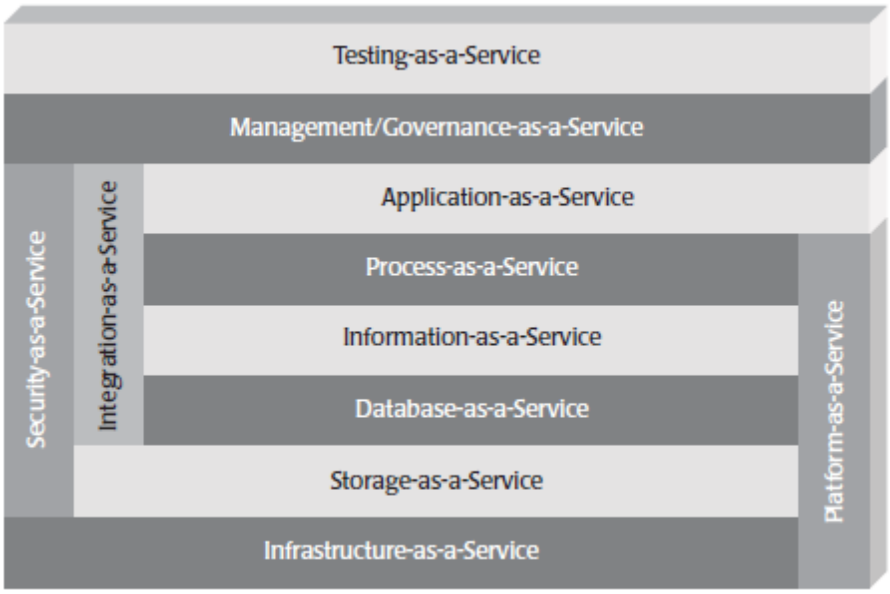

Figure 8 The categories or patterns of Cloud Computing defined by Linthicum (2010)

According to the NIST SaaS is one of the three service models of Cloud Computing. The three service models given by the NIST are:

- *Cloud Software as a Service (SaaS).* The capability provided to the consumer is to use the provider's applications running on a cloud infrastructure. The applications are accessible from various client devices through a thin client interface such as a web browser (e.g., web-based e-mail). The consumer does not manage or control the underlying cloud infrastructure including network, servers, operating systems, storage, or even individual application capabilities, with the possible exception of limited user-specific application configuration settings.

- *Cloud Platform as a Service (PaaS)*. The capability provided to the consumer is to deploy onto the cloud infrastructure consumer-created or acquired applications created using programming languages and tools supported by the provider. The consumer does not manage or control the underlying cloud infrastructure including network, servers, operating systems, or storage, but has control over the deployed applications and possibly application hosting environment configurations.
- *Cloud Infrastructure as a Service (IaaS).* The capability provided to the consumer is to provision processing, storage, networks, and other fundamental computing resources where the consumer is able to deploy and run arbitrary software, which can include operating systems and applications. The consumer does not manage or control the underlying cloud infrastructure but has control over operating systems, storage, deployed applications, and possibly limited control of select networking components (e.g., host firewalls).

Ried et al. (2010) present Cloud Computing taxonomy in their Forrester article. In Figure 9 SaaS is presented as one of the 12 Cloud Computing business models. The "level of sharing" axes indicates the extent to which the data of the company (client) is shared in the cloud (in other words: the internet) with other companies. Ried et al. (2010) define three levels of the cloud, from the lowest level of sharing to the highest level of sharing: the Private cloud, the Hosted (virtual private) cloud and the Public cloud. On the x-axes the level of business value of the IT components of a company is depicted, starting from components with the lowest business value to components with the highest business value: Infrastructure, Middleware, Applications and Information and Processes. In this grid SaaS is positioned as having a high level of sharing (Public cloud) and middle-high business value (Applications level).

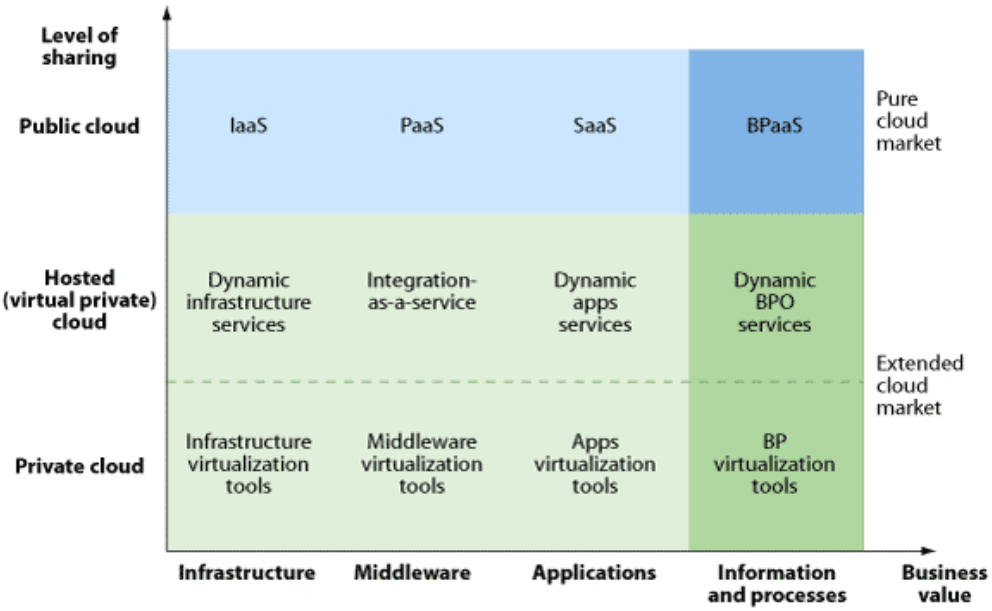

Figure 9 Positioning of the business models of Cloud Computing by Forrester (Ried et al., 2010)

In all three models described above the relationship between SaaS and Cloud Computing is given different names: Linthicum (2010) defines SaaS as *a category or pattern* of Cloud Computing, the NIST defines SaaS as a *service model* of Cloud Computing and Forrester defines SaaS as a *business model* of Cloud Computing. Although different terms are used to name the relationship between Cloud Computing and SaaS, what is clear is that Cloud Computing and SaaS are two different things and cannot be used interchangeably. In order to avoid more

confusion by introducing yet a new term for the relationship, we conclude that not all Cloud Computing applications are SaaS applications. However, all SaaS applications are Cloud Computing applications. Cloud Computing encompasses more than just SaaS; it covers all as-a-Service terms.

Since we are discussing services it is also interesting to have a look at how Cloud Computing and as-a-Service are related to SOA (Service Oriented Architecture). Linthicum (2010) gives a definition of SOA and describes the link between Cloud Computing and SOA. The SOA definition by Linthicum (2010): "An SOA is a strategic framework of technology that allows all interested systems, inside and outside of an organization, to expose and access well-defined services, and information bound to those services, that may be further abstracted to process layers and composite applications for solution development. In essence, SOA adds the agility aspect to architecture, allowing us to deal with system changes using a configuration layer rather than constantly having to redevelop these systems."

Next Linthicum explains the link between Cloud Computing and SOA: "The relationship between Cloud Computing and SOA is that Cloud Computing provides IT resources you can leverage on-demand, including resources that host data, services, and processes. Thus, you have the ability to extend your SOA outside of the enterprise firewall to cloud computing providers, seeking the benefits already described. We describe this process as 'SOA using cloud computing'." The bottom line is that in order to make the most of Cloud Computing (or SaaS), you need an architecture, such as SOA, to organize your enterprise IT.

2.3 Benefits and Risks of SaaS

In their article Sääksjärvi et al. (2005) give an overview of the benefits and risks by studying six articles about SaaS (Cherrytree, 2000; SIIA, 2001; Hoch et al., 2001; Mizoras et al., 2003; Ekanayaka et al., 2003; Walsh, 2003). The overview is created by having three researchers study the articles independently and identify the benefits and risks that were mentioned explicitly in the six articles. Therefore, this article is used as a main source for identifying the benefits and risks in our research. The benefits mentioned in Sääksjärvi et al. (2005) are both from a customer as well as provider point of view. Because our research only focuses on the customer side of a SaaS implementation we only discuss the benefits that are relevant for customers. In chapter 2.3.3 we make a distinction between benefits relating to the product level and benefits relating to the implementation level of SaaS.

2.3.1 Benefits

There are several benefits that Sääksjärvi et al. (2005) list in their article. However, the benefits are not explained in the article. In order to clarify the benefits, we use additional sources.

One of the benefits mentioned is that "*SaaS enables the customer to focus more on core competencies*" (Cherrytree, 2000; SIIA, 2001; Hoch et al., 2001; Mizoras et al., 2003; Ekanayaka et al., 2003; Walsh, 2003). By moving the responsibility of managing software to the provider, companies can reallocate resources and time on their core business.

Another benefit is that "*SaaS makes it easier and/or less costly to get access to required technical expertise*". SaaS providers' core business is developing and managing software and hosting it to their customers. They have a whole team of technical experts to fulfill these tasks. Often people are specialized in a certain application or technology. For example, there could be people resources appointed to SaaS CRM applications and other resources who are experts in SaaS e-mail applications. Usually an SME has a small group of people or maybe even one person who has to manage applications as well as maintain the infrastructure. Some companies cannot even cost justify a person for managing the IT. (Walsh, 2003) As a customer of a SaaS provider, you have easy access to the state-of-the-art

technical expertise that your provider owns. (Saugatuck, 2009) In some cases the monthly fee that you pay to your SaaS provider includes technical support.

Sääksjärvi et al. (2005) also mention the benefit that the "*system implementation time is shorter with SaaS"* than with traditional software. The SaaS model can be seen as a plug and play model. In the simplest SaaS implementation, once you sign the contract with your provider, it won't take long until you can start using the software. The software is already up and running on the servers of the provider. The only thing that needs to be done is plug you in so that you can access the application. There are no servers that need to be installed on your premises and there is nothing that you need to install on your PC or notebook.

"*SaaS enables a wider and more flexible array of payment methods (predictable and/or lower costs)*" is one of the other benefits. With traditionally deployed software the customer typically needs to pay for cost of the software application, the hardware required to run the application and the people services required to design, deploy, manage, maintain and support the application. (SIIA, 2006) With SaaS, companies pay according to the subscription based pricing method. This fee incorporates cost of the software application, the hardware and the people services. Often companies who use on premise applications cannot define their costs if you ask them how much they are spending on one particular application. Licensing or hardware costs that companies pay are easy to define, but aspects like people services and infrastructure use that maintain and offer support for the applications are difficult to determine. According to IT market analysts such as Gartner and IDC these "hidden" costs can reach upto 70 -75% of the total cost to run on premise systems. (SIIA, 2006) For the particular case of e-mail applications the article mentions that: "*the personnel costs for these traditional software applications are at a minimum 2.5 times, and can be as much as 7.5 times, the software costs (including maintenance), with a typical range of personnel expenses being 5 to 7 times the software and maintenance costs over a 3-year period*". The first column in the figure below shows the ratio of software costs versus personnel costs for e-mail applications. (SIIA, 2006)

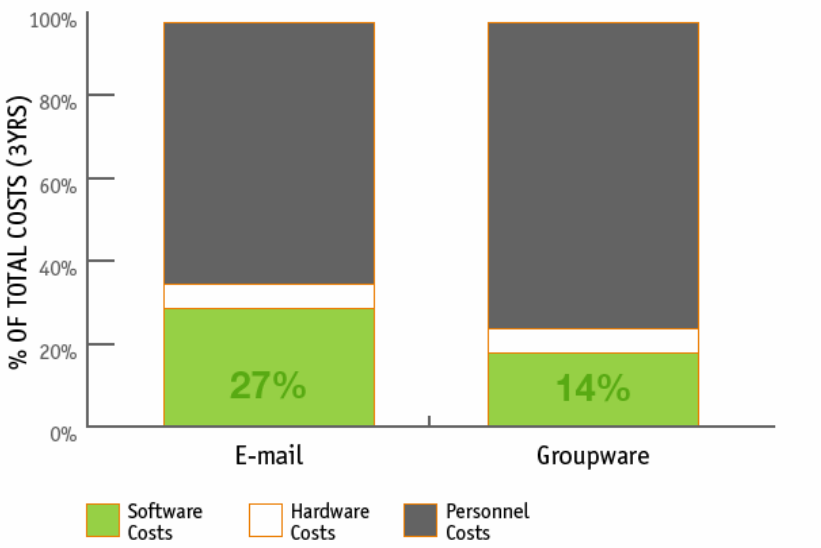

Figure 10 Personnel costs are the biggest TCO part for e-mail and groupware (SIIA, 2006)

These hidden costs can clearly not be ignored. According to the SaaS pricing strategy these hidden costs become clearly visible because they are often defined in the subscription fee. In case the subscription fee doesn't include support costs, it is still clear for the customer to take support costs into account.

Moving on to the benefits described by Sääksjärvi et al. (2005) we come to the next one: "*SaaS makes version management easier for the customer (free upgrades, no technology obsolescence etc.)"*. Unlike with traditional software deployment, with SaaS customers don't need to worry about version management. In the subscription fee the costs of the upgrades are already included. Thus customers are ensured of having the latest version without having to do anything themselves.

"SaaS provider aggregates software applications from several sources and builds a complete service offering." What we think that Sääksjärvi et al. (2005) are trying to say here is that SaaS providers use the functionalities offered in several different applications to develop an offering of their own that encompasses the functionalities from several applications. In our opinion this is not a benefit of SaaS alone. Also in traditional software deployment the vendors of the application can aggregate software applications from several sources and build a complete service offering. Therefore, we discard this benefit in further discussions.

Another advantage of SaaS is that it "*enables the customer to get access to 'best-of-breed' applications that would be too expensive to buy"*. Best-of-breed applications can be expensive if a company wants to "buy" IT (traditional software deployment). The SaaS model makes the best-of-breed applications more viable to implement because it can be rented, which makes the software cheaper to rent than to buy, according to Sääksjärvi et al. (2005).

The benefit *"SaaS makes it possible to access the software independently of location and time"* is the effect of one of the main characteristics of SaaS: hosted software. The fact that the software runs at the host, makes it possible to access the software from anywhere in the world at any time of the day. Nothing needs to be installed on your pc or notebook, except for a web browser. If you have a web browser and an internet connection to connect to the host, then you can access the software from any location at any time.

"The initial investments and costs are much lower in SaaS". In traditional software deployment customers pay large sums upfront for licenses. The customer *buys* the software, thus the payment is done up front. Besides this the company also needs to invest in hardware. According to the SaaS model there are no initial costs. The payment is done on a subscription basis. However, later in this thesis, we will show that integration and migration costs are not included in the subscription fee. These cost factors also need to be considered in the determining the costs of a SaaS implementation.

"With SaaS, the customer can get access to a superior IT infrastructure regarding reliability, security and scalability" is also mentioned as one of the benefits for SaaS customers. A SaaS provider can only sustain and develop its business if it offers a reliable, secure and scalable IT infrastructure to its clients. In his article, Wainewright (2009) discusses the lack of security measures at small businesses. In 2005 major credit card companies introduces the Payment Card Industry's (PCI) Data Security Standard in order to protect the customer's personal information. Wainewright (2009) discusses the results of a research done by Ponemon Institute and security company Imperva that shows that only a third of the companies bothers to implement the data security standard. *"According to the survey, 79 percent have experienced a data breach involving the loss or theft of credit card information and 60 percent of respondents didn't think they had sufficient resources to comply with PCI and bring about a necessary level of cardholder security."* (Eddy, 2009) Wainewright believes that reputable SaaS providers offer such security mechanisms by default and advices companies to move their payment processes to SaaS providers. Although here the example of small businesses is given regarding payment processes, it is comparable to security of e-mail applications. SaaS providers of e-mail applications also offer security mechanisms which are sometimes missing in on premise implementations at SME. SaaS makes up-scaling (and down-scaling) easier than on premise software. If a company suddenly decides to increase the number of employees, the SaaS provider can add the number of e-mail accounts for the company easily due to the architecture of the software.

