# TWO TIER ERP SYSTEMS: COMBINATION OF ON PREMISE AND CLOUD Cloud ERP Manufacturing Service Outsourcing

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Master's thesis

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## ABSTRACT

### Objectives of the Study

The objective of this study is to expand the knowledge of the existing studies related to cloud computing. The results will be presented as a figure which will illustrate the ERP integration of on-premise and the cloud. It will give an idea to the new customers of ERP systems on how to deal with two-tier ERP systems (cloud and on-premises) as well as to enhance understanding of ERP services that can be carried on their premises and what ERP services can be outsourced over the cloud.

Cloud ERP is quite a new, unclear and broad concept, since all the studies related to it are recent. Almost all cloud ERP providers describe their products as straight forward tasks. But, it still remains unclear how companies can outsource ERP services over the cloud.

This paper focuses on such ERP services that can be outsourced over the cloud, as well as the risks associated with any data or information that will be moved from in-house into the cloud.

### Findings and conclusions

ERP providers, IT consultants and manufacturing companies have confirmed that there are no differences between cloud ERP and on-premises ERP. Both ERP types contain similar modules. ERP in cloud or on-premises will serve same defined business needs.

Not all data will be moved to the cloud under cloud ERP. In a similar way not all of the services can be outsourced over the cloud using cloud ERP. The data security is the top priority of all cloud ERP providers, IT consultants and manufacturing companies.

Cloud ERP involves several partners that serve the same customer of an ERP system. Data safety is the responsibility of all the partners involved in delivering ERP over the cloud.

### Keywords

Manufacturing Companies, Cloud, ERP on-premises, Cloud ERP, ERP Providers, It Consultants, Service Outsourcing and Data Risk Management

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# 1  Introduction

The purpose of this paper is to clarify several ambiguities which surround the cloud ERP and the on-premises ERP systems. The main idea is to shed light on trade-off between cloud ERP and ERP in the companies' premises based on cloud outsourcing services, focusing on small and midsized manufacturing companies.

Various Enterprise Resource Planning (ERP) providers have proved that ERP has improved the quality and efficiency of numerous companies´ businesses. ERP systems also provide a real time support to managerial decision making. Most of the ERP systems combine all departments and business functions of the entire company into a single shared system. An ERP system helps companies to manage and integrate business activities such as planning, purchasing, inventory, sales, marketing, finance, human resources, etc. ERP enhances company´s agility and flexibility allowing different parts of the company to communicate with each other, sharing information and becoming more cohesive. The ERP system is usually installed in the companies´ computer network infrastructure.

Nowadays, cloud technology has shifted the management of hardware and software to the cloud services provider. Most of business applications are and will be moving into cloud-based computing, due to the ubiquitous of internet devices that range from smart phones to all type of other internet devices.

The next step of cloud computing has and will offer new ways to collaborate everywhere through any internet-connected computer or internet mobile devices. I learned in Business Intelligence, (Rossi, 2012), and ICT Enabled Business Process Development courses (Penttinen, 2011), that cloud application users can just open an internet browser, log in, customize their applications, and start using it anywhere at any time. The idea is similar to Software as a Service (SaaS), this term SaaS defined software being delivered as service method that offers access to software functions remotely as a web based service. The idea behind it is to use specific software at less cost without paying for the full license or owning the software.

Based on cloud solutions, ERP providers have recognized that companies have understood that investments in hardware and software are no longer a necessity. This will open new business opportunity for ERP cloud providers to offer new ERP outsourced services. Therefore due to low costs of cloud services and security issues, companies will find themselves dealing with two tier ERP systems as a combination of on-premise and cloud. This has increased an interest in cloud computing that has created a need and interest to explore cloud-based ERP systems and try to emphasize the ERP services that can be outsourced over the cloud.

In order to understand cloud ERP and service that can be outsourced over the cloud, it will be convenient to define and explain cloud ERP and cloud outsourcing.

## 1.1 Defining cloud ERP

The purpose of cloud ERP is derived from the cloud computing concept. To understand what cloud ERP means, it will be necessary to first define cloud computing. Miller (2008), described cloud computing based on cloud term which is seen to be numerous computers and servers interconnected via internet. Computers can be personal computers or network servers; they can be public or private. According to Jennings (2009, 3), the term cloud computing implies access to remote computing services offered by third parties. Cloud computing term was born due to the internet evolution, Vetle et al, (2010) informed that cloud computing gets its name as a metaphor for the internet. This metaphor was confirmed by Rittinghouse & Ransome (2010, 29), stating that the term cloud has been used historically as a metaphor for the internet. Most of researchers agree that cloud computing has three layers. Kepes (2011), Poelker (2011), and Von Stengel (2013), describe these three layers as three stacks: Software as a Service, Platform as a Service and Infrastructure as a Service as it shows in Figure 1-1.

- *SaaS applications are designed for end-users, delivered over the web*

- *PaaS is the set of tools and services designed to make coding and deploying those applications quick and efficient*

- *IaaS is the hardware and software that powers it all – servers, storage, networks, operating systems*

*Figure 1-1. Cloud computing three stacks.* Source: Kepes (2011, 3)

Federal Financial Institutions Examination Council Information Technology Subcommittee (2012, 1) defined that:

 "…*cloud computing is a relatively new term used to describe a variety of established business strategies, technologies, and processing methodologies. Although, the term cloud computing is gaining in usage, there is no widely-accepted definition, and numerous business strategies, technologies, and architectures are represented as cloud computing. In general, cloud computing is a migration from owned resources to shared resources in which client users receive information technology services, on demand, from third-party service providers via the Internet "cloud.""*

The National Institute of Standards and Technology (NIST) (2011), defined cloud computing*:*

*"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"*

In other hand Miller (2008), explained the cloud from utility or the user´s interaction perspective. The software is used via internet from a server that stores it. If the computer crashes, the document created will be stored on the server that hosts the software which can be accessed via internet by other users as well.

Similarly, if we think of ERP system being stored in a specific server in the cloud, the user will get access to ERP system via internet with prior special permission. So, cloud ERP is an ERP system hosted over the cloud by suitable provider. It will offer same services, utilities or modules that are in the ERP that is installed on the companies' computers premises.

If we think about cloud ERP as project, there are many benefits that can make ERP project easy to accomplish. Menken and Blokdijk (2009) believed in these benefits when they suggested applying cloud computing to project management. These benefits consist of quicker ERP implementations, lower costs with greater scalability, adaptability and reliability to the company´s business market environment. Menken and Blokdijk (2009) explained the utility procedure of cloud services in same way as Penttinen (2011) and Rossi (2012) by informing that cloud services are based on web applications or software, it offers solutions that can be available at any time, in any location on the globe and by any person with special permission. Here we can sense that cloud will change the way ERP users work, they will not be restricted by location or time as long as there will be an internet connection. Rittinghouse and Ransome (2010) stated that service based on website was understood earlier 1999 by former Oracle executive Marc Benioff, who pioneered the concept of delivering enterprise applications via a simple web site.

However, there are four different types of Clouds Figure 1-2, according to Huth and Cebula (2011), users can subscribe to any type of these clouds depending on their needs:

 "*As a home user or small business owner will most likely use public cloud services.*

*1. Public cloud - A public cloud can be accessed by any subscriber with an internet connection and access to the cloud space.*

*2. Private cloud - A private cloud is established for a specific group or organization and limits access to just that group.*

*3. Community cloud - A community cloud is shared among two or more organizations that have similar cloud requirements.*

*4. Hybrid cloud - a hybrid cloud is essentially a combination of at least two Clouds, where the Clouds included are a mixture of public, private, or community*".

Most of other researchers Finn et al (2012), Sabharwal and Shankar (2012) and ERP providers SAP (2013), Oracle (2013), Visma (2013), classify cloud types mainly in four categories: public cloud, private cloud, community cloud and hybrid cloud. The community cloud (figure 1-2) is seen to be part of public cloud if it does not require any specific permission, otherwise it will be part of private cloud with the need of special key or permission.
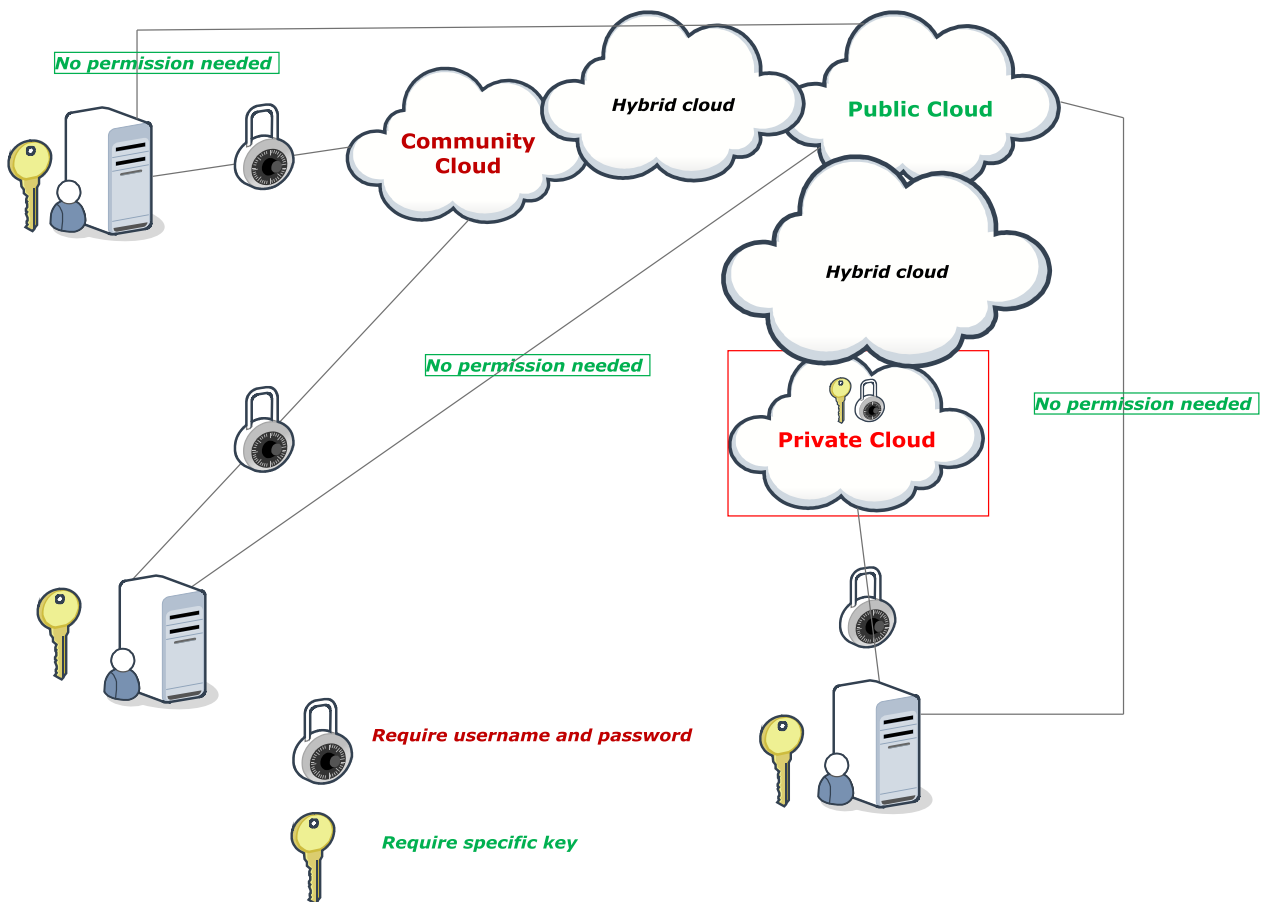
*Figure 1-2. Different types of Clouds.* Adopted from Huth and Cebula (2011) Different types of Clouds

Accordingly, companies that will use cloud ERP will have to choose between these types of clouds. But most likely the small and midsized manufacturing companies will use private cloud due to data concerns.