"SaaS broadens the selection of potential applications available to the customer" is another benefit given by the authors which in our opinion is not a benefit of SaaS above traditional software deployment. Therefore, we discard this in further discussions.

"SaaS enhances the available customization options of applications to the customer" is the last benefit that is mentioned by Sääksjärvi et al. (2005). SaaS applications are customizable to a certain extent, but compared to traditional applications they do not enhance the customization options. Traditional applications can be built from scratch, hence offering a high level of customization. SaaS applications are customizable through configuration only (chapter 2.2.1). Thus, the extent to which SaaS applications are customizable depends on the SaaS provider's level of available configuration options. This point should not only be disregarded from the list of benefits, but should be considered a risk of SaaS as is explained in the next chapter. This risk is indicated as: "*there are less tailoring and integration options available for the customer*".

2.3.2 RISKS

Sääksjärvi et al. (2005) also discuss the risk issues of SaaS implementations for customers. Again, in order to clarify the risks, we describe them with the help of some additional sources.

One of the risk issues of SaaS is that "*there are less tailoring and integration options available for the customer*". Because SaaS applications use the same application code for each customer, the applications cannot be tailor-made or designed-to-fit into the existing application environment of the customer. This makes the provider scalable, which indirectly also makes up-scaling easy for the customer. Yet, the drawback of SaaS remains that less tailoring and integration options available for the customer. One should note that this is not the case with SaaS providers of level 1 of the SaaS Maturity Model of Microsoft as shown in Figure 7 of this thesis.

"SaaS increases the risk of losing business-critical data or exposing it to third parties" is the second risk that is given in the article. Because of this risk many companies are still reluctant to move their data to a SaaS provider. Moving your business critical data off site to a database which also stores data of other customers can make your data more vulnerable than when it would be stored on premises. Also because the data is transferred over the internet it is possible that somewhere along its journey, the data can be lost due to a weak internet connection or due to interference of someone who is not authorized.

The third risk that is mentioned in the article is: "*Availability, reliability and performance-related issues are to be expected, depending on the technological solution of the SaaS provider"*. When moving your data to a SaaS provider, you become highly dependent on the provider's integrity and expertise to assure availability, reliability and performance. We discuss these risks separately, because the consequences of errors occurring to each of these three risks will lead to different kinds of problems. Availability problems can occur when the provider's servers are down. Imagine you are taking e-mail from a SaaS provider. What happens when the servers of the providers go down? You will have to wait until the problem is solved by the provider and in the meantime you won't be able to receive or send e-mails. The magnitude of impact due to availability depends on how business critical e-mail applications are for the customer. Reliability issues addressed by Chung (2008) are data confidentiality/integrity issues and encompass the following list of risks:

- Loss of business data due to inadequate ICT operations by the vendor (redundancy, back-ups, storage)
- Abuse/misuse/theft of business data due to insufficient security measures including Identity & Access Management
- Abuse/misuse/theft of business data by vendor's personnel

- Abuse/misuse/theft of business data by unauthorized external parties such as other SaaS customers
- Abuse/misuse/theft of business data by unauthorized internal parties causing breaches in the Segregation of Duties
- Non-compliance due to poor auditability
- Non-compliance due to lack of Segregation of Duties
- Uncontrolled data management caused by inadequate separation of data between different SaaS customers
- Privacy issues due to insufficient assurance to protect confidential and/or personal data

Due to inefficient use of or insufficient availability of resources end users can experience latency. Clancy states that *web-based applications inevitably hit a performance wall as they are scaled up*. (Clancy, 2007) This risk falls under performance related issues. Providers can use tools to increase performance, but the fact remains that as a customer you are dependent on the provider. Chung (2008) also gives the possible risks regarding performance and support:

- Poor performance of the serviced software due to constraints and limitations at the vendor (too many customers, insufficient capacity)
- Less flexibility and longer Time-to-market due to too standardized software or inadequate development and testing processes
- Difficulties in receiving support due to poor ICT governance at the vendor
- Poorly defined SLAs
- Difficulties in receiving support due to unclear agreements
- Imbalance between the customer's service requirements/expectations and the vendor's service delivery due to unrealistic expectations and/or inadequate mapping of services and requirements
- Long-lasting incidents and change requests due to complex root-cause analysis
- Complex service management due to multiple SaaS vendors and aggregators
- Loss of productivity by unannounced software/interface changes (Frankenstein Switch)

In exchange for the lower price, the customer is typically bound with a long-term contract (switching costs). We strongly believe that this is not only characteristic for SaaS applications. In fact, with traditional on premise installed software customers are more bound and are likely to have higher switching costs. According to the traditional model the customer makes a large investment in the IT systems and thus it will be a long-term contract that the customer signs. With SaaS, customers can ideally plug in and out anytime. The degree of vendor lock-in is minimized. There will be switching costs, because the data of the client will have to be migrated. But we believe costs will be less compared to a traditional software solution. Therefore, we discard this risk mentioned in the article in our further discussions.

2.3.3 Product and Implementation Level

In chapter 1 we explained that in order to determine whether SaaS is a promising technology or not, we will investigate the product and the implementation aspect of SaaS. We determined that we will do this by studying the benefits and risks of SaaS. In the previous sections we presented the benefits and risks of SaaS. In this section

we link the benefits and risks to the product and implementation aspects of SaaS. Table 3 shows which benefits and risks can be related to the product level and which to the implementation level.

Table 3 Product and implementation level benefits and risks

	Product level	Implementation level
Benefits	• *Enables the customer to get access to "best-of-breed" applications that would be too expensive to buy* • *SaaS makes it possible to access the software independently of location and time*	• *SaaS enables the customer to focus more on core competencies* • *SaaS makes it easier and/or less costly to get access to required technical expertise* • *System implementation time is shorter with SaaS* • *SaaS enables a wider and more flexible array of payment methods (predictable and/or lower costs)* • *SaaS makes version management easier for the customer (free upgrades, no technology obsolescence etc.)* • *The initial investments and costs are much lower in SaaS* • *With SaaS, the customer can get access to a superior IT infrastructure regarding reliability, security and scalability*
Risks	• *Less tailoring and integration options available for the customer* • *Availability and a part of the performance issues (that affect the end user experience, such as poor performance of the software, difficulties in receiving support, etc.) are to be expected, depending on the technological solution of the SaaS provider*.	• *SaaS increases the risk of losing business-critical data or exposing it to third parties* • *Reliability and a part of the performance issues (that affect the company, such as less flexibility and longer time-to-market, poorly defined SLAs) are to be expected, depending on the technological solution of the SaaS provider*.

The "Product level" column in the table lists the benefits and risks associated at the product level. These benefits and risks affect the end users directly. In the "Implementation level" column the benefits and risks are listed that affect the organization.

3 INTERVIEW RESULTS

The results of the interviews held with the five companies that we selected for our research are given in this chapter. First the dimensions according to which the interviews are structured are explained. Then the cases studies are discussed one by one.

3.1 DIMENSIONS

We aimed at conducting the case studies through interview sessions with people from several roles within an organization. However, it was only possible to take interviews with one person from each organization due to the unwillingness of companies or due to the small size of some of the companies. In order to structure the interview data, as mentioned in chapter 1.6.1, we used Eisenhardt's (1989) theory of analyzing case studies. One of the steps in this analysis was to do a with-in case analysis using the first tactic explained by Eisenhardt (1989) (select dimensions and search for with-in group similarities that are coupled with inter-group differences). The information gathered through the interviews is structured in this chapter based on these ten dimensions:

- Organizational profile
- SaaS driver
- Selection criteria for SaaS applications
- Selection criteria for SaaS providers
- SaaS applications in use
- On premise applications in use
- Implementation process
- Risk management
- Finance
- User acceptance and SaaS usability
- Decision maker's vision on SaaS

In *Organizational profile* a description of the company is given. The second dimension, *SaaS driver*, discusses the driver that made the stakeholders of the company consider a SaaS solution. In our explorative case we see that the fusion of two business units within the company, leaded to a change in the IT of the entire company. One of the considerations for the design of the new IT in the explorative case was a SaaS solution. Thus, the SaaS driver in this case is the fusion of the two business units. The dimension *Selection criteria for SaaS applications* discusses the criteria or requirements of the company for the SaaS applications. *Selection criteria for SaaS providers* discusses the criteria that each company sets when selecting the provider for their SaaS applications. *SaaS applications in use* discusses which SaaS applications are being used in the company. This tests the exposure of the company towards SaaS. With the fourth dimension, *On premise applications in use*, we assess which (relevant) applications are still being used as on premise applications. This is to test how traditional the organization still is when it comes to SaaS. The integration of SaaS with existing on premise applications could also become an issue if the company has many applications on premise. With the *Implementation process* dimension we describe how the implementation process went, from the point where the provider was selected up to the use of the application. Integration of the new SaaS application with the existing applications and migration of old data into the new SaaS

applications were found as two important tasks in the implementation process during interviews with experts. Therefore integration and migration are discussed in detail in this dimension. The following dimension is *Risk management*. In *risk management* we describe how the companies deal with the risks of the SaaS model. Because the SaaS model demands the data of the client to be off premises, some companies are afraid of losing security of their data. This is very often a reason why companies tend to stick to on premise solutions. Many companies believe that as long as the data is within their premises, it is safer. Therefore it is interesting to see how companies deal with the risks that the SaaS model brings along. This dimension also encompasses backups, availability and vendor lock-in, aspects of SaaS that are considered as major risks by some companies. One of the dimensions is *Finance.* In this dimension we discuss the financial aspect of the SaaS and the on premise solutions. In the ninth dimension, *User acceptance and SaaS usability*, we discuss how open the end users are towards SaaS and how the company copes with the wishes of these end users. In a pure SaaS setting the application is accessed through a web browser. Some argue that the fact that the applications are accessed through the web browser makes them lack in functionality compared to on premise applications. The interviewees were asked whether they felt a lack in functionality due to the introduction of the SaaS applications. The last dimension, *Decision maker's vision on SaaS,* describes the vision that stakeholders of the company have regarding SaaS.

Firstly an explorative case is described. In this case study e-mail was part of the SaaS package that the company had subscribed to, but they didn't use SaaS e-mail. The SaaS package was used for other purposes. Still, the case is interesting and we think many lessons can be learnt from it. Therefore, the case is used as an explorative case and differs from the other case studies.

3.2 Case Study 1 (An Explorative Case): NEVI

The interview was held with the Google Apps implementation project leader of NEVI in August 2009.

3.2.1 Organizational profile

NEVI stands for *Nederlandse Venereniging voor Inkoopmanagement*. NEVI is an organization that forms a network of and for procurement management professionals. Approximately 6000 professionals are part of this network. NEVI provides active networks, platforms, courses, trainings, seminars and organizes different activities where professionals can meet each other and exchange knowledge. NEVI also invests in the further development of the field by financing professors and PhDs and by setting up projects.

The organization is not only active in the Netherlands, but also has a training institution in Brazil. NEVI's training institution in Brazil employs 8 people. 40 employees work in the main office in Zoetermeer (Netherlands).

3.2.2 SaaS driver

Approximately a year ago NEVI consisted of two divisions: *NEVI Opleidingen BV* and *NEVI Vereniging*. The board's vision was to have one united NEVI for their clients. In order to realize this, the two divisions were merged into one NEVI. Soon it became clear that the merger created some new problems. NEVI Vereniging, which was first only concerned with its own division, now also needed to have information regarding NEVI Opleidingen BV and vice versa. If an employee from NEVI Vereniging was asked a question about NEVI Opleidingen BV, he or she was not able to find the answer easily. The information, spread across the company and often difficult to access, was frequently found to be outdated. The necessity for structured information rose. Another problem was the front office; the part of the organization that is the first one to come in contact with clients. The employees at the front office did not have an overview of who was present and who was absent at the office. In case a visitor came up to the front office for an appointment or a question, the employees could not help the visitor, again due to unstructured and lack of information.

3.2.3 SELECTION CRITERIA FOR SAAS APPLICATIONS

These issues led to a clear demand. A demand for a new IT system that would provide the following information:

- Showing who is present in the office
- Providing a search function in order to find the correct information
- Sharing information among colleagues
- Accessibility through the Internet from anywhere in the world

3.2.4 SELECTION CRITERIA FOR SAAS PROVIDERS

NEVI didn't have an IT staff therefore it commissioned a company to come up with a solution to their IT problems. This company said that the solution would be an intranet in which information could be structured and would become easier to find. The company brought NEVI in touch with two other companies who were specialized in offering these types of solution. The two companies were invited to present their solutions. These companies were: E-office and G-company. Whereas E-office presented a solution based on Microsoft's Sharepoint, G-company came with the idea of implementing a portal with Google Apps, a Google search engine and Google Talk. The latter solution appealed the most to the decision makers of NEVI. Another reason for this is that Google's solution provided an additional feature: accessibility of the applications through the Internet from anywhere in the world. This was particularly important for the board of NEVI, who wanted to access certain applications through the internet which in the previous situation were only accessible through the PCs in the Zoetermeer office.

The reasons why NEVI choose Google were:

- Lower costs
- Easy access of the application from any location (this would have been more difficult with the Microsoft offering suggested by E-office)
- NEVI found Google to be new, flashy and innovative. And this picture matched well with NEVI, because it is also what NEVI stands for.
- Scalability: Possibility to grow the organization easily by extending functionalities.

3.2.5 SAAS APPLICATIONS IS USE

NEVI signed a contract for the Google Apps package through G-company. Although Google Apps includes Gmail, Google Calendar, Google Docs, Google Sites and Google Video, NEVI mainly makes use of Google Sites (Intranet) to structure information. The e-mail application which is part of Gmail is not used by NEVI, but NEVI uses the Google Talk function of Gmail. Google Talk is used to see which of the employees are online and to contact them in order to exchange information faster than in the previous situation.

G-company also embedded a Google search function in the portal of NEVI. The search engine provides search in two different domains: in the databases of the Zoetermeer office or on the Internet. Information that is not crucial to the business is stored at Google's datacenters.

3.2.6 ON PREMISE APPLICATIONS IN USE

Information that is business critical for NEVI is still kept on premises. Other on premise desktop applications that NEVI uses are: Microsoft Outlook for mailing and calendar functions and Microsoft Office applications for word processing, spreadsheets and presentations.

3.2.7 IMPLEMENTATION

In the spring of 2008 NEVI identified the need for extending their IT landscape mainly in order to store, manage and access data more efficiently. In august 2008 the decision was made that Google Apps was the suitable solution for NEVI.

The project was initially led by 2 people from NEVI; a Marketing and Communication employee (the interviewee) for the project execution and the manager of the Marketing and Communication department for decisions making. The manager of the Marketing and Communication department used to do some IT related tasks for NEVI besides his job as a manager. As the tasks increased, both employees realized that a dedicated person was needed to fulfill these tasks. In January 2009 NEVI welcomed its first IT employee. Another reason for having IT personnel in house was to get a better understanding of the IT landscape. In the previous years the IT had grown step by step, but there was no clear overview of the existing systems. The other two parties that were involved in the implementation were G-company and an external party that managed NEVI's IT.

Implementation of the SaaS solution at NEVI went far from smooth. The implementation took much longer and cost much more than expected. The main reason for this according to the interviewee was miscommunication between technical and non technical people involved in the project. She believes there is always a difference in the interpretation of technical and non technical people. NEVI didn't have an IT department when it started considering SaaS. Only later in the implementation process when NEVI realized the need for in house IT knowledge and an IT employee was added to the team.

Besides this, the communication between the company that managed NEVI's IT and G-company also didn't go smoothly. The external IT provider of NEVI and G-company were required to work together to integrate the new solution with the existing systems at NEVI. NEVI's IT provider was not familiar with Google's offering and therefore it didn't always know how to deliver what was required by G-company. On the other hand G-company had limited access to NEVI's internal resources, so it depended on NEVI and the IT provider. According to the interviewee the lack of in house IT knowledge in the beginning and poor communication between the involved parties lead to major delays in the implementation process.

3.2.8 RISK MANAGEMENT

Security

For the less crucial information the risks were discussed, but NEVI trusted Google's guarantee that 99.9% of the time the data is guaranteed to be available. NEVI says it can't compete to that. Besides this, Google also makes regular backups of the data.

Knowledge is the most important asset that NEVI has. It is NEVI's core business. Therefore when the decision for Google was made, the decision makers and G-company discussed the risks involved with storing information (knowledge) at Google's datacenters. In a pure SaaS solution all information would be stored off premises. But because of the risk of losing control over the information and putting it "out there in the Cloud" NEVI decided to store its most valuable information on its own premises.

3.2.9 FINANCE

The costs were a main reason for NEVI to choose Google. Google's SaaS solution was more appealing to NEVI because in this case there would be no start up costs. NEVI didn't have to pay an expensive consultant, which would be the case if they had opted for Microsoft's solution. Especially since they didn't have IT staff, they thought that Microsoft's solution would become too expensive. NEVI expected that Google's plug and play solution which

charges 40 Euros per employee per year would turn out to be more cost saving. In addition to this there were extra costs for the integration and migration. Eventually, the costs exceeded the amount that NEVI thought it would have to spend. The main reason for this is that integration and migration took much more time than was expected.

3.2.10 User acceptance and SaaS usability

During the implementation phase a group of five employees was set up to test the new application. This group consisted of front office, ICT and management members. The group's task was to test the application and provide feedback about how the functionality could be improved.

However, because of the many delays and problems during the project, the support from the employees decreased. The number of people that eventually use the application is very little. According to the project manager we interviewed, the reason for this is that NEVI grew very fast as a company. It didn't have its own IT department. Along with the fast growth of the employees, the number of PCs has also grown quickly. There is no uniformity/no standard amongst the PCs. This leads to the fact that on certain PCs some functions work well and on others they don't.

3.2.11 The decision maker's vision on SaaS

According to the interviewee a lesson learnt is that there should have been more people with IT knowledge present from within NEVI in order to give a better judgment regarding reliability and functionality of the SaaS application. She feels NEVI should have invested more in this area.

Yet, the main thinking of NEVI regarding SaaS is positive. The decision makers believe that this is where the world is going to, so it is only natural to follow this trend.

3.3 Case Study 2: Infotrade

The interview was held in August 2009 with the CEO of a Dutch company named InfoTrade.

3.3.1 Organizational profile

InfoTrade is a Netherlands based company that offers search engine marketing for its clients. Search engine marketing is a form of Internet marketing that seeks to increase the visibility of the websites in search engine results, thereby promoting websites in search engines. InfoTrade is a partner of Google. InfoTrade originates from the online market place LeaseTrader, which was founded in 2002 also by the founder of InfoTrade. InfoTrade was founded in 2005. The company now exists of 6 employees, 1 of which works in Suriname.

3.3.2 SaaS driver

At three different points in time InfoTrade implemented different SaaS applications. The drivers that made the CEO consider a SaaS solution are discussed in this chapter.

In 2006 the CEO of InfoTrade was in search of a new accountant. He was very optimistic about SaaS, due to his earlier experience with hosted applications. He set the criteria that the accountant he would select would know how to work with a SaaS version of accounting software.

In 2008 the company was relocated to its current location. Along with the relocation of the company, the IT of the company was reassessed. The CEO had been following SaaS developments and decided that if he would keep his servers on premise he would have to find an IT company to manage the systems. A large company would be unaffordable, so he would have to choose a SME. He compared this solution to his knowledge and experience about SaaS providers and was of the opinion that a SME could never provide better service than a large and experienced SaaS provider. According to the CEO, for a SaaS provider providing proper security for the data of its

clients is crucial to its business. Therefore he decided to rearrange the IT landscape of InfoTrade with the criteria of having a SaaS solution.

The third SaaS consideration was when the CEO got interested in a SaaS application for mailing newsletters when he saw the application at another company. He saw the ease of use and got very excited about the SaaS application. It appealed to him so much that he decided to implement it in his own company. We consider this as an effect of the hype of SaaS that is being passed on from person to person.

Concluding, the drivers for considering a SaaS solution in this case were: the change of accountant, the relocation of the company to another building and the SaaS hype.

3.3.3 SELECTION CRITERIA FOR SAAS APPLICATIONS

For the SaaS based accounting software the CEO wanted accessibility from anywhere in the world. He wanted to be able to login from home. He wanted that the accountant was able to login from his own office. The criterion for the CRM application is similar. It had to be possible to access the application from any location. Again the same criterion was set for the selection of the mail and desktop applications. Besides this, the CEO wanted the mail and CRM application to be connected. He also wanted to bridge the gap between his Suriname office and his Netherlands office, by improving communication. Another requirement for the SaaS applications was that they needed to be easily extendable. InfoTrade is a growing company and as the number of employees grows, the systems should be able to grown along easily too.

3.3.4 SELECTION CRITERIA FOR SAAS PROVIDERS

When InfoTrade was looking for new accountants the criteria was that the accountant was to use hosted software. The CEO found an accountant who had recently started using Exact Online, a SaaS based accounting application. This was the reason why InfoTrade chose Exact as their accounting application provider.

In the case of selecting the CRM provider, the search was extensive. The CEO came across Salesforce.com, but during that time he did not find a company who was experienced in migrating and integrating Salesforce.com's CRM application with InfoTrade's existing applications. An alternative was an IT company that customized its on premise CRM application into a SaaS based CRM application and hosted it. However, this would become an expensive alternative because the application would be custom made, so it was refused. There was another provider who offered SaaS CRM applications, but this one too was expensive. The CEO was aware of the several providers and their offerings. He had a strong preference towards Salesforce.com, but he couldn't find a company to do the migration of his old data to the new CRM. He thought it was too risky to do the migration himself, because of the lack of experience. Then he heard about G-Company. G-Company was the first official partner of Google in the Netherlands to implement Google's offering. G-Company had worked with Salesforce.com's CRM application before. Because of this experience of G-Company and because the CEO of InfoTrade was interested in Google's SaaS offering he decided to let G-Company do the implementation.

The selection of Google as provider of the desktop applications was an obvious choice. InfoTrade was already cooperating with Google, since it was a Google Adwords Qualified Company. It was familiar with Google and a relationship already existed between the two companies. Besides, Google was a cheap alternative and it offered the possibility of integration with Salesforce.com's CRM.

There was no specific criterion for the search of a provider for the newsletter application. The CEO saw the application through someone and it appealed it him, so he took the same application as the one he had seen and from the same provider.

3.3.5 SaaS APPLICATIONS IN USE

Exact Online

Until 2006 InfoTrade used Excel to do the accounts of the company. When the CEO decided to select a new accountant in 2006, who worked with hosted accounting software, he came across an accountant that had just started using Exact Online. Exact Online is accounting software that is provided as a service. The user accesses the application using a web browser. This was the first experience of InfoTrade with SaaS applications. The advantage of the hosted accounting software according to the CEO is that he could access the application from any location. In addition, it became easy to connect the accountant to the system.

Salesforce.com CRM

When InfoTrade moved to another location, the CEO felt the need for having a CRM application. One of the criteria for the CRM application was that employees should be able to access it also from home. The second criterion was that the CRM application should also be accessible for the employee working in Suriname. Due to his positive experience with SaaS applications the CEO decided that the CRM application he would pick should also be SaaS based. Salesforce.com was chosen as provider of the CRM application because it met all criteria.

Google Apps

Due to the relocation the CEO also decided to replace its desktop applications with SaaS offerings from Google. Microsoft Outlook and Microsoft Office applications were replaced by Google Apps. This is a package that Google offers to enterprises consisting of: Gmail, Google Calendar, Google Docs, Google Sites and Google Video. Gmail is used by InfoTrade for internal and external communication through e-mail. The instant messenger, Google Talk, which comes with Gmail, serves as a tool for improving internal communication in the Netherlands office and voice chat is used to communicate with Suriname. Google Calendar is used for scheduling events and meetings. Google Docs is used for making and collaborating on word documents, spreadsheets and presentations. Because all these applications are from Google, a single sign in is sufficient. In other words, the user only has to sign in once and has access to all Google applications.

Your Mailing list Provider

Another application that InfoTrade uses as SaaS is an application to send newsletters. InfoTrade takes this service from a company called Your Mailing list Provider. All e-mail addresses of the subscribers are stored in the data centers of the provider. A new person can subscribe to the newsletter by using a text field on InfoTrade's website. The e-mail address is then automatically sent to Your Mailing list Provider, not to InfoTrade. If a new newsletter has to be created, InfoTrade employees can login through a web browser and do the layout and selection of sender addresses online.

3.3.6 ON PREMISE APPLICATIONS IS USE

Currently the only thing that InfoTrade has on premises is 1 network drive of 250GB on which old documents are stored. 80% of InfoTrade's enterprise software is from Salesforce.com and Google. For each employee there is a PC available on premises. On de PCs only some light, non business critical software is running.

3.3.7 IMPLEMENTATION

The implementation of the SaaS applications went took place in steps and was very fast. It was easy and simple according to the CEO. It took about 2 days before the CEO was convinced into choosing a SaaS based CRM application when he was looking for CRM applications. A half day was needed for customizing the CRM application. The CEO believes an on premise solution would have taken much longer to implement.

Migration

The CEO thought it was too risky to migrate customer data into the new CRM application and to integrate this application with InfoTrade's e-mail application himself. He believed that his company didn't have enough knowledge and experience in this area. He searched for a long time for an external party who was experienced in this area, but during that period not many companies existed in the software market that had this experience. When he finally heard about G-company and its experience with Salesforce.com's CRM application and Google's e-mail application, he was convinced that this was the right party of the migration and integration. G-company provided a training session for the employees in order to teach them how to efficiently work with the new applications. In 4 hours the functions of the new applications were explained to the employees. The system was documented well, so not much extra information was required.

For the migration of old e-mail data into the new e-mail application the CEO also contracted G-company. G-company was responsible for the e-mail settings and for migrating old e-mails from Outlook to the new Gmail environment.

Integration

Integration of the new SaaS applications with existing systems was not a big issue for InfoTrade. First of all, InfoTrade didn't have many existing applications with which the new SaaS applications needed to be integrated. The only integration needed was that between the CRM and the e-mail application. Google's API's and G-companies experience made the integration with Salesforce.com's CRM easy. After all, this was the main reason why the CEO chose G-Company.

We asked the CEO whether it was disturbing to have several different providers for his enterprise applications, because it would mean that the employees have to sign in separately for each application. The CEO explained that this wasn't an issue. The single sign in policy of Google allows users to sign in only once and make use of any of the Google applications. Exact Online is only used by 2 employees of the company so not everybody needs to have accounts for all applications. Employees do need to login for the CRM application, but the same login name and password is used for both Google and Salesforce.com which makes it easier for the employees to manage their credentials.

3.3.8 RISK MANAGEMENT

Security

The CEO's thoughts regarding the security issue are different from some other companies. He believes that he, being a SME whose core business is search engine marketing, could never outperform a large and experienced SaaS provider whose core business is Software as a Service. He believes that the fear of losing control over security is an emotional fear and not a rational one.

Back ups

Another perceived risk of SaaS is the fear of losing data if back ups are not made regularly. The CEO of InfoTrade says that at InfoTrade they make regular backups of Exact Online themselves. The rest of the back ups are made by the providers. At Google InfoTrade's data is running on 4 different continents. This is an assurance for him, because if one of the datacenters collapses, he knows there are other backups running. Again, he explains that he isn't able to do this himself.

Availability

Finally, some companies are afraid of the consequences of the SaaS provider's systems going down. This strong dependency of the companies on the providers, makes them feel they can't do anything themselves in such a case

in order to get the systems up again. The CEO answers: "The moment Gmail stops working I see messages on Twitter within 3 minutes. Practically the whole world starts complaining and the guys at Google cannot do anything else but put all efforts on getting the systems up again." He argues that even if he would have his systems on premises and they would go down, he probably won't be able to solve it as quickly as Google would. He trusts that an experienced SaaS provider will solve the problem faster than the IT department of a company whose core business is not IT.

Vendor lock-in

There is no issue of vendor lock-in in InfoTrade's case. It is possible to end your contract at any time, download your data and move it to another SaaS provider.

3.3.9 FINANCE

InfoTrade has a yearly contract with its SaaS providers. For Google EUR 40 per year per person is paid. InfoTrade has 5 accounts at Salesforce.com which costs them EUR 500 per year. For Exact Online an amount of EUR 60 per month is paid.

3.3.10 USER ACCEPTANCE AND SAAS USABILITY

Users of the SaaS applications at InfoTrade were open to the introduction of the applications. Particularly Gmail was not difficult to introduce. Many were already familiar with the layout and logic of Gmail, because they also used it for their personal e-mail communication. Besides this, the CEO explains that all of his employees are always eager to try out new technologies.

The CEO explains that what the employees miss in Gmail with respect to functionality is more personalized signatures. Another feature that their previous on premise e-mail application had that they miss in Gmail is easy copying and pasting of images. In Gmail the user needs to perform many actions in order to insert an image in the e-mail, in contrary to Outlook where one could insert the image by dragging and dropping. Images are sent to customers of InfoTrade quite often, so the employees do miss this feature. The documents that are made at InfoTrade are not very complex documents and usually consist of 2-3 pages. Thus, working with Google Apps is not a problem. Gaining the advantage of being able to collaborate on documents is far more important than losing the functionality of easily making complex documents.

3.3.11 THE DECISION MAKER'S VISION ON SAAS

The CEO of InfoTrade believes that man is the only hindrance in the further development and adoption of SaaS. He thinks it will take another 5 years before companies will be more open towards SaaS. "It is a mindset that people have developed during their studies or work experience. The fear is an emotional fear not a rational one." He also says that IT staff is often against SaaS because it fears losing its job. In a SaaS environment, where applications are hosted and not on premise anymore, the need for in-house IT staff also reduces. Since the IT staff is usually the only one who has knowledge about the IT, they are in a position to argue that SaaS is a risky solution for the company.

The overall advantage of the SaaS model according to the CEO is that as a company you don't have to spend your time on IT related tasks. You can focus on your core business instead, because the SaaS providers, the experts, take care of managing and running the applications.

3.4 CASE STUDY 3: OPEN UNIVERSITY

The interview was held in November 2009 with the IT Manager of the Open University.

3.4.1 ORGANIZATIONAL PROFILE

The Open University (OU) is a university in the Netherlands with 25.000 students and 800 employees. The IT department of the OU consists of 40 employees. The OU, founded in 1984, is the youngest university of the Netherlands. It is different than other universities in the Netherlands, because most of the students who join the university don't come directly from high schools. The students of the OU are regularly of a higher age group and usually they also work besides studying at the OU. The OU is a distance teaching university. Therefore there are no classes like in regular universities. Students are required to study in their own time and can start a course or study at any time in the year. Across the country there are studying centers where OU students can get together with staff and take exams. The degree that a student gets after finishing a course at the OU is equivalent to degrees from the regular universities in the Netherlands.