Both high speed internet connection and low cost high volume storage has built a strong ground for cloud services. We will see more cloud business providers growing in the future with new business models. There will be a great need of studies in the cloud field from Information System management researchers and other industries as well. Over all, cloud ERP is just an alternative way of delivering the traditional ERP as SaaS. This has and will open new field or research in cloud outsourcing.

## 1.2 Defining cloud outsourcing

In the field of Information Systems (IS) Wijers and Verhoef (2009) identified outsourcing to be:

"*…the transfer of services and where applicable staff and assets to be specialized service provider and for the duration of contract, the receipt of services at an agreed level of quality and agreed financial compensation structure* ".

The term outsourcing is explained clearly (Tinnilä 2011) to be the decision of hiring third party to handle business processes or business activities that are not part of the company´s core business.

The idea behind outsourcing is to benefit from cheaper and talented skilled forces that are not available at the manufacturing companies´ house. The outsourced skills will improve the manufacturing companies' IT infrastructures maintenances (that need to be updated often); in return the companies can focus on their manufacturing core competencies, and increase their operational efficiencies at very low costs.

The cloud outsourcing is based on same idea of the traditional outsourcing. All infrastructures and maintenances related to specific software or IT is handled by third party. In larger companies, midsized or corporate, there is a particular person who will take care of the IT outsourcing. This person has a title of Chief Information Officer (CIO), who has a central role in outsourcing the company´s nonstrategic IT functions. Cokins et al (2010) described CIO to have a leadership between art, innovation and business world disciplines, as well as being an IT entrepreneur with experience in both the art and engineering sciences. Later on Carter et al (2011) have questioned:

 "*What skills does a CIO need to successfully identify technology changes and convert IT investments into business opportunities*?"

Muller (2012) wrote, related to cloud computing and ERP system, that CIO will have a responsibility of driving business growth by cutting down costs and creating new business value. So the role of CIO will shine in any IT outsourcing business decision that will serve the company´s best interests. Therefore one of the essential skills that CIO has to embrace is the ability to understand cloud outsourcing that will align with the company´s business strategies.

Since this paper focuses on small and midsized manufacturing companies, the role of CIO will be shifted to third party IT.

## 1.3 Background for the research

A variety of studies in IS management and IT consultants fields have been conducted on cloud computing risks and security. Mather et al (2009) tackled the privacy, data security and storage in the cloud, including confidentiality, integrity and its availability.

Rittinghouse and Ransome (2010) addressed the security in the cloud as well as mobile internet device and the cloud; they offered to business executives the appropriate knowledge that is necessary to make informed and educated decisions regarding cloud services initiatives and legal issues. Krutz and Vines (2010) focused and analyzed how to secure cloud computing in term of risk issues, security challenges and security architecture. Hugos and Hulitzky (2010) explained the transformational role of cloud computing in business; they addressed service reliability by explaining why IT and business thinking must change to capture the full potential of cloud computing. Winkler (2011) announced that companies turn to cost saving using cloud computing technology as foundation for cloud services with high attention to security as primary concern.

A number of other studies were concerned about cloud software service or cloud services. Moller and Chaudhry (2012) addressed cloud ERP implementation challenges based on ERP lifecycle as well as its deployment and its adoption motives and barriers. Lately, Stair and Reynolds (2013), focused on the increased use of cloud computing throughout the world, noting that the mobile challenges and solutions will be one of the main current concerns of IS (Information System) researchers. Other research (Stair and Reynolds 2013) was about how information systems can increase profits and reduce costs as they review the latest on e-commerce and enterprise systems, artificial intelligence, virtual reality, social media and green computing as well as ethical and social issues.

Some ERP vendors have already the cloud ERP services to offer as example Missbach et al (2013) introduced various facets of building and operating a SAP ERP infrastructure exploiting cloud

technologies. The authors concentrate exclusively on the set up and operation of the SAP ERP infrastructure without giving details on how to install and customize the SAP ERP on the cloud.

IT consultants in general are the first professionals who will have perfect knowledge about cloud ERP from implementation to the actual use of ERP system. As example, Mattison and Raj (2012) highlighted the potential benefits of moving to a cloud-based ERP solution as follow:

> ➢ *"Faster implementation: easier to use and deploy*
> ➢ *Greater flexibility: system configuration, pricing is more flexible*
> ➢ *Lower total cost of ownership (TCO), (especially start-up cost),: savings can be 30% to 50% of total cost of ownership compared to on-premise ERP*
> ➢ *Less dependency on IT staff and/or on-premise hardware "*

These benefits were already understood from Ellis (2010), who added that SaaS ERP deployment can put a company on the path to the top right corner.

These potential benefits of cloud ERP fall into the cloud outsourcing category. It shows that Information System (IS) researchers, IT consultant, ERP providers and ERP customers are aware of the significance of cloud outsourcing.

Overall, most of these studies related to cloud outsourcing are of recent nature. The nature of the cloud being multidisciplinary field will require more studies to be done in order to make the cloud more mature. All the researchers of the cloud, in a way or the other, have taken in consideration the security and risk issues related to cloud computing. Grobauer et al (2011), tackled risks related to cloud computing in term of cloud computing vulnerabilities, threats and risk as interchangeable terms. They pointed out that firms have to be aware of the possible vulnerabilities lurking in the cloud. In my opinion the security and risk issues will persist as the main concern in the IS field no matter how the IT technology will be developed in the future.

Nevertheless, only few studies have been conducted about cloud ERP services. Hofmann and Woods (2010) announced that most of companies that shift their IT activities to the cloud face challenges of security and limited ability to tailor their ERP with their business processes. Aiton and Russell (2011) introduced only few ideas about services on cloud based subscription related to cloud ERP product, which they compare to on-premises ERP solutions.

McCLure (2012) has described ERP to be part of cloud computing "Ethers", she noticed that the acceptance of the cloud computing has increased the interest in moving ERP system to the cloud. Numerous small and midsized manufacturing companies see cloud ERP as an alluring opportunity to move ERP into the cloud, but before that, there will be a need to understand how the cloud works.

## 1.4   Research questions and objectives of the research

It is very clear that cloud computing has and will change the way of carrying business activities. All IS researchers, ERP providers, ERP consumers and cloud providers have recognized the benefits of using cloud ERP under the umbrella of the cloud outsourcing concepts.

Nowadays many ERP providers and third party outsourcing offer integrated solutions of ERP on premise and cloud. As it was mentioned before, these solutions are offered based on SaaS business model. Small and midsized manufacturing companies avoid the burden of maintaining on premise applications and focus on their core business by buying the related functionality as a service through the cloud. Yet, the cloud outsourcing is a vast field which will need a large number of contributions from all involved business parties. (Academics, private, government, consultants etc.)

Correspondingly, the cloud ERP is quite a new, unclear and broad topic, since all the studies related to it are recent. Almost all cloud ERP providers describe their products and services as straight forward tasks. But it still remains unclear how companies will outsource ERP services on the cloud. This paper will be focused on ERP services that can be outsourced over the cloud, as well as the risks associated with any data or information that will be moved from in-house into the cloud.

This study will expand the knowledge of the existing studies related to cloud computing. The results will be presented as a figure which will illustrate the ERP integration of on-premise and the cloud. It will give an idea to the new customers of ERP on how to deal with two-tier ERP systems (cloud and on premises). It will enhance the understanding of the ERP services that can be carried on their premises and what ERP services can be outsourced over the cloud. Alternatively, this research will be a guide for new customers of ERP in manufacturing field to make a decision on

which services to outsource on the cloud through cloud ERP. They might not need to purchase an ERP system at all.

The research was performed based on several ERP providers, ERP purchasers and IT consultants.

The data collection was gathered based on semi-structured interviews, open discussions, a webinar and several ERP seminars. As a researcher, I kept in mind the fundamental questions related to the research topic with free comments from the correspondents. This has helped me to focus and gain more data for the research topic. It has been an easy approach to receive answers from ERP providers' agents, manufacturing companies' representatives in ERP seminars and IT consultants. During the interview with the correspondents, I assembled free comments from ERP providers, IT consultants and ERP customers about cloud ERP as part of my data collection.

The study is based on both qualitative and quantitative methods. I used text mining tools to analyze the interviews, literature review text and IT consulting latest report about cloud ERP and the latest social media blogs (2013). The research goal is to find new information or new patterns that are related to cloud ERP outsourcing in manufacturing field, for that reason this paper has answered this main question:

What are ERP services that can be outsourced over the cloud?

Due to data and security issues these two sub-questions will be answered to as well:

1. What ERP data can be kept on premise and what can be moved to the cloud?
2. How safe is cloud ERP compared to on-premises ERP?

## 1.5   Structure of the study

The study begins by introduction as first chapter.  The introduction presents ERP system and cloud computing benefits then defines cloud outsourcing, cloud ERP. This will help the reader to easily understand cloud ERP concepts once he or she has been familiarized with ERP, cloud computing and cloud outsourcing.

The second chapter consists of methodology used in this research. It will be followed by literature review chapters. Literature review consists of chapters three and four: the chapter three is reserved

to literature review of ERP on-premises and cloud ERP, the chapter four is reserved to ERP cloud service outsourcing.

Chapter five represents the framework of how data is collected and how it is used to find new results related to cloud ERP services. It gives an overall idea on tools that are used to answer the research questions of this paper.

Chapter six contains the information about the data gathered to be used in chapter seven.

Chapter seven addresses the results of the gathered data and present new hidden knowledge related to cloud ERP service outsourcing.

Chapter eight contains data analysis, findings and discussions based on the hidden knowledge discovered in chapter seven.

Finally, the last chapter contains the conclusion of this research paper that answers the three research questions of this thesis.

# 2 Methodology

This study aims to examine cloud ERP outsourcing issues that will be brought up in the literature review and try to find the services that can be outsourced over cloud ERP. Simultaneously, the data security is an important aspect in this research.

This chapter describes the methodology and data research design used in this thesis. The chapter is divided into three sections. The first section of this chapter begins with discussing the methodology used in this research. The second section of this chapter contains the data collection procedure and technique used in data analysis and the source of information used to conduct this research. The third section in this chapter is reserved to the validity and reliability of this research.

## 2.1 Research design

The research begins by a literature reviews related to ERP on-premises and cloud ERP. All of the literature is focusing on cloud ERP outsourcing which can be found in articles, books, reports of IT consultants and other research. All literature review materials used in this paper are recent, from between 2009 and 2013. Later on, the research is followed by an own empirical study and examine the cloud ERP outsourced services issues brought up in the literature review. In order to have a clear view of the empirical study, a suitable framework will be introduced.

## 2.2 Data collection

The data collection procedure is based on interviews with IT partners of cloud ERP providers, ERP seminars, IT consultants and ERP users. IT professional comments from social media blogs are another source of data to be used in this research. The data collection consists also of interviews with several companies in the manufacturing field that considers the adoption of cloud ERP. I visited specific company that implement ERP system and received emails from several companies in manufacturing field.

The interviews are based on open questions and built objectively without interfering or guiding the respondents to specific answers. The other data sources are collected from the scholar studies and recent articles that focus on cloud services outsourcing and cloud ERP.

The RapidMiner, free software, is the tool used for the empirical analysis in order to find new knowledge regarding the cloud ERP services outsourcing. All the data is transformed to text files. Then the data is analyzed using RapidMiner text mining as suitable technique to discover the hidden patterns related to cloud ERP services outsourcing.

## 2.3  Target groups

The target groups are divided into three parts:

1) The companies who have already adapted on-premises ERP and thinking to acquire cloud ERP

2) IT consultants

3) ERP providers

# 3 Literature review of ERP on-premises and cloud ERP services

This chapter contains three sections. The first section starts by introducing ERP on-premises business module and its services. This section looks at previous research and information system studies related to ERP services.

The second section of this chapter is reserved to discuss issues related life cycle of the traditional ERP, this will help the reader to understand the important drivers ERP as SaaS.

The third section in this chapter focuses on previous work conducted on ERP as SaaS based on SaaS business model. In the end of this chapter there is a practical example which shows the cost differences between traditional ERP and cloud ERP. This will help us to understand cloud ERP outsourcing services in the chapter four.

## 3.1 ERP based on on-premises business model

Different information system researchers refer to traditional ERP as ERP system on-premises. The traditional ERP system is based on on-premises business model. This means that ERP software or system is shipped to the customer after testing it and installed in the customers´ local computers. Based on on-premises business model, D'souza et al (2012) recognized that all services related to ERP have to be maintained by the owners of the ERP in their premises, service includes provision of hardware, hosting, deployment and configuration updating of the ERP system. The ERP owners based on on-premise business model have a strong control of managing, controlling and accessing their own data. So what is an ERP system? Why it is so important?

Addo-Tenkorang and Helo (2011), defined ERP as:

*"….an enterprise-wide information system that integrates and controls all the business processes in the entire organization. The Enterprise Resource Planning (ERP), system is an enterprise information system designed to integrate and optimize the business processes and transactions in a corporation. The ERP is an industry-driven concept and systems, and is universally accepted by*

*businesses and organizational industries as a practical solution to achieve an integrated enterprise information system solution".*

The ERP system is in general installed more or less in all company´s computers. In case the company has subsidiaries either in same country or in foreign countries - case of corporate companies -same system can be installed in all company´s computer abroad.

The ERP main advantage is: all users or employees with ERP literature can communicate easily through intranet or via internet. An ERP system, usually, comprises a number of fully integrated business modules, which cover almost every feature of the company´s business management (Figure 3-1). Gartner (2012) revealed that:

 *"Enterprise resource planning (ERP) is defined as the ability to deliver an integrated suite of business applications. ERP tools share a common process and data model, covering broad and deep operational end-to-end processes, such as those found in finance, HR, distribution, manufacturing, service and the supply chain."*

Magal and Word (2011) examined in depth the core concepts applicable to all ERP modules. They took SAP ERP system as a practical example to explain how those concepts can be utilized to implement business processes, by showing how SAP ERP system can help companies in managing efficiently their businesses.

Same modules can be found in any company´s computers that are connected to each other virtually. It enables all company´s members from different business departments within the company, from normal employees to top management to communicate in real time. Figure 3 shows the most common modules that can be found in a typical ERP system.

Each employee will use his or her module according to the department he or she belongs. For example, the logistics clerks will log in the ERP system and work in the area that touches their work activities. They can check the inventory level, trace the goods and exchange information with other departments smoothly in real time.

*Figure 3-1. Typical ERP system modules.* Source: Green Beacon Solutions (2013)

By looking to the figure 3-1 we can see that all business departments are connected to each other. The figure 3-1 translates the precedent ERP definition of Addo-Tenkorang and Helo (2011). The data and information in the ERP system can flow easily through the entire company. In other words it enables all managers of the company to get access to same information. However some researchers looked at ERP system as product that has a life span or life cycle, because the ERP system needs to be upgraded or replaced with newer one.

## 3.2 Traditional ERP life cycle

Almost all researchers that criticized ERP system have taken life cycle as important perspective before implementing such system. The life cycle of an ERP starts usually from system design, installation, configuration, customization, integration, testing, deployment, operate, maintain and upgrade, as it shows in Figure 3-2
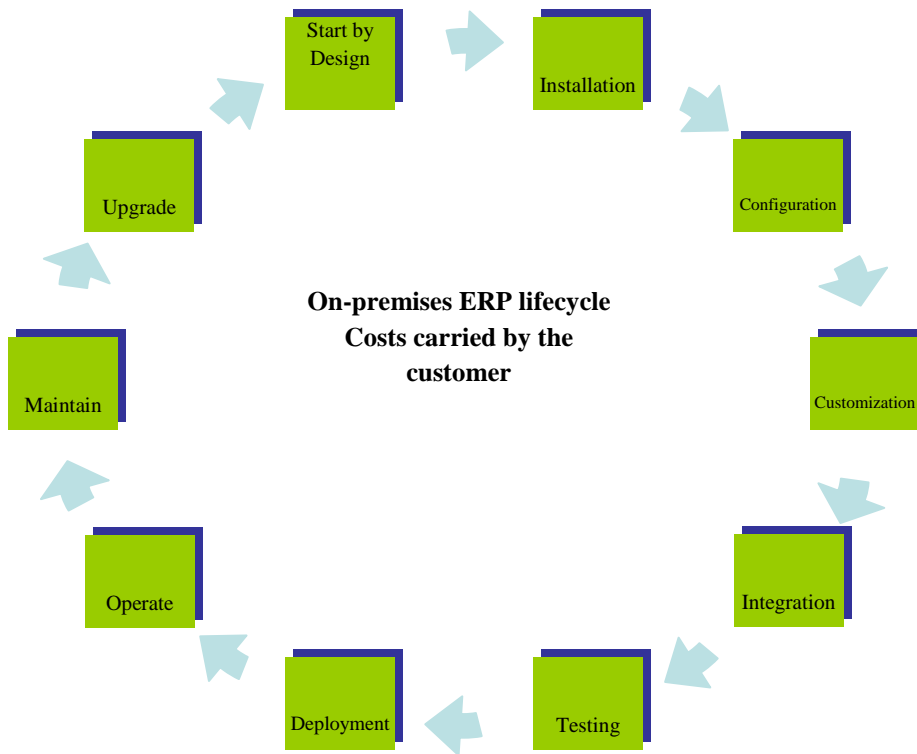
*Figure 3-2. On-premises ERP lifecycle.* Adopted from Penttinen (2011)

The firms that have adopted an ERP system have to maintain their applications until the end of the system life span. A proper ERP maintenance is necessary condition to achieve the benefits expected of ERP packages, adding that heavy ERP maintenance creates a complex projects that will result in failure. (Salmeron and Lopez 2012)

Kimberling (2010), who has fifteen year experience in ERP consulting, pointed out that the software itself is not the problem by arguing the existence of ERP vendor over 20 years in this field. The ERP failure or its termination is due to misalignment between the business and the software itself. He added that vendors sometimes make several releases of new version of their ERP and the new release may or not be aligned with the businesses needs as Figure 3-3 illustrates.

*Figure 3-3. Long-term misalignment of ERP system.* Source: Panorama Consulting Group LLC (2010)

In other hand, all the time when new version will be released, the company has to upgrade all its versions in all computers. This might create a deviation between initial business requirement and initial implementation whenever a new version will be installed (figure 3-3). Upgrading will take a great deal of troubleshooting time, resources and costs. The companies' employees may not be able to use their computers while the ERP system is upgraded, unless it will be done overnight which can be more costly.

Chuck et al (2010) informed that ERP success requires a full lifecycle perspective to be taken in consideration by the companies that adopt ERP. In their case study they explored and identified critical success factors of ERP adoption. They insisted in maintaining and supporting of ERP from an early stage in the project lifecycle. They pointed out that poor planning and management of maintaining and supporting ERP services can jeopardize the normal operations of an ERP system and the delay of the companies´ businesses activities. Lifecycle of an ERP have been tackled by Albadri and Abdallah (2010) from the users´ training and their ability to use the ERP applications, they recognize users to be the most important driver of the ERP life cycle including (pre-implementation, implementation and post implementation). They added that users´ issues are recognized as important yet inadequately addressed.

Elragal and Haddara (2011) as well as Penttinen (2011), acknowledged that a variety of research has been undertaken focusing on ERP system lifecycle, but insignificant attention is paid to the replacement of an ERP with another. The research was focusing on the reasons and timing that

forced small and midsized companies to replace their ERP systems. They found out that the reasons of replacing of ERP were: wrong selection, users were not involved in the selection process and lack of an official implementation methodology.

The common issue related to ERP on-premises implementation is due to the budget overrun. Panorama Consulting Group (2011) announced that ERP tends to cost 40 to 45 percent more than the original budgeted projections for many reason as it shows in the figure 3-4. In general this reason can be related to the lack of having a clear idea of the total ERP project.