3.4.2 SAAS DRIVER

The Student Council of the OU requested the OU board to provide the students with a university e-mail facility. Before this, the OU didn't provide e-mail accounts for their students. Most students used their private accounts or created accounts by themselves to use for their OU communication. The OU had an overview of the e-mail addresses of their students, but this was not a very reliable overview. Approximately 2 years ago the Student Council requested the University board that the students would like to have an e-mail address provided to them by the university.

Several alternatives in order to accommodate the students' request were considered. The OU realized that e-mail is actually a commodity. They asked themselves whether they should build it themselves or take it as a service from an external provider. The university board realized that it would not be a strategic move to set up their own e-mail systems. They believed that an experienced provider would be better in managing e-mail accounts than the OU.

3.4.3 SELECTION CRITERIA FOR SAAS APPLICATIONS

Initially the only application that the OU wanted to implement was e-mail. Later also Google Docs and Google Talk were introduced and are now used by students for creating and sharing documents. The criteria for the e-mail application were first of all having a web-based application that could be accessed from any location. Secondly the mailboxes needed to have a minimum storage space of 100MB. Thirdly, the e-mail application was required to be compatible with the existing e-mail clients that were used by the students.

3.4.4 SELECTION CRITERIA FOR SAAS PROVIDERS

At the time that the OU made the decision to look for e-mail providers, Google was the most experienced provider on the market. Also, the first four years of use of Google Apps were free for universities. This was an important reason for the OU to choose for Google. Another reason for choosing Google was that Google uses open standards with respect to its applications. This would mean that integrating Google Apps with existing applications would be easier. Another criterion set by the OU was that the provider was to ensure that the application would be available with minimum downtime. Finally, the risks for vendor lock-in were evaluated by the OU and because Google uses open standards for their Gmail solution, these risks were considered limited.

3.4.5 SAAS APPLICATIONS IN USE

Google Apps

One of the SaaS applications that the OU has implemented is Google Apps. From the several applications that are part of the Google Apps package, the OU currently mainly uses Gmail. The e-mail addresses are not recognizable for the receiver as Gmail addresses, because they have the domain name of the OU (*studentname*@ou.nl).

Approximately 13.500 students use this application. The students have also started using Google Docs to create and share documents for project collaboration.

Administration

The employees of the OU use an administration application to manage their leave from work. Besides this there is also a SaaS based application to manage the corporate financial administration and the registration of students. These applications are only used by OU staff, not by students.

3.4.6 ON PREMISE APPLICATIONS IS USE

A part of the e-mail applications that is used by the OU is still managed on premise. These are the e-mail systems that incorporate the mailboxes, calendars and contacts for the 800 employees of the OU. These mail systems already existed before Gmail was introduced at the OU. It would have been a large project to migrate all data of employees to Google, because also the calendar and contact functionality are involved. Therefore Gmail was introduced only for students. The second reason for keeping the mail data of the employees on premises was an emotional one. According to the OU the data that the employees exchanged was more crucial (and sometimes confidential) than the data exchanged by the students. Therefore, the risk was emotionally believed to be too large to move the data off premises.

3.4.7 IMPLEMENTATION

The part of the implementation that took most of the time was the legal contract. The OU appointed their company lawyer to study and understand the contract correctly. One of the goals was to understand the privacy aspects of the contract, because the laws that applied to their contract agreement were not Dutch laws. In the OU's case it was the Californian law that formed the basis for the contract. It took about 4 to 6 weeks in order to understand and agree upon the contract.

The technical part of the implementation took about 1 month.

Migration

There was no migration of data needed, because before the implementation of Gmail there were no existing mail accounts for the students.

Integration

The mail accounts of the students needed to be integrating with some of the existing systems. The IT department of the OU built the integration blocks (account provisioning and authentication) themselves. It was not a difficult process, because according to the OU Google has a clear and concise description of how to integrate the existing systems to their software.

3.4.8 RISK MANAGEMENT

Security

The OU believes that they can never outperform a large and experienced SaaS provider whose core business is SaaS on the security aspect. Yet, the OU understands that some people are not in favor of moving their data into Google's cloud. Therefore, the OU doesn't require that their students make use of the e-mail facility that the OU is offering to them. Students are asked to approve upfront that the OU will let Google create an account at Google's datacenters. It is up to the student to decide whether or not he or she wants to make use of the OU e-mail facility. Eventually 13.500 students out of a total of 25.000 OU students opted for OU's e-mail facility. The larger part of the students didn't want to make use of the OU accounts, because of two main reasons: they were either against

the idea of moving their data into Google's cloud or they already had an e-mail account and didn't want to manage any additional accounts.

In order to ensure security the OU stores the credentials of the students on premises. SAML (Security Assertion Markup Language), a secure XML based communication mechanism for communicating identities between organizations, is used to exchange information between the OU and Google in order to give users access to the Gmail accounts. The exchange of SAML messages between the OU and Google is transparent for the user. This means that the user just needs to open the webpage to sign in and the rest of the process is not visible to the user.

Back ups

Backups of the mail accounts are made by Google. Similar to the security issues, the OU believes they can't provide better backup systems than Google.

Availability

The OU feels positive about the 99.9% guarantee of uptime of Google. They say that it would be impossible to maintain that uptime if they would maintain the mail systems on premises. Also, in case the systems went down there would be too much pressure on the IT department of the university to solve the problem. In case systems go down at Google, they would try to recover the problem as soon as possible, since it is their core business.

The IT manager of the OU is positive about Google, even though the OU has experienced problems with the availability of Gmail. There have been 2-3 moments that the students weren't able to reach their mailboxes.

Vendor lock-in

Avoiding vendor lock-in was important for the OU, because their contract with Google is only for 4 years. After the expiration of the contract the OU wants to be free in choosing another SaaS provider.

3.4.9 FINANCE

Google Apps is free for universities for the first 4 years of use. What happens after 4 years is unclear for the OU.

3.4.10 USER ACCEPTANCE AND SAAS USABILITY

The student council was the initiator of having a mail facility from the OU, thus many students were open to the introduction of Gmail. Yet, the numbers show that more than half of the students didn't opt for opening a Gmail account through the OU. As discussed earlier, a part of these students doesn't want to have their data at Google out of principle. Another reason for not making use of the mail facility of the OU is that students already have an account and don't want to manage another account. Some of the users, who did choose to open an OU account, were already familiar with Gmail and therefore were open in accepting Gmail. Also, some students opted for a Gmail account because they wanted an OU e-mail account.

3.4.11 THE DECISION MAKER'S VISION ON SAAS

The IT manager's vision on SaaS is that there are still some bridges to overcome. One of the problems is trust. The interviewee also believes that in the coming years the providers will grow and will solve most shortages that SaaS applications have nowadays. He also believes it is a matter of daring and trust on the side of the customers. Companies need to study the risks and get extensive advice on legal issues. The interviewee also says that in the future the software taken as a service will be more tailor-made, adjusted to the needs of the customer. As an example he mentions the case of the LA municipality with whom Google signed a contract for 34.000 users. Initially the LA municipality was reluctant to put their data into the cloud, because they thought that the confidential data of their residents would not be safe in Google's cloud even with encryption. This triggered Google to develop a new offering: the Gov Cloud. The Gov Cloud, as the name suggests, was developed especially for

governments. The Gov Cloud meets the requirements of the government; guaranteeing that the data of the government is stored and processed only within the boundaries of the United States. (Wijkstra, 2009)

3.5 Case Study 4: Koninklijke Militaire Academie

The interview was held in November 2009 with a former employee of the Koninklijke Militaire Academie (KMA), the Royal Military Academy, which is now a part of the Nederlandse Defensie Academie (NLDA). This case study is different from the previous case studies. In this case there was no implementation of a SaaS application. In contrary to the first three cases the KMA has chosen not to implement SaaS e-mail. The interviewee was a logistics professor at the KMA from 2002 up to 2009.

3.5.1 Organizational profile

The NLDA stands for the Dutch Defense Academy. It provides military training, personal training and academic education for the Dutch Defense members. The NLDA also conducts scientific research. The NLDA consists of several divisions: the Royal Institute for Marine (KIM), Royal Military Academy (KMA), Faculty of Military Sciences, Institute for Defense Courses, HRM-Academy, Course Top management Defense and Dutch Institute of Military History. The organigram below shows how the KMA fits into the NLDA.

Figure 11 Organigram Nederlandse Defensie Academie (http://www.defensie.nl)

The KMA quarters are set up in Breda in the Netherlands. Every year thousands of cadets and approximately 200 students are trained to become military officers. 200 civilians and militaries work for the KMA in order to support the education of the officers, either directly or indirectly. The KMA provides military and technical education for officers of the Royal Army, Royal Air force and the Royal Gendarmes.

3.5.2 SaaS driver

The KMA uses an on premise SaaS e-mail application for its employees. Each employee has a mailbox of 100 Mb and is allowed to send mails of maximum 5 Mb. According to present-day standards this is very little. The employees of KMA feel that this limits them in their communication as most of the project files exceed the 5 Mb limit. To give you an idea of present-day standards, today's larger SaaS e-mail providers offer 25 Gb mailboxes,

which is 250 times more than the mailboxes at the KMA. Also the maximum size of an e-mail is now approximately 25 Mb, five times more than currently allowed at the KMA.

However, the consideration for replacing the current e-mail application with a SaaS solution was disapproved by the decision makers. The interviewee explains why according to him a SaaS solution was disregarded:

- Decision makers believe SaaS would lead to higher security risk for e-mail
- Moving your mailboxes to an external provider would increase the chances of receiving spam
- ICT employees are scared of losing their jobs
- Higher level management does not have sufficient knowledge about the latest technological trends (including SaaS). They are not aware of the pros and cons of SaaS.
- The decision makers believe that today's SaaS e-mail applications don't offer better functionality than on premise e-mail applications. The main advantage of SaaS e-mail applications compared to on premise e-mail applications, according to them, is cost saving. If SaaS providers would offer SaaS e-mail applications with more and improved functionality compared to on premise e-mail applications, SaaS would become a more attractive solution for companies including the KMA.

The standards set by the KMA were seen as limitations by the employees. In order to work more efficiently and communicate faster, employees started creating their own ways to bypass the limits imposed by the IT policies of the KMA. One of the solutions was transferring data by means of USB sticks. Others started using their personal e-mail accounts which made it possible to send larger files. Ironically, this increased the security risk the higher level management was worried about.

3.5.3 SELECTION CRITERIA FOR SAAS APPLICATIONS

A SaaS solution was not considered by the higher level management of the KMA, therefore no criteria were set up. However, based on the interview, we can state that the employees who were in favor of a SaaS application wanted the SaaS application to have larger mailboxes. They also wanted the size of the e-mails to be larger. According to them this would speed up communication.

3.5.4 SELECTION CRITERIA FOR SAAS PROVIDERS

Due to the same reason as stated in the previous section, no information was available on this topic.

3.5.5 SAAS APPLICATIONS IN USE

There are no SaaS applications in use by the KMA that we know of.

3.5.6 ON PREMISE APPLICATIONS IS USE

The e-mail accounts of the employees are currently stored on premises of the KMA. All desktop applications are Microsoft applications.

3.5.7 IMPLEMENTATION

No SaaS application was implemented by the KMA, therefore information was available on this topic.

3.5.8 RISK MANAGEMENT

No SaaS application was implemented by the KMA, therefore information was available on this topic.

3.5.9 FINANCE

The KMA never considered a SaaS solution, therefore no cost analysis data was available.

3.5.10 USER ACCEPTANCE AND SAAS USABILITY

The idea of using SaaS instead of on premise e-mail started from the employee level of the organization. The employees were not happy with the current e-mail solution and were eager to use a new SaaS e-mail solution which would provide them more storage space, leading to faster communication. Therefore, users are expected to accept a SaaS solution very easily. However, whether all or a majority of the employees would accept a SaaS solution was not studied.

3.5.11 THE DECISION MAKER'S VISION ON SAAS

The employees of the KMA are eager to adopt a SaaS e-mail solution. They believe that a SaaS e-mail solution would provide faster and easier communication compared to the current on premise solution.

Being a part of the Ministry of Defense, the KMA has to follow tight security policies. Therefore the higher level management of the KMA is not in favor of SaaS. It believes that SaaS will only lead to more security risks.

3.6 CASE STUDY 5: UNIVERSITY OF TWENTE

The interview was held in December 2009 with the Corporate Information Managers of the University of Twente (UT). Similar to the previous case, in this case there was no implementation of a SaaS application. The UT has been considering SaaS, but until now it has chosen not to implement a SaaS e-mail application.

3.6.1 ORGANIZATIONAL PROFILE

The University of Twente (UT) is a university in the Netherlands with approximately 8250 students and 2800 employees (http://www.utwente.nl/feitenencijfers/onderwijs/, 2008). The UT calls itself an entrepreneurial research university. It is the only Campus University in the Netherlands and provides academic education and research in a wide variety of fields. The UT is part of the 3TU federation and works cooperatively with Delft University of Technology and Eindhoven University of Technology. The UT is also a member of the European Consortium of Innovative Universities. The ICT department of the UT consists of approximately 100 people.

3.6.2 SAAS DRIVER

The main reason of the UT for considered SaaS is that it possibly offers quality and/or efficiency advantages for the UT, especially when it is considered in cooperation with other universities. Also, SaaS was a logical result of an identified technological development in the society.

3.6.3 SELECTION CRITERIA FOR SAAS APPLICATIONS

The UT has two important criteria for the SaaS applications:

- The privacy of their students and employees should be guaranteed
- The SaaS application should be easy to integrate with the existing UT applications

The interviewees explain the first point. Not all SaaS providers currently allow their clients to determine or know where their data is stored physically. The data could be anywhere in the world. This means that the law of the country where the data is stored will be applied to the data. Since the UT is not able to know in which country its data is stored, it also doesn't know what laws are applicable to its data. Consider for example the case that the UT's mailboxes are stored in the United States of America (USA). With the recent terrorist activities going on, it could be possible that the USA government has the right to access some student's e-mail account because it is

possible according to the USA law. The UT along with eleven other universities is against this aspect of SaaS. They want to guarantee privacy for their students.

The second criterion requires the SaaS application to be easily integrated with the existing UT applications. The UT has several applications that are currently connected to its e-mail application. If the UT would select a SaaS e-mail application, it should take as little time as possible to connect it to the other systems.

The decision makers believe that a SaaS e-mail solution like it is offered today is not suitable for their university. In fact, the university collaborates with other universities in the Netherlands who are all of the same opinion. They have agreed that either all eleven universities will sign up with Google or Microsoft together or none of them will. The OU case is different, because it is not a government subsidized university. It doesn't fall under these eleven universities.

3.6.4 SELECTION CRITERIA FOR SAAS PROVIDERS

The interviewees talk about two providers: Google and Microsoft. The current offering of Google complies with the second criteria of the UT: easier integration with existing applications. When a student gets admission to the UT, the student's information is recorded in a system called Osiris. An e-mail account is then created for the student and is coupled to the student's entry in Osiris. Google provides an easy to implement solution for the UT in order to integration Gmail with Osiris. The reason for not choosing Google is that Google is not transparent to their customers about where the data is located.

On the other hand, Microsoft does provide this information to their clients. But they lack in comprising the second point. It is more complicated to integrate Microsoft's SaaS e-mail solution with Osiris.

Thus, both large players of the SaaS e-mail market lack on one of the criteria set by the UT. However, the interviewees believe that both Google as well as Microsoft are working on solving the respective problems.

3.6.5 SAAS APPLICATIONS IN USE

There are no SaaS applications in use by the UT.

3.6.6 ON PREMISE APPLICATIONS IS USE

The e-mail accounts of the students and employees are currently stored on premises of the UT. The UT has a central service point (ICTS) who are responsible for maintaining e-mail systems and other IT systems for all faculties spread out across the campus.

3.6.7 IMPLEMENTATION

No SaaS application was implemented by the UT, therefore no information was available on this topic.