**REASONS FOR BUDGET OVERRUNS**
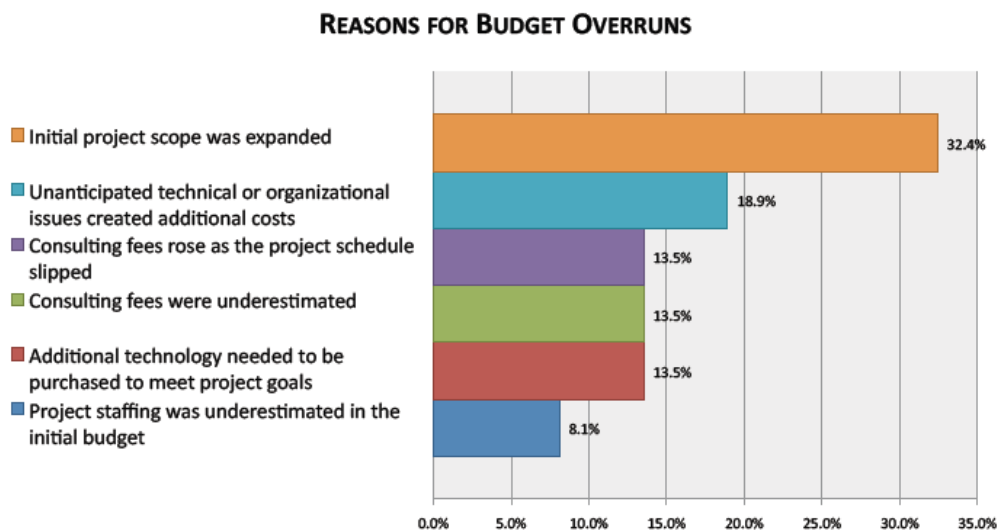


*Figure 3-4. Reason for budget overruns.* Source: Panorama Consulting Group (2011)

All these critical researchers' findings and customers' complaints have pushed the ERP providers to think about other alternatives to minimize the issues of an ERP on-premise. The evolution of internet with high speed and the popularity of online services have encouraged the creation of so called Software as a Service (SaaS). Therefore ERP providers started to offer ERP as SaaS or cloud ERP.

## 3.3 ERP based on SaaS business model

This section starts by giving the reason behind offering ERP in form of SaaS which is based on SaaS business model. Then define this business model and try to link it to the outsourcing concept. The second part of this section gives price comparison of ERP SaaS versus ERP on-premises based on real example from ERP provider.

### 3.3.1 ERP as SaaS

Implementing ERP system on-premises is proven to be expensive and time consuming. Enterprise software modules are frequently extremely expensive and very complicated to manage for most of the companies. Consequently, this has pushed the ERP providers to create new services called ERP as SaaS. These new services are based basically on SaaS model. Danaiata and Hurbean (2010) defined SaaS business model:

*"As a term, SaaS is generally associated with business software and is typically thought of as a low-cost way for businesses to obtain the same benefits of commercially licensed, internally operated software without the associated complexity and high initial cost, the customer has little or no up-front acquisition costs, no hardware or software to buy, and no numerous support IT staff to hire and train".*

ERP as SaaS falls under the companies' IT service outsourcing which is defined by Davis et al (2011, 343):

*"IT service outsourcing is the practice of hiring another company to perform some or all of your IT operations functions (that is, hiring the company to provide the people and processes necessary to perform the function), Commonly outsourced operations include help desk operations and PC support. This can obviously go hand-in-hand with the outsourcing of IT systems and infrastructure. For example, if you have placed your IT equipment in another company's data center, you are also likely to hire that company to perform data center operation activities (such as tape operations, hardware support, and so on). Similarly, if you deploy cloud computing, it is a given that the cloud provider will perform the operations over the cloud infrastructure."*

Therefore, SaaS model has changed the on-premises IT role from focusing on deploying and supporting ERP to managing the services that ERP provides might offer over the cloud.

River Cities Capital Funds in their report (2011) looked at SaaS business model as:

*"…a transformational delivery model for business software and associated data, both of which are hosted in the cloud and accessed via a web browser. As compared to on-premise software vendors that maintain multiple versions of their software, pure SaaS vendors need only deploy and support*

*a single instance of the software codebase across all of their customers. This multi-tenancy approach extends significant economies of scale to customers by way of shared infrastructure and operational support for the software*".

So, here we see that SaaS word is well associated with cloud term. Later on, Djohnson (2012) explained that Software as a Service (SaaS) is a term of renting software over the cloud, he added that easy applications have monthly rental fees, while more complex solutions such as accounting and ERP software are offered based on annual rental fees. The figure 3-5 shows ERP as SaaS.

**ERP is used through web browser with special permission**

ERP as SaaS offered
from Provider via
Internet on the
cloud
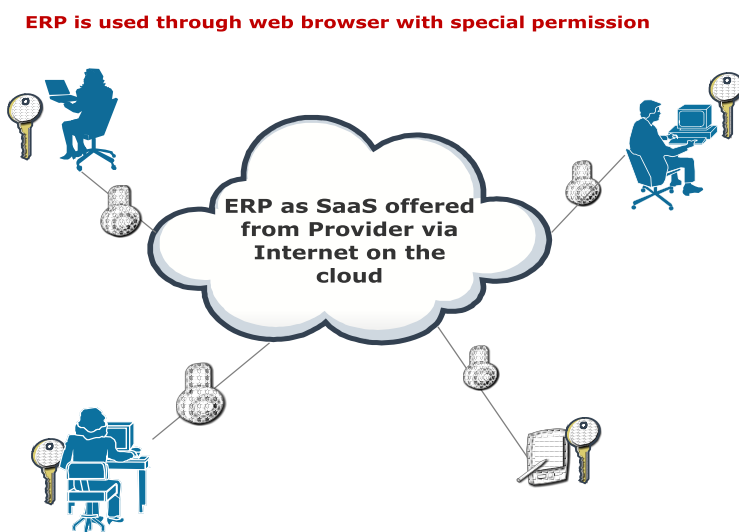
*Figure 3-5.ERP as SaaS offered from Provider via internet on the cloud.* Adopted from SaaS definition of Danaiata and Hurbean (2010), River Cities Capital Funds (2011) and Djohnson (2012).

The figure 3-5 shows that ERP as SaaS is not installed in any company´s computer rather than it is installed on the ERP provider´s cloud or third party cloud provider. The users of ERP as SaaS will need only username and password as authentication. This will enable users to gain access to the ERP that contains similar modules of traditional ERP on-premises. I disagree with Danaiata and Hurbean (2010) who claim that there is no hardware needed for using ERP based on SaaS business model. From the figure 3-5  we can see that the employees who will use ERP system need a computer or any mobile device to log into the cloud ERP. Thus companies will have some costs related to computers´ maintenance in the house.

Nevertheless, ERP as SaaS is much cheaper than the ERP on-premises. The last section in this sub-chapter represents the cost comparison between ERP as SaaS and ERP on-premises.

### 3.3.2 Cost of ERP SaaS vs. cost of ERP on-premises: practical example

According to Boyum IT (2013) who implemented and supported SAP ERP for 15 years, the cloud ERP is cheaper than ERP on-premises as it shows in table 3-1.

*Table 3-1. Prices comparison of ERP on-premises and ERP on the cloud*

| Prices comparison of ERP on-premises and ERP on the cloud | | |
|---|---|---|
| | **Cloud ERP** | **ERP on-premises** |
| **20 users** | 2000 euros/month | 50000 euros |
| **30 users** | 3000 euros/month | 75000 euros |
| **40 users** | 4000 euros/month | 100000 euros |
| **50 users** | 5000 euros/month | 125000 euros |

Source: adopted from an e-mail received from Boyum IT (2013)

The example of the price comparison is based on SAP Business All-in-One ERP package which is meant for small and midsize manufacturing enterprises who desire to use ERP system. The prices increase as the number of users increase for both cloud ERP and on-premises ERP. The clerk of Boyum IT (2013) points out that:

"*The on premises-column includes only licenses, prices does not also include the implementation project, just licenses*".

From the table 3-1 we can see that ERP based on SaaS business model is cheaper than having the whole system installed in the companies' computers, this will allow small and midsized manufacturing companies to benefit from using ERP in similar way as having ERP system built on-premises. But there are numerous aspects to take in consideration when shifting ERP to the cloud such as benefits and risks associated with cloud outsourcing services.

From table 3-2 we can find annual cost saving if new customer chooses cloud ERP over on premises ERP as follow:

*Table 3-2. Annual cost saving when customer choose Cloud ERP over on-premise ERPP*

| | Annually cost saving when customer chooses Cloud ERP over on-premises ERP | | | |
|---|---|---|---|---|
| | ERP on-premises (€) | Cloud ERP annualy fees (€) | Annualy cost saving (€) | Annualy cost saving % |
| **20 users** | 50000 | 24000 | **26000** | **52 %** |
| **30 users** | 75000 | 36000 | **39000** | **52 %** |
| **40 users** | 100000 | 48000 | **52000** | **52 %** |
| **50 users** | 125000 | 60000 | **65000** | **52 %** |

Source: adopted from table 3-1

Table 3-2 shows that if new customer uses cloud ERP the saving cost can exceed 50% compared to the on-premises ERP. These results are confirmed already by Mattison and Raj (2012) as well as Elis (2010) who explained the cost saving of using cloud ERP in the term of lower total cost of ownership.

## 3.4   Summary

The purpose of this chapter was to define the idea behind an ERP system. ERP software is usually installed in the companies' computers and it is referred as on-premises ERP business model. The ERP system comprises a number of fully integrated business modules, which cover almost every feature of the company´s business activities and processes. The traditional ERP has a lifecycle which starts usually from system:  design, installation, configuration, customization, integration, testing, deployment, operate, maintain and upgrade. These lifecycle steps can cause budget to overrun or misalign between the business and the software.

In other hand the ERP based on SaaS business model is less expensive than the traditional ERP which is based on on-premises model. Most of small and midsized manufacturing companies can afford to use ERP as SaaS in similar way of having the whole system installed on-premises.

# 4 Cloud computing service outsourcing

First section in this chapter introduces current cloud computing service outsourcing, in order to have a clear idea about how cloud outsourcing is adapted and understood by several firms. For that reason I will use a specific IT consultant research. The chapter continues with section 4.2 by introducing the benefits of cloud outsourcing and links it to the cloud ERP. The third section addresses issues and main concern related to cloud outsourcing. The fourth section takes a closer look at cloud ERP life cycle and compares it to the traditional ERP life cycle.

## 4.1 Current cloud outsourcing

Deloitte Consulting LLP (2012), survey response of outsourcing and in sourcing from over 23 different countries and 22 primary industries from around the globe announced that:

*"...outsourcing continues to go main stream as another standard business practice that should be evaluated as business needs mandate. Information Technology, Finance, and Human Resources continue to lead the business processes in outsourcing".*

The results showed (Figure 4-1) that 47% of the companies do not use cloud computing services, 23% do not know if they are using cloud services and only 30% are aware of cloud services and are using it.

If we add 23% of companies who do not know that they are using cloud service and 47% of companies who do not use cloud computing services we get 60% of companies that are not basically using cloud computing. This will necessitate launching many studies and research in this field. But this paper will focus only on ERP services that can be outsourced over the cloud.
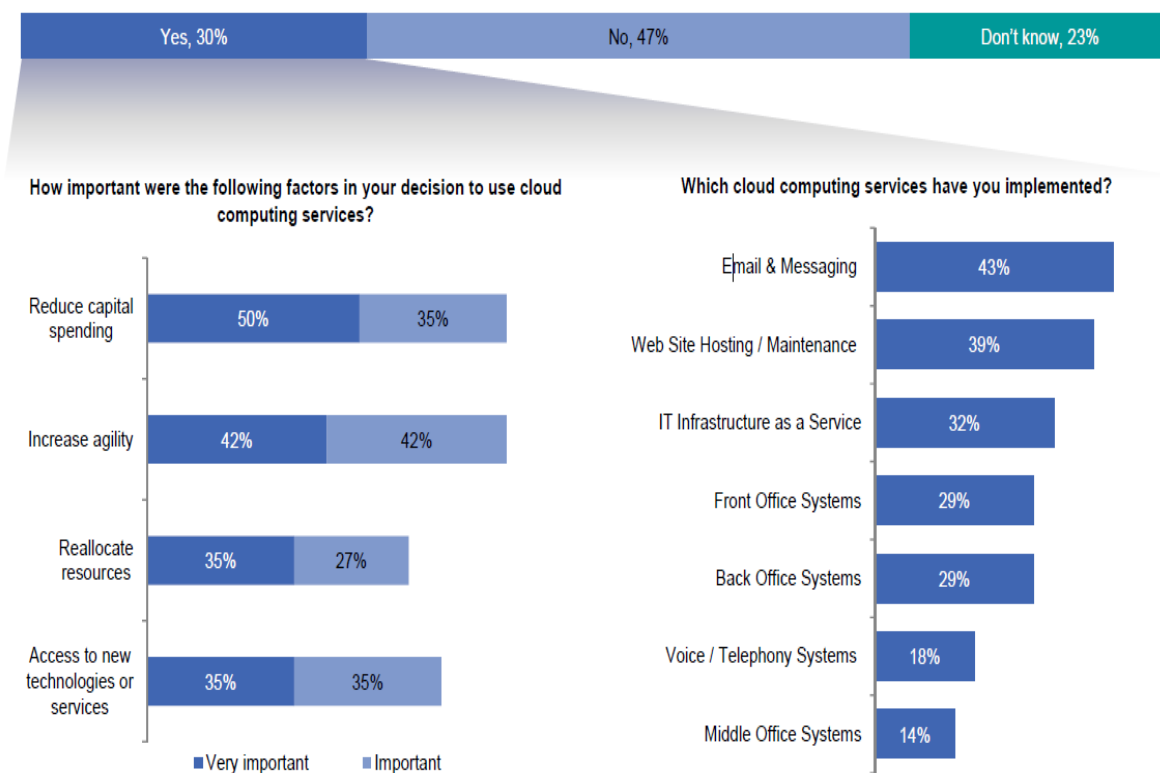
*Figure 4-1. Important factors that drive cloud computing services compared to the already implemented cloud computing services*. Source: Deloitte Consulting LLP (2012, 9)

The picture shows that e-mail and messaging, website hosting, maintenance, IT infrastructure, front office systems, back office systems, voice, telephony systems and middle office systems are most current services that companies outsourced over the cloud. Almost 30% of IT infrastructure is outsourced over the cloud. The figure 4-1 shows also the reasons behind using cloud computing such as reducing capital spending, increase business agility, reduce IT resources and gain access to new technologies.

According to the report which is based on this survey, Deloitte Consulting LLP (2012) has predicted the increasing in the IT outsourcing over the cloud as well as in other field, Figure 8.

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Information Technology — 76% — 81%
Operations — 42% — 53%
Finance — 37% — 53%
Human Resources — 30% — 46%
Legal — 40% — 42%
Real Estate/Facilities — 32% — 41%
Procurement — 24% — 36%
Sales/Marketing Support — 11% — 24%

■ Currently uses outsourcing     ■ Expected future increase in outsourcing
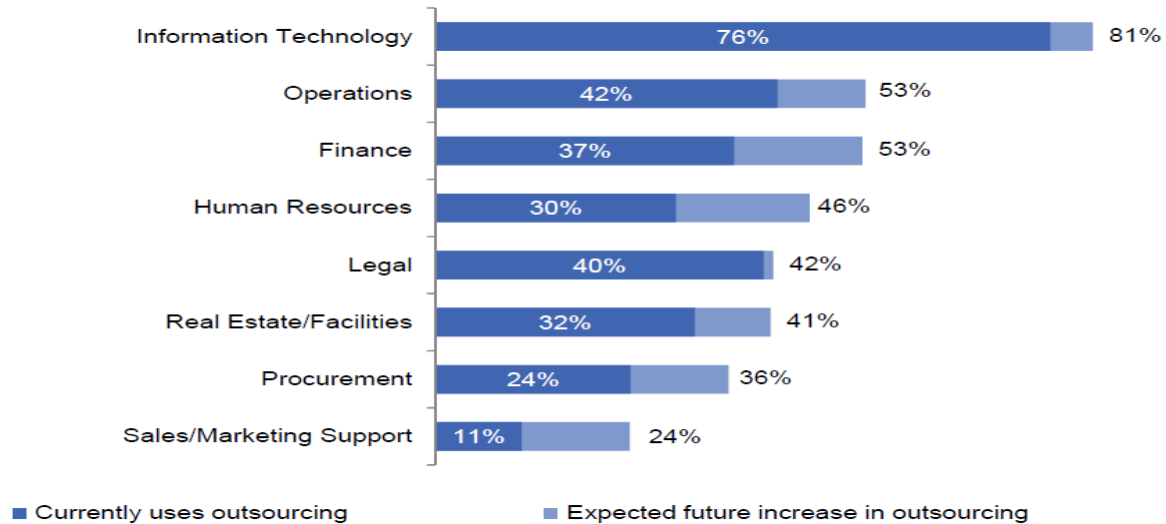
*Figure 4-2. Current and expected future uses of services outsourcing.* Source: Deloitte Consulting LLP (2012, 8)

In other hand most of cloud ERP contains modules of finance, human resource management, sale and marketing and each are estimated to grow (figure 4-2), successively with: 53%, 46% and 24%.

Figure 4-2 contains few modules that are found in most of ERP systems, therefore it gives an idea about various services that can be outsourced to the third party over the cloud.

These growth predictions of outsourcing services over cloud have raised a curiosity to take a look at the latest studies and research related to the benefits of cloud service outsourcing. This will help to gain good idea about cloud ERP services that will be outsourced over the cloud.

## 4.2 Benefits of cloud ERP service outsourcing

This sub-chapter 4.2 is divided into seven sections; each section presents benefits of cloud ERP service outsourcing. It starts by presenting cloud computing services as another form of outsourcing. The sub-chapter 4.2 ends by focusing on data safety benefits.

## 4.2.1 Alleviating risks

According to Clemons and Yuanyuan (2011), cloud computing services can be viewed as a form of outsourcing; they added that the bright side of outsourcing is that essential risks of all outsourcing contracts are shared among the contractors. Similarly, cloud ERP services fall in cloud computing category. ERP customers and the contractors have a mutual benefit as partners that complete each other over the cloud. Both partners will build a trustful relationship based on win-win concept.

## 4.2.2 Service cost saving

According to Velte et al (2009, 3) and Sosinsky (2011) using cloud services will cut cost by eliminating upfront expenses for hardware and software. The maintenance, up grading of ERP and hardware associated with it over the cloud is processed in the provider´s premises. As it was mentioned in section 1.3, the main benefit of cloud outsourcing is using ERP system at low costs and flexibility of doing business over the cloud. Ellis (2011) shares same idea about cost saving with Mattison and Raj (2012) in section 1.3 by adopting ERP over the cloud. Djohnson (2012), the only cost associated with ERP system is the predictable fixed monthly fee for the utility. According to cloud ERP providers such as SAP (2012), Oracle and Microsoft Dynamic (2013), the availability of ERP as SaaS is 24/7; the customers will not face any shut down of services.

Mattison and Raj (2012) have compared the on-premises ERP and cloud ERP four years cost saving based on the concept of total cost of ownership from the research of Hurwitz and Associates as it shows in the Figure 4-3.
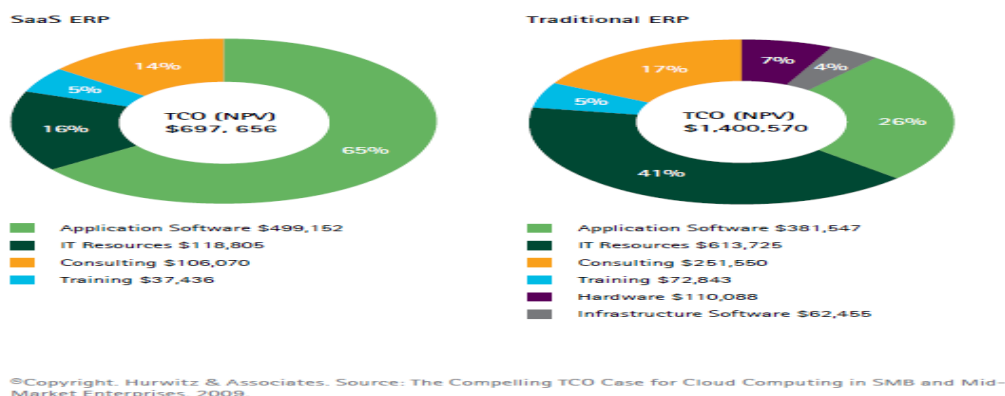


*Figure 4-3. Four-Year Total Ownership Cost Distribution (TCO), Comparison: On-Premise ERP vs. SaaS ERP for Mid-Market Enterprises.* Source: Mattison and Raj (2012, 5)

Figure 4-3 shows that SaaS ERP eliminates hardware and infrastructure software costs related to ERP. The cost saving is:

(381547 + 613725 + 251550 + 72843 + 62455), $- (499152 + 118805 + 106070 + 37436), $ = 1382120 $ - 761463$ = 620657$.

This saving can be used either for product development or launching other beneficial projects. Yet this comparison does not attribute the costs related to implementation of either cloud ERP or on-premises ERP.