3.6.8 RISK MANAGEMENT

No SaaS application was implemented by the UT, therefore no information was available on this topic.

3.6.9 FINANCE

Google Apps is free for universities for the first 4 years of use. Therefore the UT wouldn't be paying anything for the first 4 years of the contract if it would opt for Google. What happens after 4 years is unclear.

3.6.10 USER ACCEPTANCE AND SAAS USABILITY

Since the UT doesn't have any plans to introduce SaaS e-mail, the user acceptance and SaaS usability has not been studied yet. When asked about the difference in functionality between the current e-mail systems of the UT and SaaS e-mail functionality, the interviewees believe there wouldn't be a major loss or gain of functionality.

3.6.11 THE DECISION MAKER'S VISION ON SAAS

The interviewees' vision is that SaaS e-mail will be adopted, but in 10 years, not now. Both believe that there is still room for improvement on the side of the SaaS vendors. Information needs to become more transparent to the client. Therefore they disagree with the term "Cloud". "Storing your data in the Cloud" implies that your data is somewhere you don't know of. The CIOs of the UT highly object to this image of SaaS. They want the location of the data to be made visible to the clients.

4 DATA ANALYSIS

In this chapter we analyze the data gathered during the case studies. The five cases have something in common; in all cases a SaaS solution was considered to replace or extend existing on premise solutions. In three of the cases, the organizations implemented some form of a SaaS solution. In the other two cases the decision makers decided that a SaaS solution was not suitable. The first case, the NEVI case is used as an explorative case because NEVI did not implement any SaaS e-mail application. However, we can still learn lessons from this case about SaaS in general.

We analyze the case studies based on the theory of Eisenhardt (1989) as explained in chapter 1.6.1. We use Eisenhardt's cross-case pattern search methodology and combine it with the second tactic explained in her article (list pairs of cases and list similarities and differences between the pairs). First the three cases in which a SaaS solution was implemented will be compared to each other by discussing the similarities and differences. Then the two cases in which SaaS was not implemented will be compared to each other.

4.1 NEVI AND INFOTRADE

Table 2 gives an overview of Case NEVI and Case InfoTrade based on the ten dimensions discussed in chapter 3.1.

Table 4 Cross-case pattern analysis of Case NEVI and InfoTrade

Dimensions	Case NEVI	Case InfoTrade
Organization size	SME (40 FTE)	SME (6 FTE)
Organization type	Private sector	Private sector
Organization description	Platform for procurement professionals	Search engine marketing
SaaS drivers	Fusion of two business units	Relocation of company, new accountant, SaaS hype
Selection criteria for SaaS applications	Showing who is present in the office, centralization of data and search function for searching through it, improved communication, sharing information, global accessibility	Global accessibility, improved communication
Selection criteria for SaaS providers	Costs, new, flashy and innovative provider suiting the image of NEVI, scalability	Costs, reputation of SaaS provider, easy integration with other applications, easy migration of old data
SaaS applications in use	Google Sites (Intranet), Google Calendar	Google Apps (Gmail, Calendar, Docs, Sites, Voice), Exact Online, CRM, Your Mailing list Provider
On premise applications in use	Microsoft Outlook, Microsoft Office, a part of the knowledgebase	250 GB network drive for old data
Implementation process	Time consuming, many delays, difficult	Fast, easy & simple
Risk management	Keeping business critical data on premises	Only selecting large and experienced SaaS providers, trusting SaaS provider handles security better than himself, trusting SaaS provider makes better back ups than himself, trusts SaaS provider will be able to get back online faster

		that himself, no vendor lock-in
Finance	EUR 40 per person per year for Google Apps	EUR 40 per person per year for Google Apps
Usability	Pros: Easier to find information, Improved collaboration (chat) Cons: Doesn't work equally well on every PC	Pros: Improved collaboration Cons: Gmail misses advanced options for signatures, Gmail misses easy inserting of images into mails.
User acceptance	Reluctant	Very accepting
Decision maker's vision on SaaS	"SaaS, this is where the world is heading to. It's only natural to move along with the world."	"Man is the only hindrance in the further development and adoption of SaaS. It will take another 5 years before companies will be more open towards SaaS."

4.1.1 SIMILARITIES

Both organizations are SME and are from the private sector. The companies have two selection criteria in common for selecting the SaaS applications: improved communications and global accessibility. Both companies had costs as their criteria on which they would select the SaaS provider. This means some providers who might have complied with the requirements were not selected because they were too expensive. The only similar SaaS application that is used between both companies is Google Calendar. In both cases this application is not used much. Because both companies have taken Google as a provider, they pay the same amount which is EUR 40 per person per year. The usability dimension shows that in both cases the users find the collaboration between colleagues to be improved with the implementation of the SaaS application. In some situations this is through Google Talk, where colleagues can quickly communicate with each other and collaborate. In addition, in InfoTrade's case this is realized by Google Docs, which enables users to work on documents in an easier way than was possible with premise based applications. Finally, a clear similarity is seen in the vision of the stakeholders regarding SaaS. Both are optimistic about SaaS and truly believe that it is the future.

4.1.2 DIFFERENCES

Although both organizations fall in the SME category, NEVI almost has 6 times as many employees as InfoTrade. So its worthwhile to keep this difference in mind. In both cases the drivers for considering SaaS as a solution were different. NEVI was going through an organizational change where two divisions of NEVI were going to fuse. This required knowledge of both divisions to be centralized and easily accessed. It made NEVI think about reorganizing their IT or adding some new functionality to it. One of the possible solutions was SaaS. The reason why SaaS was considered at InfoTrade was different. Here the relocation of the company to another building, a new accountant, and the hype of SaaS were key drivers for the SaaS consideration. The *Selection criteria for SaaS applications* dimension shows us that except for improved communication and global accessibility NEVI also set the criteria that the application should provide an overview of who is present in the office, it should provide centralization of data and a search function for searching through it and it should make it possible for sharing information between colleagues. Whereas costs were the main criteria that NEVI considered when selecting the SaaS provider, InfoTrade set some more criteria: reputation of SaaS provider, easy integration with other applications and easy migration of old data. These criteria were equally important. When looking at what SaaS applications are in use in both companies, we see that InfoTrade has considerably more SaaS applications than NEVI. Logically, the dimension *On premise applications in use* shows us that NEVI has considerably more on premise applications than InfoTrade. When we evaluate the implementation process of both companies we see a clear difference. The implementation at NEVI was time consuming and difficult. NEVI experienced many delays and feels frustrated about the way things have gone. In contrast to this, InfoTrade experienced no difficulties at all. It was very positive

about how fast and simple the process was. The risk management dimension shows how both companies cope with the risks of SaaS applications; the CEO of InfoTrade strongly believes that experienced SaaS providers will be better able to manage security, back up and uptime than he will ever be able to do with in house knowledge. NEVI, however, is positive about SaaS yet reluctant when it comes to business critical data. NEVI has taken, what seems to be, a middle road by keeping their business critical data on premises and moving only non critical data to the Cloud.

Both companies pay the same amount to Google, although their use of applications is quite different. It is remarkable that although NEVI is paying for the entire Google Apps package which includes Gmail, Google Calendar, Google Docs, Google Sites and Google Voice, it is only using Google Sites and Calendar. NEVI's effort to spare their employees as much tension as possible in the time of the organizational change is the reason for this decision. The interviewee at NEVI says: "The employees are already going through a lot of change because of the fusion. We want to slowly introduce the other applications such as Gmail, Google Doc, etc." Most of the employees were not used to the different logic and interface of Gmail. Thus it would require them to put more effort in learning it than the employees at InfoTrade who were already familiar with Gmail.

In some cases it might be difficult to use this dimension to compare case studies, because it strongly depends of the type of application you consider. For example, in our analysis we are considering not only the usability of e-mail applications but also the usability of other SaaS applications. The "easier to find information" advantage that NEVI mentions is based on the Google Sites application (intranet). InfoTrade does not use Google Sites. In the same way InfoTrade mentions that the employees miss advanced options for signatures and easy inserting of images into mails. This usability issue is regarding e-mail, which is again not used by NEVI. Thus, when considering these two differences for further analysis one should keep in mind that the two parties are talking about different applications. A "valid" difference is that at NEVI the settings of the PCs didn't allow the application to work equally well on each PC. This last difference leads us to the next dimension: *User acceptance*. Because the application doesn't always function, users have become pessimistic about the application. It is clear that the users of both companies think very differently about the new technology.

4.2 NEVI AND OPEN UNIVERSITY

Table 3 gives an overview of Case NEVI and Case Open University based on the ten dimensions discussed in chapter 3.1.

Table 5 Cross-case pattern analysis of Case NEVI and Open University

Dimensions	Case NEVI	Case Open University
Organization size	SME (40 FTE)	25.000 students and 800 employees
Organization type	Private sector	Private sector
Organization description	Platform for procurement professionals	University
SaaS drivers	Fusion of two business units	Student council asked for e-mail provisioning by OU
Selection criteria for SaaS applications	Showing who is present in the office, centralization of data and search function for searching through it, improved communication, sharing information, global accessibility	Web-based e-mail application (global accessibility), minimum storage space of 100MB per mailbox, e-mail application required to work with students' existing mail client, minimum downtime
Selection criteria for SaaS	Costs, new, flashy and innovative	Costs

providers	provider suiting the image of NEVI, scalability	
SaaS applications in use	Google Sites (Intranet), Google Calendar	Google Apps (Gmail, Calendar, Docs, Sites, Voice), payroll application, corporate administration application, students' registration application
On premise applications in use	Microsoft Outlook, Microsoft Office, a part of the knowledgebase	Microsoft Outlook, Microsoft Office
Implementation process	Time consuming, many delays, difficult	Technical part of implementation was quick (1 month), legal part of implementation took 4-6 weeks
Risk management	Keeping business critical data on premises	Keeping part of business critical data on premises (employees' e-mail accounts and e-mail credentials of students), spending sufficient time on understanding SLAs, informing students of the mail accounts being at Google and giving students the choice to create an account or not, trusting SaaS provider handles security better than himself, trusting SaaS provider makes better backups than himself, trusting SaaS provider will be able to get back online faster that himself
Finance	EUR 40 per person per year for Google Apps	First 4 years with Google are free for universities
Usability	Pros: Easier to find information, Improved collaboration (chat) Cons: Doesn't work equally well on every PC	No information available
User acceptance	Reluctant	Varies: part of students doesn't want to have their data at Google out of principle, part of students already has e-mail account and doesn't want to manage another account, part of the students are happy with Gmail
Decision maker's vision on SaaS	"SaaS, this is where the world is heading to. It's only natural to move along with the world."	"In the coming years the providers will grow and will solve more shortages that SaaS applications have nowadays. It is a matter of daring. Companies need to study the risks and get extensive advice on legal issues. In the future the software taken as a service will be more tailor-made."

4.2.1 SIMILARITIES

Table 5 shows that both NEVI as well as the OU are from the private sector. Both organizations provide a platform for people to gain and exchange knowledge. Although the criteria for selecting the applications differ between the two organizations, there is one thing that they have in common: both organizations want an application that is globally accessible. The higher management of NEVI wants to be able to access the applications from any location and the OU wants their students to be able to access their e-mail from any location. This is a key characteristic of SaaS, so a SaaS solution is suitable from this point of view. The main reason why both organizations chose Google was lower costs. The on premise applications that are used in both cases are Microsoft applications. In both cases there was no existing on premise application that has been substituted by the new SaaS application. In the NEVI case, the SaaS solution was an addition to the existing on premise applications. In the OU case the SaaS solution was also an addition to the existing on premise applications. Before the implementation of SaaS e-mail the students of the OU didn't have any e-mail facility at the OU. The employees of the OU however, did use OU e-mail. This was however premise based not SaaS based. With the implementation of SaaS at the OU, the e-mail facility for the employees did not change. Thus, a new application was added to the existing applications. Although what is perceived as business critical data is different for both organizations; at NEVI knowledge is business critical data and at the OU the credentials of the students and the e-mail accounts of the OU employees are considered business critical, both organizations take the same measurements to minimize security and privacy risks. They do this by keeping a part of the critical data on premises. Finally another similarity that is seen between both cases is the positive belief in SaaS by the decision makers of both companies.

4.2.2 DIFFERENCES

The main organizational difference between the cases is the size; NEVI is the SME with around 40 FTE whereas the OU counts around 800 FTE and 30.000 students. The driver for a new SaaS based solution was different for both organizations. At NEVI the reason was the fusion between two parts of NEVI. At the OU the Student Council requested the OU to provide them with e-mail accounts. We expected that this would mean that the users, in case of the OU the students, would clearly accept the introduction of the e-mail application. Although the acceptance is higher in the OU case compared to the NEVI case, still a large part of the students of the OU refused using SaaS e-mail. However, it should be noted that a reason for refusing a Gmail account was also because students already had an e-mail account and didn't want to manage another one. It was not solely because the students didn't accept SaaS based e-mail. Due to the difference in SaaS applications to be selected, the "criteria for selecting SaaS applications" and "SaaS applications in use" fields mentioned in the table are different from each other. As discussed before, NEVI's goal was not implementing SaaS e-mail but a solution for sharing and storing knowledge. The implementation process in both cases was perceived to be different. NEVI found the implementation to be time consuming and difficult and experienced many delays. The OU also spent more time than planned, but the interviewee was less negative about it. In the OU case the technical part of the implementation was reported to be quick. The part that took most of the time was the legal part; understanding the contract with the help of a legal expert. In the previous section we discussed that both the organizations kept a part of their business critical data in order to cope with security and privacy risks. On top of this, the OU takes some more measurements in order to manage the risks of SaaS. As seen in the implementation process, the OU finds it very important to spend sufficient time on understanding SLAs. Because in a SaaS setting you are moving your data and the responsibility of managing and maintaining your data to an external party, you are making yourself dependant on them. In most SaaS cases your data could be in some other country than were your company is situated in. The OU believes it is important to make clear and correct SLAs with your provider and to understand the legal consequences of moving your data to another country. The OU also gives its students the option of not opening an account at Google. The students are told in advance that if they sign up for an OU e-mail account, their data will be stored somewhere in Google's datacenters. This is something that not all companies can do. In most cases the companies won't be able

to provide their employees with a choice. The OU says that the only thing besides taking these measurements is to trust your provider. The OU believes that the SaaS provider will be able to act faster and more efficiently than the IT department of the OU, because it's not the OU's core business. Finance wise, there is a difference between both organizations. Because the OU is a university, Google offers free use of Google Apps for the first four years. There was no information available for the OU case regarding the usability of the SaaS application. Therefore we cannot make a comparison with the NEVI case on this aspect.

4.3 INFOTRADE AND OPEN UNIVERSITY

Table 4 gives an overview of case Infotrade and case open University based on the ten dimensions discussed in chapter 3.1.