### 4.2.3 Easy access

Mobile cloud computing represents an opportunity to deploy ERP over the cloud due to ever-increasing cell phone and Smartphone use, ERP cloud providers are talking about cloud mobility services (e.g. SAP 2013). The ubiquitous of internet devices such as smart phones, Ipads, internet tables and portable computers will encourage customers to use the cloud ERP. It helps their employees to get access to ERP system and work from anywhere at any time even in the blue sky. Numerous of business trips take long time and nowadays several airlines (e.g. Norwegian airlines), are offering internet access during the trip.

### 4.2.4 Dashboard

Several ERP providers include dashboard as added value that allows managers to promptly comprehend their businesses performances based on suitable key metrics. The dashboard is usually intended to be used by the top management who do not necessary have strong IT literature, by transforming complex company data into interactive dashboards. Therefore through cloud ERP managers can monitor employees and other business performances across the organization with key performance indicators (KPIs).

According to Proactivesoft (2011), before customers can use dashboard, they need to login to the ERP system, customers can perform the following functions:

- *Compare KPI by years or centers or locations month by month.*

- *Customize four main windows with selected Key performance indicators.*

- *Customize the graph type & colors.*

- *Copy one graph to another application like Excel.*

This represents a practical prove that ERP providers did understand the importance of embedding dashboard technology in their ERP system.

### 4.2.5   Focus on core business

Nearly all of companies, especially, midsize or small manufacturing companies do not afford to have own IT expert in the house due to the high costs associated with it. Typically, these companies operate in businesses that are not related to IT. They use IT only to run their business smoothly and enhance their competitive advantage in their market. Therefore, they prefer to focus on their core business by outsourcing IT activities. But still these companies can have IT staff that has a CIO whose role is to manage, train and outsource IT activities.

Consequently, the company IT staff, especially, CIO will focus on managing and aligning IT infrastructure with the company´s business strategy. CIO will have plenty of time to make great use of information that will be extracted from cloud ERP, then transform it to the knowledge that will help managers to make right decision.

### 4.2.6   Implementation

 The ERP implementation over the cloud will be performed by the cloud ERP provider or cloud ERP partners. The traditional ERP implementation takes long time to be ready and to be used by the company´s employees. As example Vaisala Corporation has acquired Oracle ERP System in 2007, the first release of the system contained only HR module, and then later they continued to implement other modules. Vaisala announced in 2011 that:

*"Implementation of the company-wide ERP program progressed in 2011 with go-lives in Germany and the USA. Roll-out will continue until the end of 2012".*

Therefore, during these years of implementation the cost will increase as there are chances that the whole system will miss-align with the company´s business strategy as it was shown in (figure 3-3). Vaisala has reported the cost of implementing ERP system in many of its financial reports from 2007 until 2011. So, an ERP system on-premise is costly also to large companies, but in this paper the focus will be paid only to small and midsized manufacturing companies. However, the cloud ERP implementation takes less time than an ERP on-premise. Consequently, the customers of cloud ERP will save great time and resources reserved to troubleshooting and implementation of ERP.

### 4.2.7 Data safety

Here safety means that the customer makes sure his or her data is safe in the cloud in case of unexpected disaster, lack of electricity power, earthquake, floods, hurricane etc.

Federal Financial Institutions Examination Council Information Technology Subcommittee (2012), translated data safety in term of recoverability**:**

**"***How will the service provider respond to disasters and ensure continued service? Do the financial institution's disaster recovery and business continuity plans include appropriate consideration of this form of outsourcing, the service provider's disaster recovery and business continuity plans, and the availability of essential communications links?* "

Although, the cloud outsourcing offers plenty of benefits there are many issues related to it. All CIOs or IT responsibles will treat this manner as most sensible issue to be taken in consideration when ever outsourcing any ERP IT activity over the cloud.

## 4.3 Issues and concern related to cloud ERP outsourcing

This sub section 4.3 represents issues and concerns related to cloud ERP outsourcing, it´s divided into seven sections, its starts by dealing with security, data control, cloud ERP vendor or cloud ERP provider selection, added applications, cloud ERP response, cost and ends by cost lock-in.

### 4.3.1 Security

It was mentioned in section 1.3, security and risks related issues are the main concern that all academic researchers, cloud ERP consumers and providers worry about regardless how the IT will develop in the future. When we look at cloud territory it comes to our mind that there are numerous or countless players out there, (figure 4-4)



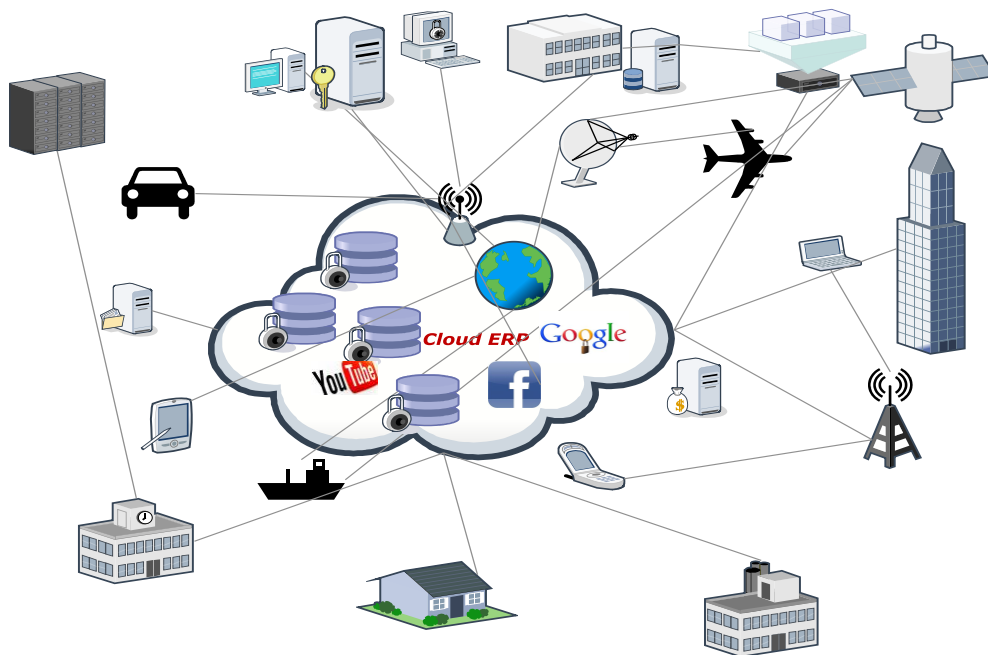*Figure 4-4. Players involved in cloud if the cloud is used as metaphor of internet.* Adopted from section 1.1

As the section 1.1 defined the cloud computing as metaphor of internet, the Figure 4-4 gives a clear idea that once an internet device is connected to the net or the cloud, the user will interact with other users according to the platform he or she is log in. Here we can see (Figure 4-4) that cloud ERP is

there somewhere lying in the cloud. Basically anyone with right password and username will get eventually access to the cloud ERP. There is abundance of people with impressive skills (negative hackers), who will understand how to talk to the cloud ERP server and they can get access to valuable information that should remain secret. This information can be either sold to the competitors secretly or destroyed deliberately. Thus, we have witnessed that large companies who claim to have secure system that cannot be penetrated have been a victim of wrong doing from hackers. Polyakov et al (2011) pointed out in general, all business processes are contained in ERP systems, and significant damage may be caused based on what they call: Industrial espionage, sabotage and fraud. They explained the espionage threats that target data by getting access to only one of these ERP areas or module:

- *Financial Data, Financial Planning*
- *HR data, personal contact details*
- *Customer Lists*
- *Corporate Secrets*
- *Supplier Tenders*
- *Customer Lists*

The sabotage threat occur when attacker gets a devastating denial from getting access to a certain service in the ERP, then the attack may stop the ERP from functioning or some modules to mal-function. Polyakov et al (2011). The fraud threat is described to be depending on the automation level in the ERP. The attacker can create a fake client ID; make fake transfer of money for his or her own benefit. Polyakov et al (2011)

The Figure 4-5 shows ERP network within the company´s infrastructure. The intruder uses internet as a bridge to connect with the corporate network as it shows in red arrows. In worst case, there might be intruders or hackers from different part of the globe. The issues of security have been already addressed before the existence of cloud ERP. The security issue rose due to the external connections meaning that the company´s computers that have traditional ERP are connected to the net. So the internet represents the gate that allows intruders to enter if the gate is not well secured (Figure 4-5).

The most interesting and distressing information presented by Polyakov et al (2011) is that the security in ERP field is wide and there are some areas still not well covered.
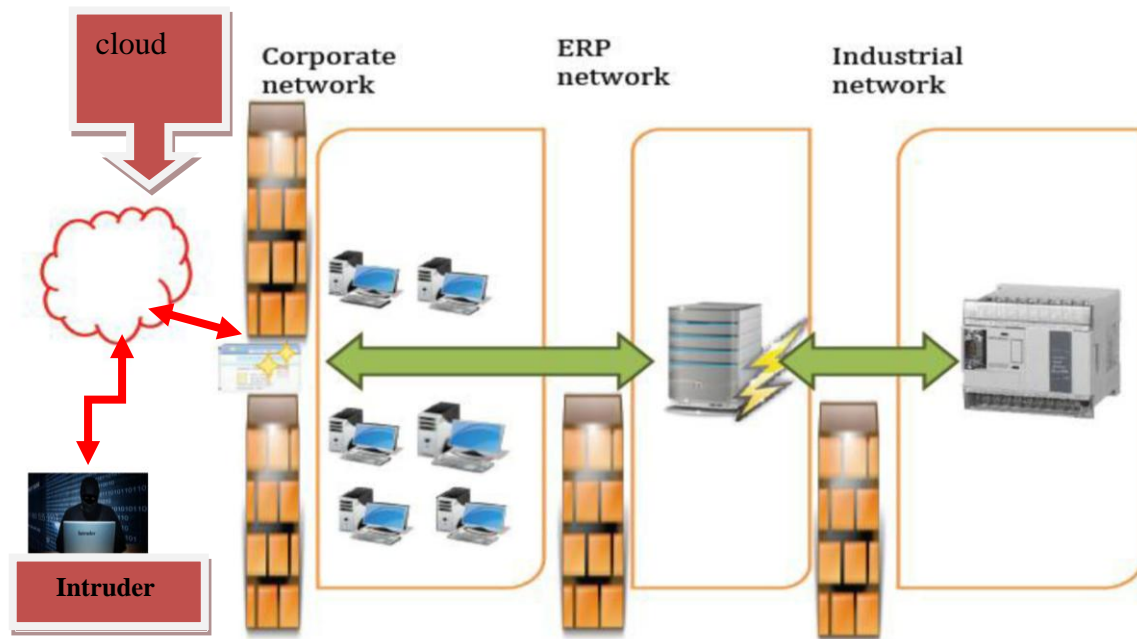
*Figure 4-5. The security issue rises due to the external connection.* Adopted from ERP Scan (2011)

From the Figure 4-5 we can see that the ERP is installed on company´s computers and connected to the internet. The cloud ERP therefore has same characteristics but do not reside in any corporate computer rather than having a place in the cloud (figure 4-5). Correspondingly, security issue will remain, but the burden of security can be shifted to the cloud ERP provider or other expert third party in cloud security. As a result, moving ERP to the cloud might be less risky than having it on-premises stressing that the cloud provider has a strong security tools.

### 4.3.2 Data control

When data is entered or moved to the cloud in general there has to be a clear rules about the data uses. CIO in any company or the person who takes care of cloud ERP will have to take in consideration the control of data over the cloud. No company will accept any lost or leak of data to the outsiders especially to it's the competitors. Herath and Kishore (2009) looked at data control under many terms as security, decoding of data, data privacy, data sharing, data methodologies, data warehouse, data base, data requirement etc. Yuanyuan (2011) tackled the issue of data controlling under the cloud outsourcing concerns in many terms such as data security, critical confidential data, data integrity etc. Thus, controlling own data is the prior concern that can be find in any advice from almost all researchers in the field of IS, IT consultants and cloud computing providers. Here

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companies ought to carefully select the right cloud ERP vendor, cloud ERP providers and cloud provider.

The data that will be moved to the cloud will not be necessary in the cloud ERP provider premises. The ERP provider may as well use third party such as renting the cloud space. Therefore, the data will be under direct responsibility of the firm who own the data. The indirect responsibility will be under the third party, the actual owner of the cloud. But it is ultimately necessary that the customer or the firm who will use cloud ERP is aware of the third party from the beginning of using ERP as SaaS. The cloud ERP provider has to inform his or her customer in case of using third party as cloud provider.

### 4.3.3   Cloud ERP vendor or cloud ERP provider selection

 The vendor of cloud provider and cloud ERP customer relationship will be like marriage, there has to be trust and commitment between both sides in order to help each other. Each one will take care of his or her responsibility. The provider will have all the company information running over his or her cloud infrastructures, therefore the customer of cloud ERP has to find the right trust worthy provider. The provider has to fulfill all benefits of cloud outsourcing in section 3 and strong legal agreements related usually to data ownership and data protection. However, finding the right partner will require firms to compare different cloud ERP providers and cloud providers, by looking to these factors:

> *History*: usually provider with long history will prove his or her success in understanding customers and their businesses requirements. The provider that helps companies to establish an alignment between business strategy and execution. Provider with long history is sign of reliability and business continuity.

> *Market share*: Provider with high market share will give an idea that it provides best business solutions. Most of the companies tend to copy other successful companies technology under the term of isomorphism. According to Panorama Consulting Group (2011), the top three know ERP providers are: SAP, Oracle and Microsoft Dynamics as it shows in Figure 4-6.
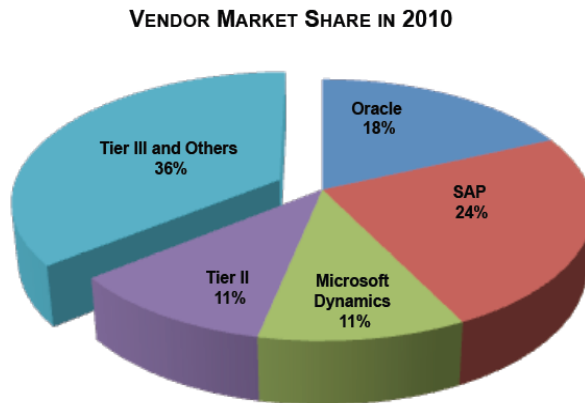
*Figure 4-6. ERP providers market share in 2010.* Panorama Consulting Group (2011)

All companies from different fields understand that the use of same ERP system will help them to run their business smoothly.  Maybe this is the reason most of the companies will use common ERP provider.

- ➢ *Services*: it helps firms to competently deal with business challenges, ensure fulfillment and certainty of business performance. Mostly it aligns ERP business processes with other suitable technology to the firm´s goals. Most of the firms do not have unique business requirements. The provider has to have ability to understand different business requirements.

- ➢ *Availability of the provider*: The cloud ERP provider has to be available whenever the firm needs to make some changes or fix some problems related to the software functionality. The provider has to act fast in fixing unexpected problems related to the use of the cloud ERP system.

- ➢ *Location:* Usually in cloud, data can be stored in a remote location on servers maintained by a cloud provider or by the third party. Every firm has to know the location of their provider and the location of the cloud. In general, if the provider is closer to the company it offers some security to its customers. Close means, that the provider has a subsidiary or partner who will answer the customer's questions and offer the necessary support whenever it is needed. The other sensitive matter is the location of the cloud, meaning in which town or country is the cloud storage. It is highly recommended to keep in mind that the rules are different from one country to the other when it comes to legal issues especially when we talk about data control.

> *Costs charged*: The most important is service pricing. Cloud ERP provider has to offer a reasonable price that will be equal to the value of its services. Usually these prices are fixed to a known monthly or yearly fee. Keeping in mind that cheaper or higher prices from other providers will not necessary offer high value. In this case cloud ERP customer will have to track record of the provider with cheaper or higher services such as offered guarantees, service agreement and conditions infrastructure facilities and most importantly the provider's financial stability.

## 4.3.4   Added application

As we know, not all companies have unique business requirements. Penttinen (2011), nearly all of companies, typically, add several applications on top of their ERP system to manage their specific functions or industry specific requirements.

The added application will not necessary be offered by the cloud ERP provider. The process of adding extra application has to happen in the cloud, therefore the customer of ERP or CIO will have to bring both cloud ERP provider and the application provider to work together in order to form a smooth ERP system. It might create some delay in delivering the whole project in time from the ERP provider.

The added application possibly time to time require an update which will make the cloud ERP system open to an extra player. This will add extra costs and vulnerable issues, in other words the added application might be used as entry gate from an external intruders. The worst case scenario is that update can push the whole system to deviate from the company´s business strategy or business requirement as it was shown in figure 3-3.

## 4.3.5   Cloud ERP response

Cloud ERP will require a fast internet speed to ensure the response times that can be expect from the users compared to the on-premises response. The idea behind cloud is to be able to get access from anywhere at any time to cloud ERP and use its modules that are identical to the modules in the on-premises ERP.

The response can be fast over the cloud, if both the cloud provider and the cloud ERP users will have adequate bandwidth with high speed; this is hard to adapt particularly in places or countries where internet infrastructures are very weak. Väänänen (2013), if the user wants to send e-mail or small data with few kilobytes it will not be an issue with small internet connection. But when it comes to transmit or retrieve a huge data from own computer device to the hosted cloud ERP it will definitely require high speed internet.

### 4.3.6 Costs

Arnesen (2013) described moving ERP to the cloud as moving cost from an in-house expenditure to an outsourced expense (figure 3-2), which is similar to buying a car (on-premises and hosted) vs. riding a city bus (cloud), he added that annual subscription fees are higher than annual maintenance fees for on-premises solutions.

The example of cloud ERP cost provided by Boyum IT (2013), table 1 in section 3.3.2, gives a clear idea about annual cost based on monthly cost which can be higher as the users of cloud ERP increases. The example does not include higher implementation costs which can be performed by third party. We have to keep in mind that Boyum IT (2013) prices are meant for small and midsized companies only.

In a long run, ERP as SaaS may de-pass the on-premises costs. Panorama Consulting Group (2009) understood that ERP as SaaS can be compared to the notion of leasing vs. buying a car; ERP as SaaS become costly if the company grows and add more employees to the ERP system.

### 4.3.7 Vendor lock-in

Although, the cloud ERP customer would find a suitable provider there will be risks associated to the cloud ERP providers in term of Vendor lock-in. The ERP customer cannot only sign a contract to use ERP over the cloud for definite fees. Each customer has own specific business processes needs, therefore, using cloud ERP will require a specific customization before adopting the software package. Cloud ERP provider choice is extremely crucial step which customers have to take in consideration before using an ERP system over the cloud. The vendor of ERP has to be chosen based on win-win concept and having the ability to offer a long lifecycle for his or her product.

Cloud ERP vendor lock-in is seen to be cheaper compared to on-premises ERP, in an interview with (Heydari, 2013), if the customer decides to skip upgrading on on-premises ERP, at specific point the customer will need to upgrade the ERP system as the business requirement changes. In that case the customer has to pay for all other previous upgrading if he or she wants to use the latest version of the ERP on-premises. Heydari (2013) describes this process to be similar of building multi-storey building, one cannot build fourth floor without building first, second and third floor. This process is well presented in ERP lifecycle.

As in ERP on-premises, the lifecycle of cloud ERP is an important aspect to be taken in consideration by both cloud ERP provider and cloud ERP customers.

## 4.4 Cloud ERP life cycle

The cloud ERP life cycle is almost similar to the life cycle of ERP on-premises in section 3.2 which starts from design until upgrade as it shows in Figure 4-7.

The costs associated to cloud ERP during each lifecycle steps are shifted to the ERP provider who will manage and take care of all the necessary changes that touch the cloud ERP system. Some cloud ERP providers may charge their customers during the implementation phase (e.g. SAP cloud ERP provider). Some other cloud ERP provider may include the implementation as part of monthly or yearly fee.
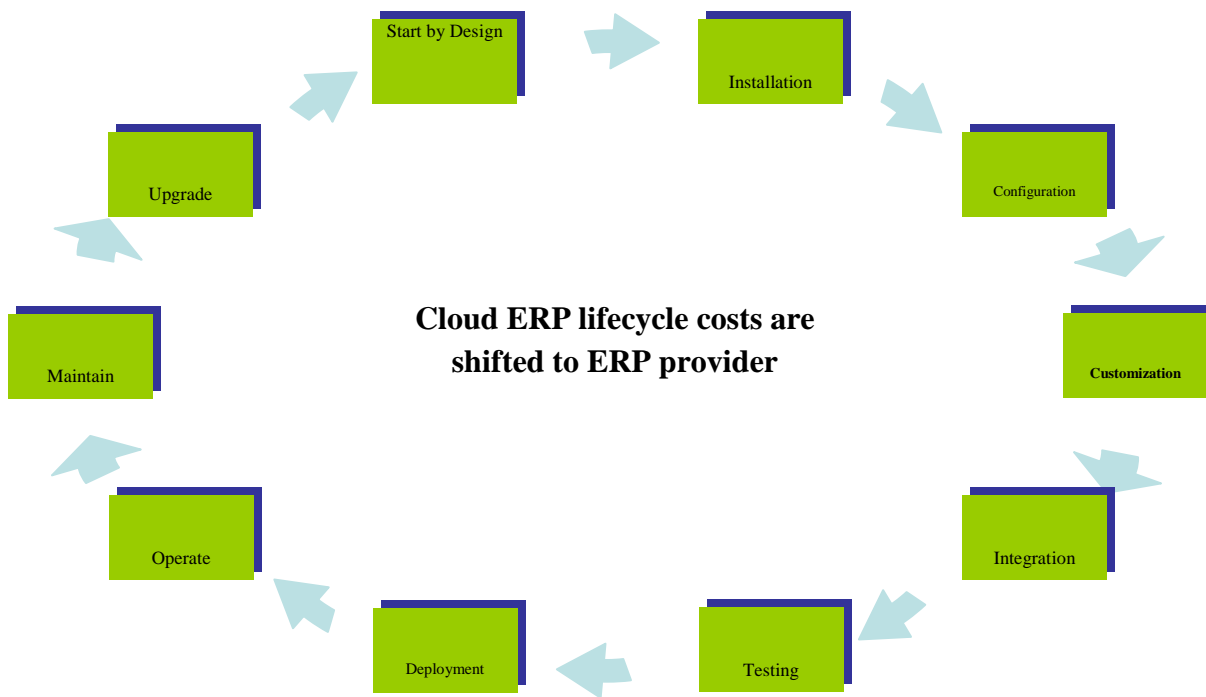
*Figure 4-7. Cloud ERP life cycle.* Adopted from Figure 3-2 which was adopted from Penttinen (2011).