Table 6 Cross-case pattern analysis of Case InfoTrade and Open University

Dimensions	Case Infotrade	Case Open University
Organization size	SME (6 FTE)	30.000 students and 800 employees
Organization type	Private sector	Private sector
Organization description	Search engine marketing	University
SaaS drivers	Relocation of company, new accountant, SaaS hype	Student council asked for e-mail provisioning by OU
Selection criteria for SaaS applications	Global accessibility, improved communication	Web-based e-mail application (global accessibility), minimum storage space of 100MB per mailbox, e-mail application required to work with students' existing mail client, minimum downtime
Selection criteria for SaaS providers	Costs, reputation of SaaS provider, easy integration with other applications, easy migration of old data	Costs
SaaS applications in use	Google Apps (Gmail, Calendar, Docs, Sites, Voice), Exact Online, CRM, Your Mailing list Provider	Google Apps (Gmail, Calendar, Docs, Sites, Voice), payroll application, corporate administration application, students' registration application
On premise applications in use	250 GB network drive for old data	Microsoft Outlook, Microsoft Office
Implementation process	Fast, easy & simple	Technical part of implementation was quick (1 month), legal part of implementation took 4-6 weeks
Risk management	Only selecting large and experienced SaaS providers, trusting SaaS provider handles security better than himself, trusting SaaS provider makes better backups than himself, trusts SaaS provider will be able to get back online faster that himself, no vendor lock-in	Keeping part of business critical data on premises (employees' e-mail accounts and e-mail credentials of students), spending sufficient time on understanding SLAs, informing students of the mail accounts being at Google and giving students the choice to create an account or not, trusting SaaS provider handles security better than himself, trusting SaaS provider makes better backups than himself, trusting SaaS provider will be able

		to get back online faster that himself
Finance	EUR 40 per person per year for Google Apps	First 4 years with Google are free for universities
Usability	Pros: Improved collaboration Cons: Gmail misses advanced options for signatures, Gmail misses easy inserting of images into mails.	No information available
User acceptance	Very open	Varies: part of students doesn't want to have their data at Google out of principle, part of students already has e-mail account and doesn't want to manage another account, part of the students are happy with GMail
Decision maker's vision on SaaS	"Man is the only hindrance in the further development and adoption of SaaS. It will take another 5 years before companies will be more open towards SaaS."	"In the coming years the providers will grow and will solve more shortages that SaaS applications have nowadays. It is a matter of daring. Companies need to study the risks and get extensive advice on legal issues. In the future the software taken as a service will be more tailor-made."

4.3.1 SIMILARITIES

Both the companies are from the private sector. When we look at the selection criteria for the SaaS applications we see that both the companies wanted global accessibility to the applications. In both cases costs played an important role in selecting the SaaS provider. The organizations both chose Google as their SaaS provider for Google Apps. Besides Google Apps both companies use other SaaS applications such as Exact Online, CRM, Your Mailinglist Provider (Infotrade) and a SaaS based payroll application, corporate administration application and students' registration application (OU). The implementation process was in both cases fast and without any hindrances. As the risk management field shows, both the companies trust that the SaaS provider will be able to handle certain tasks better than they would be able to do themselves, such as handling security, backups and quickly recovering if systems go down. The interviewees of both companies were very positive about SaaS. Both believe that in the future more companies will move their businesses to the cloud.

4.3.2 DIFFERENCES

There is a clear difference in the size of the organizations. Infotrade is a company existing of 6 people, whereas the OU is a company with 800 employees. The software implementation we are considering in our research is being implemented for the 30.000 students of the OU versus the 6 employees of Infotrade. Looking at the organizational profile we also see that the companies have different core businesses. Infotrade is in the search engine marketing business and the OU is a university. The SaaS drivers were in both cases different. In the case of Infotrade there were three drivers: relocation of the company, a new accountant who worked with SaaS applications and the fact that the CEO of the company became interested in SaaS because he saw this new technology somewhere else. We indicate the latter as "SaaS hype". In the case of the OU the driving force of the request of the Student Council. Besides both companies wanting the SaaS application to provide global accessibility for their users, there are some differences in the criteria that both companies set for the SaaS application. Infotrade wanted the SaaS application

to improve communication between the employees. The OU's criteria were focused on e-mail, such as the SaaS application should have mailboxes with a minimum storage space of 100MB per mailbox, it was required that the e-mail application would work with students' existing mail client and that the application would have minimum downtime. In selecting the the SaaS provider Infotrade had some criteria that the OU didn't. Infotrade selected the SaaS provider based on the possibility of easy integration of its SaaS application with Infotrade's existing applications and easy migration of Infotrade's data into the datacenters of the SaaS provider. There are no premise based applications in use at Infotrade. At the OU the mail application for the employees is however still premise based. Also other desktop applications in use are applications such as Office from Microsoft. Because of Google's offer for universities, the OU can use Google Apps for free for the first four years. Infotrade pays an amount of EUR 40 per person per year for Google Apps. As discussed before, no information on the usability of the new SaaS applications was available for our research. Therefore, we cannot compare the cases on this aspect. Users of Infotrade used Gmail also for their personal e-mail exchange and were very positive about it. Perhaps this made them more open to accept Google Apps being introduces into their work environment. A part of the users at the OU were open to accepting Gmail, but a large part still didn't sign up for an e-mail account. Two reasons were reported during our case study for the fact that students didn't sign up: some students were in principle against their data being at Google's datacenters and some students already had e-mail accounts which they used for the OU e-mail exchange and didn't want to manage another new account. Whatever reasons there might be, there is a clear difference between the two cases. One should consider however the size of the companies when analyzing the difference in user acceptance. In a setting of 6 employees, even the employees who are reluctant towards a new SaaS based e-mail application will be convinced more easily to accept the application than in a setting of 30.000 students.

4.4 KMA AND UNIVERSITY OF TWENTE

The two cases in which the organizations chose not to implement SaaS are KMA and UT.

Table 7 Cross-case pattern analysis of Case KMA and UT

Dimensions	Case KMA	Case University of Twente
Organization size	200 students and 200 employees	8250 students and 2800 employees
Organization type	Government sector	Government sector
Organization description	Academy for the Dutch Royal Military	University
SaaS drivers	Outdated e-mail standards (100Mb mailboxes) are hindering fast communication	Logical result of an identified technological development in the society
Selection criteria for SaaS applications	Larger mailboxes	The privacy of students and employees should be guaranteed. The SaaS application should be easy to integrate with the existing UT applications.
Selection criteria for SaaS providers	No information available	Provider should deliver application that complies to above two criteria
SaaS applications in use	None	None
On premise applications in use	Microsoft Outlook, Microsoft Office	Microsoft Outlook, Microsoft Office
Implementation process	Not applicable	Not applicable
Risk management	Not applicable	Not applicable
Finance	Not applicable	Not applicable
Usability	Not applicable	Not applicable
User acceptance	According to the interviewee the	Not applicable

	users are very willing to accept a SaaS solution	
Decision maker's vision on SaaS	User's p.o.v: "A SaaS e-mail solution would provide faster and easier communication compared to the current on premise solution." Higher management's p.o.v.: The KMA has to follow tight security policies. Therefore the higher level management of the KMA is not in favor of SaaS. It believes that SaaS will only lead to more security risks.	"SaaS e-mail will be adopted, but in 10 years, not now. There is still room for improvement on the side of the SaaS vendors. Information needs to become more transparent to the client."

4.4.1 SIMILARITIES

The similarity seen between the KMA and UT case is that both organizations are from the government sector. Both of the organizations educate students. Both the organizations have not implemented any SaaS applications.

4.4.2 DIFFERENCES

The size of the organizations is very different. The KMA consist of 200 students and 200 employees. The KMA is the academy for the Dutch Royal Military and the UT is a university, funded by the government. The UT consist of 8250 students and 2800 employees. Whereas in the KMA case the main driver for considering SaaS was outdated e-mail standards, in the UT case SaaS consideration was a logical result of an identified technological development in the society. The reasons that both the organizations didn't chose for a SaaS solution was different in both cases. The KMA's reasons were:

- Decision makers believe SaaS would lead to higher security risk for e-mail
- Moving your mailboxes to an external provider would increase the chances of receiving spam
- ICT employees are scared of losing their jobs
- Higher level management does not have sufficient knowledge about the latest technological trends (including SaaS). They are not aware of the pros and cons of SaaS.
- The decision makers believe that today's SaaS e-mail applications don't offer better functionality than on premise e-mail applications. The main advantage of SaaS e-mail applications compared to on premise e-mail applications, according to them, is cost saving. If SaaS providers would offer SaaS e-mail applications with more and improved functionality compared to on premise e-mail applications, SaaS would become a more attractive solution for companies including the KMA.

The UT didn't decide to implement SaaS because none of the SaaS providers offers an application that meets both of its two requirements:

- The privacy of students and employees should be guaranteed.
- The SaaS application should be easy to integrate with the existing UT applications.

In the UT case study we didn't find any information regarding user acceptance. In the KMA case, the interviewee said that employees were finding ways to bypass the limits imposed by the IT policies. Employees started transferring data by means of USB sticks or using their personal e-mail accounts. This makes us believe that users at the KMA would easily accept a SaaS solution if it would make their e-mail communication faster and easier.

There is also a clear difference in the vision on SaaS of both companies' management. At the KMA SaaS is considered to increase the chances for security risks. The interviewees of the UT are of the opinion that the form in which SaaS e-mail applications are currently offered in the market is not good enough. There is still a lot of room for improvement.

4.5 SUMMARY

In all our case studies we see that a SaaS solution was considered. As we discussed in the beginning of the chapter, there is a clear division of the cases: on one hand there are case studies in which the companies have decided to implement SaaS and on the other hand there are companies who have considered SaaS but decided not to implement a SaaS e-mail application.

The comparison between the cases shows us that in three of the five cases a SaaS solution was implemented. The companies in these three cases were all from the private sector. The other two cases in which a SaaS solution was not found suitable were both from the government sector. The main reason for choosing a SaaS solution was cost savings. In the cases where SaaS was not implemented, cost savings was not enough reason for the companies to implement SaaS. Here, complying to the policies of the organizations was more important.

The literature research and interviews show that in some cases the implementation of a SaaS solution can be done easily. In two of our case studies (NEVI and InfoTrade) we see that the companies who implemented SaaS chose SaaS without spending much time and resources on preparing for the implementation. In InfoTrade's case the outcome was positive. Step by step InfoTrade's CEO added another SaaS application to the company's application portfolio. The addition of a SaaS application complied with the company's policies, the selection of the providers was not too complicated and the integration between the systems went smoothly. However, the implementation doesn't always turn out to be so easy. Take the NEVI case for example; here the implementation process took longer than expected, cost more than expected and after the implementation many end users weren't happy because the applications didn't function properly at certain desktops. The decision makers could have addressed the problems before hand if they would have had an overview of the issues to be addressed in a systematic way.

5 THE SAAS DECISION MAKING FRAMEWORK

In this chapter the SaaS Decision Making Framework is presented. The information gathered from literature reviews, expert interviews and case studies gave us more insight into the steps that need to be taken and issues that need to be addressed when implementing a SaaS solution. With this framework we provide guidance for companies on how to address crucial decision making issues.

5.1 MANAGING THE SAAS DECISION MAKING PROCESS

The framework provides a set of questions that companies, who want to determine whether SaaS is a suitable solution for them, need to ask themselves. Questions are indicated with parallelogram shapes. By answering yes or no, the reader is led through the chart to the next question or to an action. Actions are indicated with rectangular shapes. The framework has two end points. One end point suggests that SaaS is suitable for the company and the other recommends not implementing SaaS. The questions are divided into eight categories:

1. Motivations for SaaS
2. Legal, security & ethical issues
3. Tailor-made versus off-the-shelf
4. Integration
5. Migration
6. End-user awareness & acceptance
7. Evaluation of benefits & risks
8. Cost analysis

The categories, questions and suggested actions are derived from the literature review as well as the case studies. The first part (category Motivations for SaaS) of the framework consists of a number of questions which are derived from the identified benefits of SaaS. Categories 2 to 5 of the framework are derived from the risks of SaaS. The order in which the risks are addressed is determined by the lessons learnt from the case studies. E.g. from the case studies we learnt that even if SaaS may cut costs, legal and ethical impediments form a holdback for companies. Therefore the questions regarding legal, security and ethical motivations are discussed first in the framework. After addressing the risks, we ask the reader to study end-user awareness and acceptance of SaaS. From our case studies we learnt that in most cases the decision makers did not consider the user acceptance aspect in their decision making process. Addressing the risks had a higher priority in all case studies compares to creating user awareness and acceptance. Therefore this latter category is placed after the risks. The next step is the evaluation of SaaS benefits and risks. Although for some companies costs is the number one deciding factor for choosing SaaS, there are also companies that don't opt for SaaS even if it promises major cost savings (for example the UT case). Therefore, the cost analysis is placed as the last step in the framework. The SaaS Decision Making Framework is split in two parts for clarity purposes. The framework is shown on the next pages in Figure 12 (part 1) and Figure 13 (part 2). In the following section each step in the framework in explained in more detail.

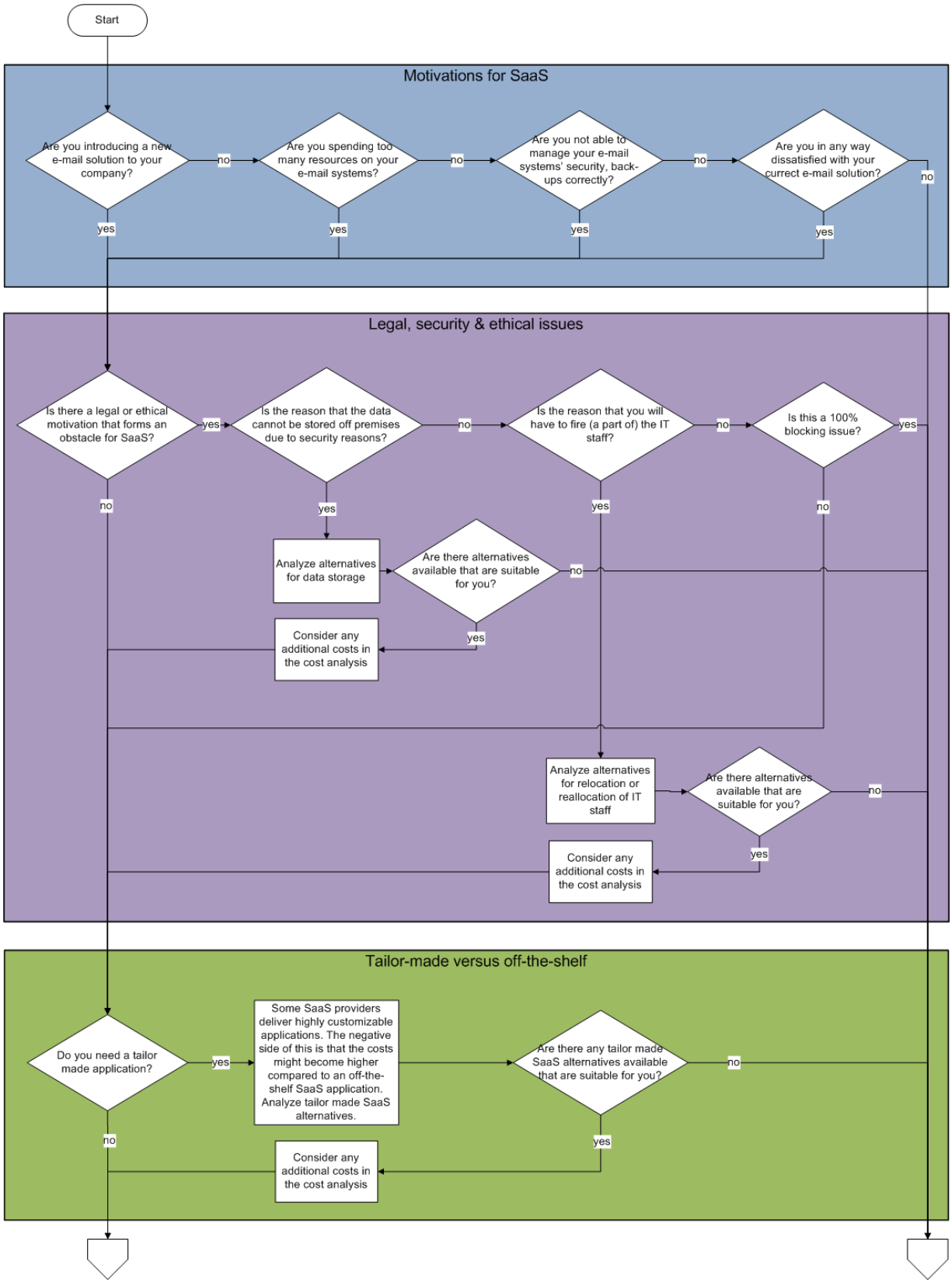

Figure 12 SaaS Decision Making Framework (part 1)

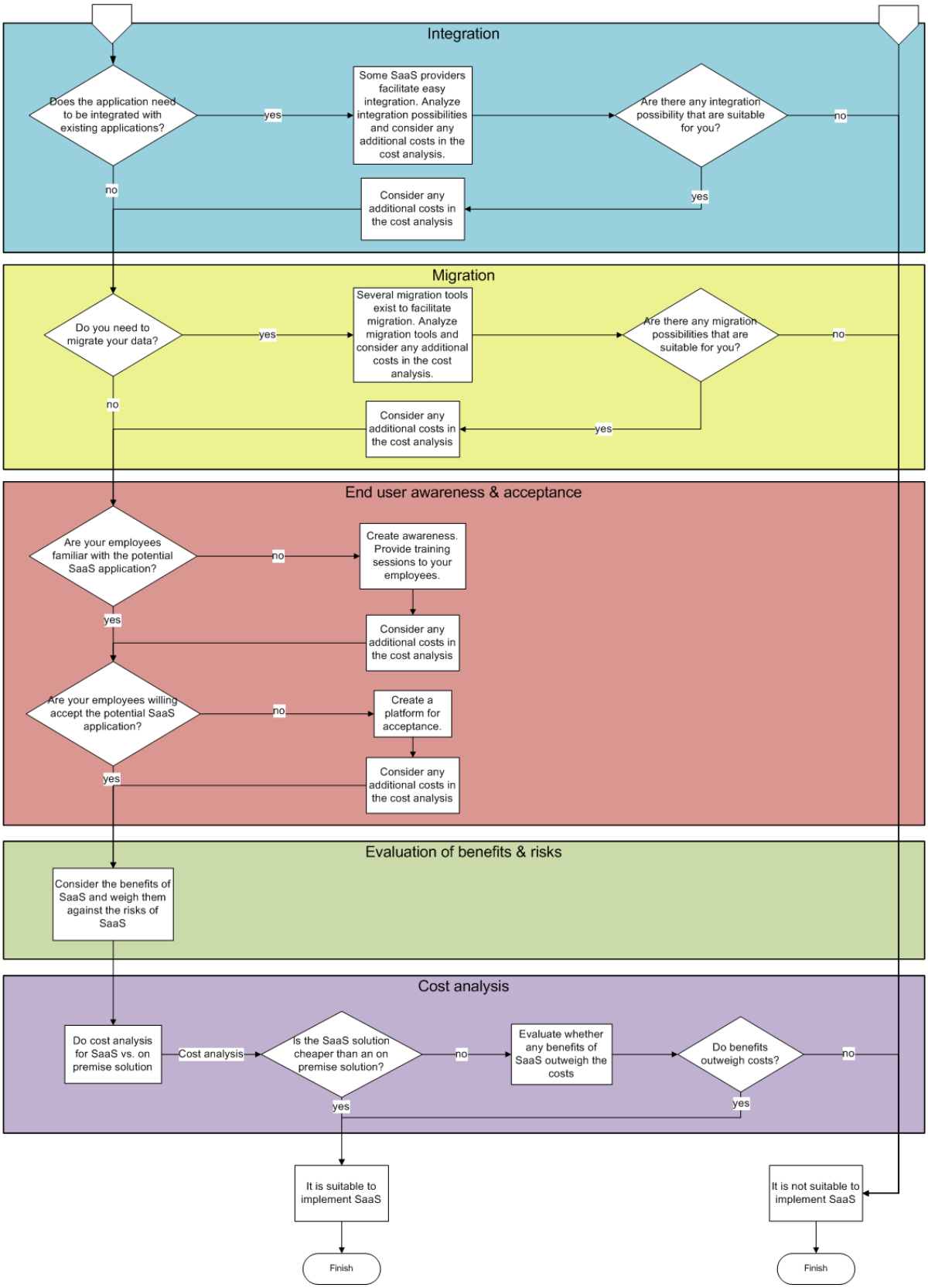

Figure 13 SaaS Decision Making Framework (part 2)

5.1.1 MOTIVATIONS FOR SAAS

The questions in the first section are based on reasons for companies to consider SaaS: when introducing a new e-mail solution, overspending resources on current e-mail systems, not being able to manage e-mail systems' security and back-ups correctly or when having dissatisfaction with current e-mail solution. In case a company is coping with any of these three problems, SaaS could offer a solution. The reader is then directed to the next section of the framework in order to further determine whether SaaS is a suitable solution or not.

The framework starts in the upper left corner at the "Start" symbol. There are two scenarios in which we advice the use of this framework: 1) you are a new company looking for an e-mail solution or 2) you are looking for a new e-mail solution to replace your existing one. The first question in the framework is asked in order to determine which of these scenarios the reader is in. Companies who have just started up and who are looking for a new e-mail solution (scenario 1) will be directed to the "Legal, security & ethical issues" section of the framework. Companies who are looking for a new e-mail solution to replace their existing one will be guided through the first section: "Motivations of SaaS". First the company is advices to assess whether it is spending too many resources on their e-mail systems. What is "too many" needs to be determined by the company itself. If the reader believes the company should be spending fewer resources on their current e-mail systems then the answer to this question is yes, and the reader is directed to the next section in the framework in order to further assess whether SaaS is a better solution than a premise based one. During the case studies we came across companies who were of the opinion that they would never be able to manage the security and backups of their e-mail systems as well as an experienced SaaS provider would do. In case the reader thinks that the company is not able to manage the security and back-up of the e-mail systems on premises, SaaS could be the solution. Therefore the reader is directed to the next section in the framework. In the other case the reader is led to the next possible motivation for SaaS. Now the reader is asked whether the company is in any way dissatisfied with the current e-mail solution. One of the reasons could be that the e-mail solution is outdated. We saw this in the KMA case, were the users felt that their e-mail application was an impediment to their work. Another reason why users might be dissatisfied is because they can't access their e-mail from home or other locations. SaaS enables global accessibility and could therefore be a motivation for companies to consider SaaS based e-mail applications. In the company is satisfied with its current e-mail solution, we believe there is no reason for the company to consider a new (SaaS) solution. Therefore the reader is directed to the outcome that a SaaS solution is not suitable for the company.

5.1.2 LEGAL, SECURITY & ETHICAL ISSUES

This section addresses compliance issues of SaaS. The first question that the reader needs to answer is whether there is any legal or ethical motivation that forms an obstacle for implementing SaaS. This question is asked in reference to two aspects of SaaS. The first one is the legal or security aspect regarding data storage. In a SaaS setting the data of the company is taken off premises. Many people believe that putting the company data outside office walls increases the risk of security breaches and data loss. As discussed earlier, this fear is not entirely justifiable. There's a group of people who are of the opinion that an experienced SaaS provider, whose core business is delivering software to its clients and making sure the client data is secure, will be better able to take care of the client's data than an inexperienced client himself. We advise the reader to understand these risks and making sure that the potential SaaS provider will handle your data with care. Spend enough time on understanding the Service Level Agreements (SLAs). In the OU case study we saw that a legal advisor was appointed to study the SLAs in depth.

Taking it a step further, in case your SaaS provider is a large provider with datacenters across the world, your data is likely to be stored in several different datacenters. In some industries there are strict policies regarding the location of the company's data. Take for example the municipality of Los Angeles, USA, consisting of 30.000

employees. (Sarno, 2008) As discussed earlier, being a federal agency the municipality needs to conform to strict IT policies. One of the policies is that the data of any federal agency in the US is not allowed to be stored across country borders. The LA municipality was interested in Gmail, but because Google stores several instances of their clients' data across continents, Gmail was initially not a possible solution. According to one of the interviewed experts, similar rules apply to other industries such as the healthcare or financial industry. If your company is in one of these industries, it is likely that your policies cannot be changed or bent because of government imposed laws. This doesn't mean that SaaS is not suitable for you. The solution for the LA municipality was that Google eventually came with a unique offering for federal agencies; this was called the Gov cloud. The Gov cloud allowed the data to be stored within country borders. In the case of Microsoft the client has the option of discussing its preferences regarding data storage locations with Microsoft. In summary, find out where your data will be stored, keeping in mind that your data is likely to be stored outside country borders. Study your policies to check whether this SaaS aspect complies with your policies. If it is an issue, discuss this with your potential providers in order to see if you can reach to a suitable solution. If you find an acceptable solution, remember to consider any additional costs that you might have to make for this solution later on in the cost analysis. If you don't find a suitable solution for your data storage, we believe SaaS is not the solution for you.

The second aspect of SaaS that we refer to is the ethical aspect regarding the IT staff. If you have your e-mail systems on premises, an (in-house or outsourced) IT department is responsible for installing, maintaining and updating it. When you decide to move the e-mail systems off premises, you will probably need to fire or reallocate your IT staff. However, this will not always be the case. Consider our case study on NEVI. When NEVI started the SaaS implementation project, there was no IT staff within the company. During the process the project leaders identified the need for having in house IT knowledge. A new job was created within the company and an IT engineer was hired. We advise you to consider the possibilities for your IT staff. If you find an acceptable solution, remember to consider any additional costs (or cost savings) that you might have to make for this solution later on in the cost analysis. If firing staff is inevitable, and this is something that your company cannot compromise with, we believe SaaS is not the solution for you.

If after considering the alternatives for the above mentioned issues there are still reasons that are 100% blocking issues, our advice is that SaaS is not suitable for you. These issues can be related to Architecture, Security, Compliance and Service Delivery. We advise you to gather the requirements and constraints of your company in these areas and address them at this point in the process.

5.1.3 TAILOR-MADE VERSUS OFF-THE-SHELF

Moving on to the next section in the framework we advice the reader to consider whether a tailor application is truly what the company needs. In chapter 2.2.1 we discussed that with SaaS it becomes unviable to customize the application for each client. Thus, SaaS applications in general are designed to be configurable, but not customizable. For a company who has very specific needs, an off-the-shelf application might not suffice. Although it is not viable to host highly customizable SaaS applications, during our expert interviews we learnt that there are providers who do deliver such applications. We do believe that this will increase costs. We advise the reader to check alternative providers and discuss how customizable their applications are. In case you find a tailor-made SaaS solution keep two things in mind: consider the additional costs in your cost analysis later and find out about the provider's background. Since the SaaS provider of highly customizable applications will be able to reach economies of scale more difficultly than the provider of an off-the-shelf application, how will it be able to support growth? If you are a growing company who wants to add 50 new accounts in a month, is your provider able to support this? In case you don't find a provider who can deliver tailor-made applications through the SaaS model, and your requirements are so specific that an off-the-shelf application is not right for you, then our advice is that SaaS is not a suitable solution for you. Although in practice e-mail applications will not be tailor-made, we include

this question in our framework because it is applicable for e-mail applications in theory and for SaaS applications in general.

5.1.4 INTEGRATION

The next issue that we came across during our case studies was integration. In some cases integration was easy and in others it was a highly time consuming part of the process. The question we want you to ask yourself is: Does the new application need to be integrated with other applications? For some companies it is enough to have a standalone e-mail application which is not linked to other systems. In this case your answer to the question is no and you can carry on to the next section in the framework. In most cases companies want to link their e-mail application with for example a calendar or maybe even the CRM. In order to link the new e-mail application with the existing applications you will need connecting components. Usually these are not included in the SaaS contract. You have two options for getting the right components: design them yourself or outsource it to a third party. If you have the knowledge in house you can design the components yourself. If not, there are also companies in the market specialized in building integrating components for SaaS applications. We recommend you to consider the pros and cons related to these alternatives. One important aspect to consider when selecting your integration solution is vendor lock-in. Select a solution which minimizes the risk of vendor lock-in. Some SaaS providers work with open standards. This makes it easy for the client to develop or get the integration components developed. If you find a suitable integration solution, consider the additional costs that follow getting the integration components in place. If there are no integration solutions for your situation, we don't recommend a SaaS solution. Integration is a very big concern to most companies. You cannot simply decide to choose SaaS without having your integration issues solved. In the case of the University of Twente one of the reasons for not implementing SaaS was the fact that the university wanted the SaaS e-mail application to be integrated with several other existing applications.

5.1.5 MIGRATION

The next part of the framework reminds the reader of the issue of migrating old data to the SaaS vendor. If you are starting from scratch, you have no old data to migrate. In this case, the answer to the question is no and you can move on in the framework. In case you do have to migrate your old data, there are some alternatives that you can consider. You can develop a migration tool yourself in order to move your data or you can select a migration tool available in the market. Companies such as Avanade, G-company, E-office are specialized in migrating data. Find the suitable party for your migration. When selecting this party, find out whether it has experience with your potential SaaS application and SaaS provider. Like we mentioned in the previous section, we would like the reader to pay attention to risks of vendor lock-in also in this part of the decision making framework. Consider the costs of migration in your final cost analysis. If there is no suitable migration solution (for example migration costs are too high), then you should consider that SaaS might not be the suitable solution for you.

5.1.6 END-USER AWARENESS & ACCEPTANCE

Next, we address the user awareness and acceptance aspect of SaaS within the organisation. In most scenarios where there is change, there will be resistance from (some of) the employees. With proper change management the resistance can be decreased or even eliminated. In the framework the reader is asked whether employees are familiar with the potential SaaS application and way of working. In case the employees are not familiar with it, we recommend the company to provide training sessions for the employees. Besides this, we also advise to invest in gaining support from the employees. (SIIA, 2006) In the NEVI case, a test group consisting of employees across the company was set up to get feedback from the employees. Such initiatives can help gain more support from employees. The costs associated with these measurements should be considered in the cost analysis.

In this category we advise the reader to analyze the acceptance of SaaS among the employees. Users will always differ in their opinions of accepting SaaS. What might be considered as an improvement in for example the usability of the new SaaS application to one person might be an impairment to the other. An example of this is also seen in the case studies. In InfoTrade's case the employees found the interface of Gmail easier to work with. They were already exposed to the way Gmail works, by means of e-mail conversations. The same application was not introduced at NEVI because the project leaders were afraid that this new way of working was too big a step for their employees. This shows that the success of SaaS is highly dependent on the level of acceptance by the employee. Another fear that we came across in one of our expert interviews is that people are afraid that the application will become slower when moving it to the provider compared to an application that is on premises. We advice the reader to take user acceptance into consideration before making the decision to implement SaaS. If there is resistance within the company, we advise you to create a plan that will increase user acceptance. One way of doing this is by creating end user test groups (as seen in the NEVI case) during that will help you evaluate the implementation of SaaS.

5.1.7 EVALUATION OF BENEFITS & RISKS

Now that we have addressed the possible drawbacks of a SaaS implementation, the next step in the framework is to evaluate benefits and risks of SaaS. The benefits and risks are explained in detail in chapter 2.3. Although the major risks have been discussed in the previous sections of the framework, it is important to consider the risks again and weigh them out against the potential benefits of SaaS. We advise the reader to consider the benefits by appointing weights to the benefits according to which benefit is most important to the company on quality of product and implementation level. The risks and possible solutions for coping with these risks should then be weighed against the benefits of SaaS.

5.1.8 COST ANALYSIS

In the cost section, we want you to ask yourself: is cost saving a deciding factor? If costs are not deciding then based on your previous answers the framework leads you to the final recommendation: SaaS is suitable for you. In case costs are deciding, you will need to do a cost analysis for the SaaS versus on premise e-mail solution. If the SaaS solution is more expensive than the on premise, the framework leads you to the final advice: SaaS is not suitable for you. If the SaaS solution is less expensive than the on premise e-mail solution, we can conclude that on all fronts SaaS is a suitable solution for your company.

Cost analysis in more detail

In this sub chapter the financial aspect of the SaaS implementation is considered in more detail. What we've learnt from the case studies and expert interviews is that in contrary to what most clients think, the costs of a SaaS implementation doesn't only consist of the subscription fee. In most cases there are more aspects that define the total cost. Below we define the factors that should be considered in the cost analysis.

The biggest cost factor of SaaS applications is the subscription fee charged by the SaaS vendor. This fee includes the monitoring, maintenance and upgrades of the application. (SIIA, 2006) Some vendors include training and support of the end-user in the subscription fee too. In NEVI's case there was no training included in the subscription fee. (Case study NEVI, 2009)

At some stages in the framework we advise the reader to consider some additional costs in the cost analysis. In summary, where applicable the reader is advised to consider any additional data storage, IT staff re(al)location, customization, integration, migration, training and change management costs. These cost factors, along with those described by SIIA (2006) are depicted in Figure 14.

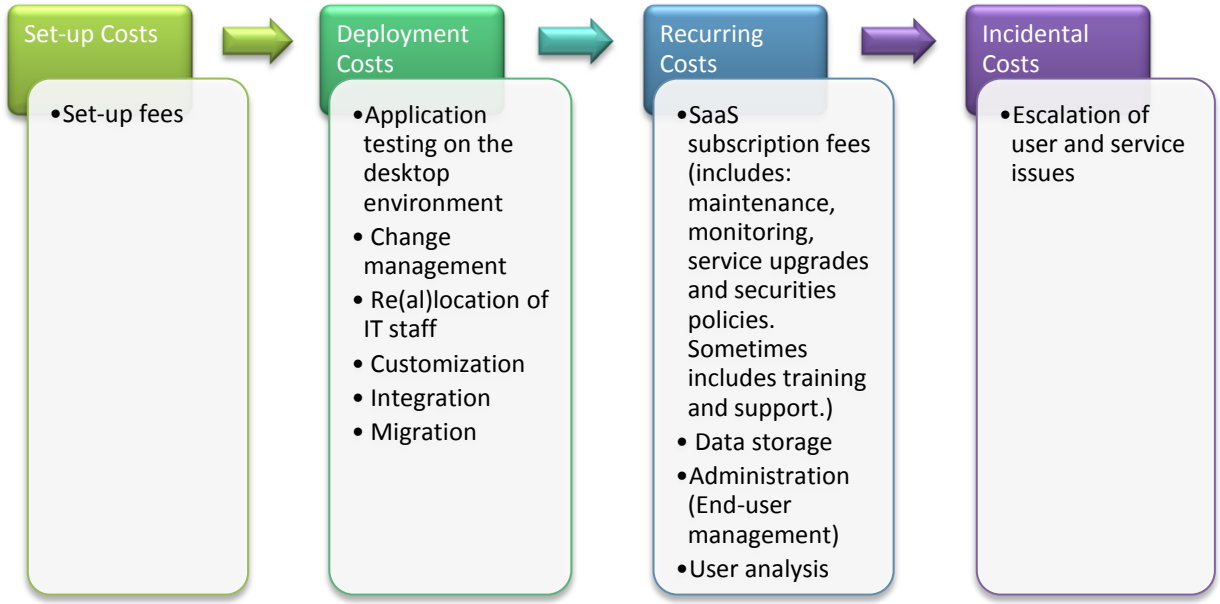

Figure 14 Summary of the cost allocations of a SaaS deployment

The cost factors discussed above are split into four parts: Set-up costs, Deployment Personnel Costs, Recurring Costs and Incidental Costs. The first part Set-up Costs includes set-up fees that a company will need to pay in the beginning of the implementation process. Deployment Personnel Costs are costs associated with application testing on the desktop environment, change management, re(al)location of IT staff, customization, integration and migration. Application testing on the desktop environment is a cost factor mentioned by SIIA (2006). Before the SaaS application is introduced to the whole organization, it is advisable to test the application on the desktop environment. The rest of these cost factors are the additional costs that we mentioned in the previous paragraph. In the third part the Recurring costs are identified. The recurring cost for a SaaS application is the subscription fees. The figure shows what components the subscription fee usually includes. To the recurring costs, we have added data storage costs. If your SaaS provider agrees to grant your specific data storage needs, like Google created the Gov cloud, it is likely that you have to pay an additional amount on top of the subscription fee. Also, with some providers you can increase your data storage capacity by paying an additional amount on top of the subscription fee. Other cost components related to Recurring costs are: data storage, administration and user analysis costs. Incidental costs include any costs related to the escalation of user and service issues. (SIIA, 2006)

When considering a SaaS scenario we advice the reader to consider the shift of IT expenditures from Capital Expenditures (CapEx) to Operational Expenditures (OpEx). CapEx includes costs that are made on acquiring physical assets for the purpose of running your business. Some examples of IT CapEx are costs of printers, servers, laptops, networking equipment, etc. OpEx defines the operational costs of running a business. Some examples of IT OpEx are: telephone service, leased network lines, printer cartridges, etc. The costs made in an on premise software deployment setting (software licenses, servers, networking equipment) are typically registered as CapEx. In a SaaS setting the costs (monthly fees for internet hosting, data center rack space, offsite backup, etc.) are considered as OpEx. The discussion is on whether the shift from CapEx to OpEx is financially beneficial to your business or not. The opinions on this point are divided. The reason why it is difficult to determine which of the two scenarios is cheaper is that the correct IT costs are difficult to define. For example, in the discussion on the cost comparison companies compare the hardware costs and software licensing costs in an on premise setting to the monthly fees of a SaaS provider. Often the operational costs in the on premise setting are not included in the discussion, making

the on premise solution look cheaper than the SaaS solution. The operational costs that are often left out are summarized by Golden (2009):

- The direct costs that accompany running a server: power, floor space, storage, and IT operations to manage those resources.
- The indirect costs of running a server: network and storage infrastructure and IT operations to manage the general infrastructure.
- The overhead costs of owning a server: procurement and accounting personnel, not to mention a critical resource in short supply: IT management and its attention.

We urge the reader to include these cost factors in the discussion of the on premise version SaaS scenario.

6 CONCLUSION AND RECOMMENDATIONS

In this final part of the thesis we discuss the conclusion, recommendations and ideas for further research.

6.1 CONCLUSION

The research shows us that the technology for the Software as a Service (SaaS) delivery model is ready and many SaaS providers have emerged who are offering several different kinds of applications. There is also a large pool of potential customers who are showing interest in SaaS, especially in this time of economic crisis as companies are investigating alternatives to cut down costs. However, what is missing is a clear value proposition of SaaS for the customer with an understanding of the risks involved. The other missing part is that it is not clear what considerations the companies need to made in order to assess whether or not to implement SaaS.

During our research we studied the ins and outs of the SaaS business model and in particular of enterprise e-mail applications offered as SaaS. The benefits and risks of SaaS were studied and a framework was designed to guide companies through the decision making steps for implementing SaaS.

We will answer the sub questions given in chapter 1.5 one by one below, leading to answering the main research question.

1. *What is Software as a Service?*

The first sub-question was answered by means of desk research and expert interviews in chapter 3. During the desk research and interviews we learnt that there is no universally accepted definition of SaaS. However, while comparing the different sources we see that there are some similarities between the definitions. Instead of selecting one of these definitions or creating our own, we define SaaS by a set of characteristics derived from the several definitions.

- *Hosted.* SaaS is a software distribution model in which applications are delivered, maintained and upgraded (i.e., hosted) by a vendor/service provider;
- *Network based delivery*. Services are delivered to customers over a network, typically the Internet;
- *Pay-per-use.* SaaS is a subscription-based service model;
- *Multi-tenant*. A SaaS application typically has a multi-tenant architecture;
- *Customization through configuration*. A SaaS application is typically configurable, but not customizable

In order to understand SaaS we also studied the historical background of software delivery and the placement of SaaS herein. We learnt that the rapid developments in the field of web applications and standards boosted the development of on-demand applications. The development of on-demand applications led to the rise of Application Service Providers (ASP). Some people use the terms ASP and SaaS provider interchangeably. In our opinion there is a clear distinction between the two. What makes SaaS different is that SaaS applications are Rich Internet Applications (RIA). RIAs are very similar to desktop installed applications to end users in the sense that they offer more functionality and detail than web based applications in the time of the emergence of ASPs. As a user you can barely notice a difference between a desktop installed application and a good SaaS application. This is what makes SaaS “new” compared to applications provided by ASPs.

2. What are the benefits and risks of Software as a Service, both quality of product and implementation wise?

With the article of Sääksjärvi et al. (2005) as our basis we discussed the benefits and drawback of SaaS based e-mail applications in chapter 2.3. A distinction was made between product (directly affecting the end user) and implementation (affecting the organization) level benefits and risks. Table 8 shows which benefits and risks can be related to the product level and which to the implementation level.

Table 8 Product and implementation level benefits and risks

	Product level	Implementation level
Benefits	• *Enables the customer to get access to "best-of-breed" applications that would be too expensive to buy* • *SaaS makes it possible to access the software independently of location and time*	• *SaaS enables the customer to focus more on core competencies* • *SaaS makes it easier and/or less costly to get access to required technical expertise* • *System implementation time is shorter with SaaS* • *SaaS enables a wider and more flexible array of payment methods (predictable and/or lower costs)* • *SaaS makes version management easier for the customer (free upgrades, no technology obsolescence etc.)* • *The initial investments and costs are much lower in SaaS* • *With SaaS, the customer can get access to a superior IT infrastructure regarding reliability, security and scalability*
Risks	• *Less tailoring and integration options available for the customer* • *Availability and a part of the performance issues (that affect the end user experience, such as poor performance of the software, difficulties in receiving support, etc.) are to be expected, depending on the technological solution of the SaaS provider*.	• *SaaS increases the risk of losing business-critical data or exposing it to third parties* • *Reliability and a part of the performance issues (that affect the company, such as less flexibility and longer time-to-market, poorly defined SLAs) are to be expected, depending on the technological solution of the SaaS provider*.

The above mentioned benefits and risks of SaaS are the generally perceived benefits and risks. However, they are not absolute. What could be considered as an important benefit for one company could be considered less important for the other. Take for example the benefit "*the initial investments and costs are much lower in SaaS*". In the case of InfoTrade this was an important benefit. Mainly because of cost savings the CEO of InfoTrade decided to move his on premise e-mail to Google. However, in the case of the KMA and the UT we saw that even though a SaaS solution was likely to reduce the IT spending higher management didn't opt for it. Following company security policies and assuring privacy of the e-mail data was much more important than cost savings. Therefore, we believe that when balancing the benefits and risks against each other every company needs to investigate what is most and least important to its own particular situation.

3. *What consideration do companies need to make before implementing a Software as a Service based e-mail application?*

The framework in chapter 5 depicts the considerations that companies need to make before implementing SaaS. The framework starts with addressing the possible benefits of SaaS and continues with addressing the risks and drawbacks. At each step the company needs to make a decision. This way the reader is led through the issues that need to be addressed for his or her particular situation. The framework's underlying reasoning is that sometimes the suitable solution might not be readily available. In this case you need to discuss and negotiate with providers in order to come to a fitted solution.

We now continue the discussion with answering the main research question:

Does Software as a Service enterprise e-mail provide superior quality and improved implementation compared to premise-based enterprise e-mail and what considerations do companies need to make before implementing a Software as a Service based e-mail application?

Whether SaaS enterprise e-mail provides superior quality and improved implementation compared to premise-based enterprise e-mail partly depends on the requirements of the company that wants to implement it. Superior quality is subjective to the end users of the application. For example, our case studies showed that a company where the employees were already used to Gmail in their personal e-mail communications the employees were very open to accepting Gmail at work. In another case where employees were used to Microsoft's Outlook and didn't know the conversation type view of Gmail, the employees were very reluctant in accepting the new SaaS application. For the latter company end users thought that SaaS enterprise e-mail was not of superior quality. We conclude that whether SaaS enterprise e-mail provides superior quality compared to premise-based enterprise e-mail depends on the opinion and experience of end users.

A benefit of SaaS that we discussed earlier is that the system implementation time is shorter with SaaS than with traditional software (as experienced by InfoTrade). In the simplest SaaS implementation, once you sign the contract with your provider, it won't take long until you can start using the software. The software is already up and running on the servers of the provider. In case the SaaS implementation is complex such as when the new SaaS application needs to be integrated with existing systems or data from old applications needs to be migrated to the SaaS provider, the implementation cycle should not be underestimated. Integration modules will be needed in order to fit the new SaaS application into the existing IT landscape of the company. The scope of our research was e-mail systems; however this conclusion is also applicable to other SaaS applications because integration and migration issues remain the same for any other SaaS applications. Thus, whether SaaS provides improved implementation compared to premise-based implementation depends on the level of integration and migration that is required in the implementation.

Finally, the considerations that companies need to make are discussed in the framework and in chapter 5. The considerations are based on the business value that SaaS can provide to the client and the risks that should be addressed before moving critical data to the SaaS provider.

6.2 RECOMMENDATIONS

More and more companies are showing interest in Cloud Computing and large companies have even made the news by moving their e-mail to an external SaaS provider. Earlier we explained that still some companies are keeping their data on premises because benefits and risks of SaaS are not clear. In order to clarify the benefits and

risks and to come to a well founded decision we presented the SaaS Decision Making Framework. The framework addresses the risks step-by-step, giving advice on how to handle each risk.

It is our belief that in most cases, an intermediary is needed to manage the SaaS project. Accenture can play a suitable role here. With the help of our SaaS Decision Making Framework companies can be guided in their decision making process. The client should be explained the business value that SaaS could bring to the company and what risks the client needs to address based on the benefits and risks identified in chapter 2.3.

The case studies showed us that in order to keep some control over their data companies keep a part of their data on premises. This was seen in two of the three cases that we studied. We recommend such a hybrid setting for clients who have to follow strong security and privacy policies. We believe keeping a part of the company data on premises will affect some of the following benefits. For example, because a part of the data is kept on premises, the customer needs resources in house to manage the data. This will divide the focus that otherwise could be put on the core competencies of the company. Another important point is that customers need to include the on premise expenses in the total expenses of the new SaaS solution. The costs of the SaaS application now become less predictable. Furthermore, initial investments will become higher than in a pure SaaS setting since an on premise solution needs to be taken into account. In a pure SaaS setting the security of the customer data is the responsibility of the SaaS provider. In a hybrid setting the responsibilities change. Everything that is on premise becomes the responsibility of the company itself. Thus, it's important to note that a hybrid solution accounts only for a part of the afore mentioned SaaS benefits.

6.3 Further Research

Finally, we end this chapter by discussing some ideas for further research.

This research can be extended in future by doing more case studies with companies who have implemented SaaS based e-mail and companies who have rejected a SaaS solution. The larger the number of cases, the stronger the research. The data gathered during the case studies also becomes more reliable if the interviews are conducted with several different stakeholders within the same company, because each stakeholder is likely to have its own perception of the benefits and drawbacks.

During the research we also saw that compared to the USA and the UK, companies in the rest of Europe seem to be more cautious when it comes to moving their data off premises. It would be interesting to see the consideration that USA and UK based companies make in order to understand why they are less reluctant to move their data to the SaaS provider.

The next step after our research, after the decision has been made to implement SaaS, is to study the implementation process. Also in this area there is still a lack of frameworks and guidelines. This kind of research can help guide the client through the implementation process; starting from setting up requirements to selecting the SaaS vendor to fully running the SaaS implementation through the entire enterprise.

In chapter 5.1.8 we presented the cost factors that define the SaaS implementation costs. We didn't study cost estimation methods for determining these cost factors. We recommend further research on cost estimation methods, hereby splitting the cost factors into two categories: an estimation of the initial investments and an estimation of future cost reduction (ROI).

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