Each cloud ERP customer is recommended to be aware of the cloud ERP life cycle since it is not a straight forwards project to implement. Although, all the steps of cloud ERP life cycle are performed by the ERP provider there will be need to involve the customer in each step of the life cycle.

## 4.5  Summary

This chapter has introduced the benefits of cloud ERP service outsourcing as well as issues and concerns related to cloud computing. There are evidences showing growth of outsourcing services over the cloud. By taking a look at the latest studies and research related to the benefits of cloud service outsourcing, helped to understand the profit of cloud service outsourcing. The benefits of outsourcing services of the cloud ERP over the cloud are: alleviating risks with right partner, easy access to the ERP system, cheap and quick implementation of the system, focus on core business, service cost saving, promote visualization in terms of dashboard and data safety.

Nevertheless, data safety might be a major concern if cloud ERP customer does not know who is in charge of it. All the benefits from outsourcing services over the cloud can turn against cloud ERP customer if he or she does not know how to master outsourcing over the cloud. Similarly to on-

premises, cloud ERP has lifecycle, except that all cost related to the steps involved in ERP lifecycle are shifted to cloud ERP provider.

# 5 Framework

This chapter represents the framework that will help to answer the main question in this research paper:

What are ERP services that can be outsourced over the cloud?

Later on it will help in answer two sub-questions of this research as well:

What ERP data can be kept on premise and what can be moved to the cloud?
How safe is cloud ERP compared to on-premises ERP?

In order to build a proper framework for manufacturing cloud ERP services that can be outsourced over the cloud, it will be wise to list all ERP modules that can contain possible outsourced services. These services can be extracted from the modules and functionalities that build up an ERP system and other extra applications that are not offered by the ERP provider. In traditional ERP system we can find these following modules, Erptips (2013):

- *Financial Accounting (FI)*

- *Financial Supply Chain Management (FSCM)*

- *Controlling (CO)*

- *Materials Management (MM)*

- *Sales and Distribution (SD)*

- *Logistics Execution (LE)*

- *Production Planning (PP)*

- *Quality Management (QM)*

- *Plant Maintenance (PM)*

- *Project System (PS)*

- *Human Resources (HR)*

For small and midsized business manufacturing companies the ERP provider have different ERP product than that they offer to large companies. For example, SAP offers the ERP system called SAP Business All-in-One solution which they claim that it helps to drive growth, build operational excellence and optimizes financial performance and outperform the competition, SAP (2011).

Depending on the company´s business, its suppliers, its partners and its clients; each company will have its own customized ERP system.

The framework will be focused on cloud ERP which is meant to be used by midsized or small manufacturing companies.

Väänänen (2013) understood that midsized or small business companies' growth is enhanced by being able to coordinate information in one system from materials management, transportation, production, finance, human resources, sales, marketing, until the end user. He named that system to be an ERP which can act as an organization wide control centre. ERP will collect information and reports from different divisions and make them available to other departments. With the help of the cloud, the information is updated by the proper users in real-time and it can be accessible at any time to anyone who has an access to the control center.  Väänänen (2013) and von Stengel (2013) agreed that not all midsized or small business companies need the complete range of functionality available in the traditional ERP suite. Each ERP suite usually contains modular format, allowing customers to implement only the modules they need, and they can add more lately if required when they grow in business. Von Stengel (2013) explained that Oracle cloud ERP parallel with ERP on-premises provides a wide range of industry specific modules.

The understanding from Väänänen (2013) and Stengel (2013) is that cloud ERP has same modules as on-premises ERP modules as it was mentioned in section 3.3.1.

The framework is built based on three steps. First step consists of gathering data from different sources. The data consists of text documents, PDF files, text files. The source of data gathering is shown in details in chapter six.

Second step consist of transforming all data to text files.

The fourth step is to upload text files to RapidMiner and extract hidden knowledge using text mining technique. (Chapter seven)

The fifth step consists of data analysis, findings and discussions (chapter eight)

The last step produces the conclusion of this research with suggestions for further research. (Chapter nine)

When developing framework each step is linked to the literature review of this paper. The framework is described in figure 5-1.
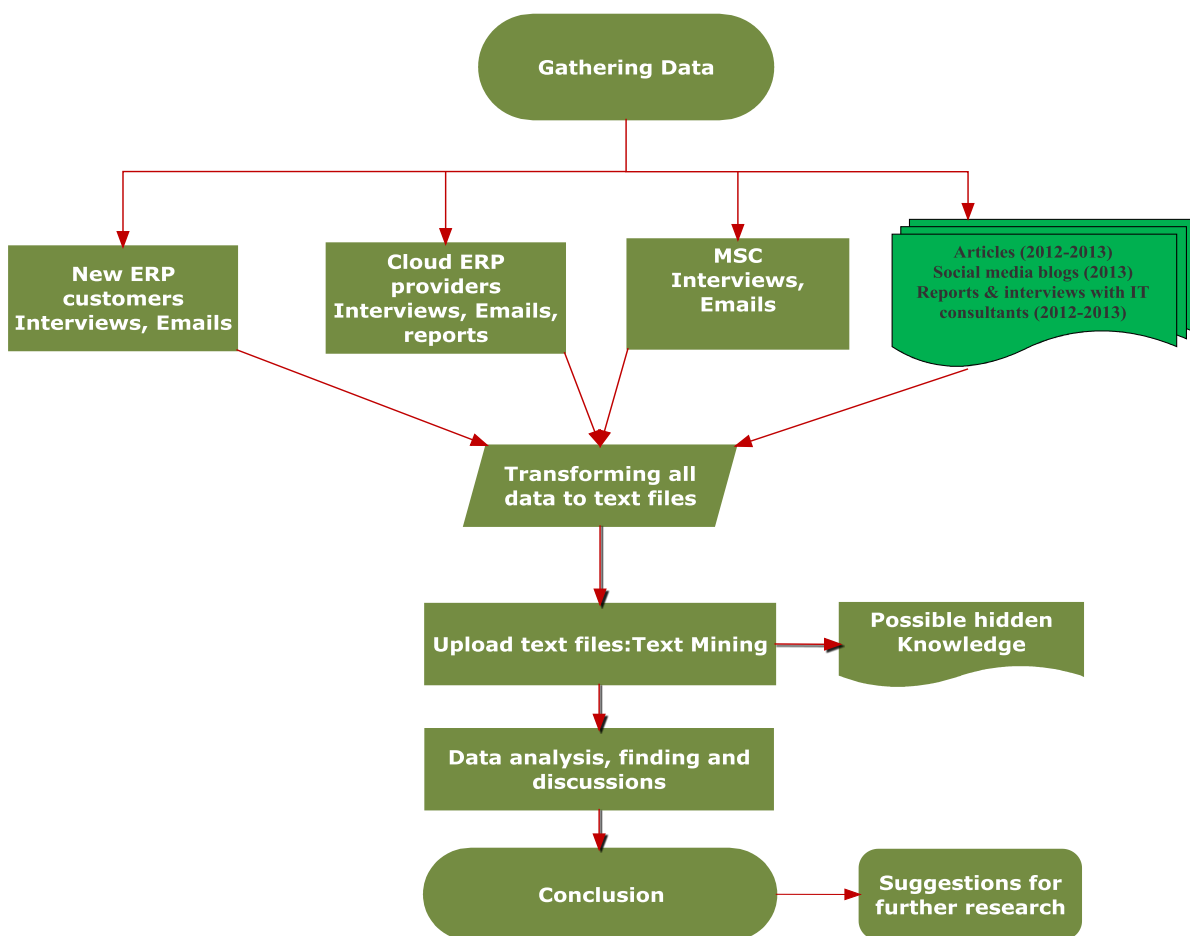


*Figure 5-1. Empirical study framework*

# 6 Data gathering

This chapter contains the source of data that will be used to answer the main research question and the two sub-questions of this thesis. The chapter six is developed into six sub-sections; the first four sub-chapters are presented according to the source of data as follow:

1. Articles, Social media blogs, Reports & interviews with IT consultants

2. Midsized and small business companies interviews (manufacturing field)

3. Cloud ERP providers interviews

4. ERP customers interviews

The fifth sub-chapter contains the hidden patterns from main three categories: companies, consultants and cloud ERP provider. The last sub-chapter summarizes this chapter content and opens the door to the finding and discussions of this thesis.

## 6.1 Articles, social media and IT consultant interviews

Due to the fast change that occurs in the information technology, all the articles, social media blogs and IT consultant reports that are used in this paper are not older than two years. This will make the research reliable and accurate.

 "*According to Angela Eager, research director for enterprise software and application services at TechMarketView, the SaaS market appears to be in rude health. Analyst firm Gartner reckons spending on SaaS will hit $22.1bn in 2015, up from $14.5bn in 2012. Yet SaaS vendors aren't making money*". (Wolpe, 2013)

In my opinion this prediction is far away from reality due to the nowadays economic situation, I would say that, using rule of the thumb, spending on SaaS will remain stable or slightly rise to $16bn in 2015 for the reason that IT software prices declining all the time, that is why Wolpe (2013), in same article, was unsure about if SaaS is going to break into ERP in a serious way. Additionally, Garrehy (2013) announced that:

*"There are a number of ERP systems developed 20 and 30 years ago that are still effectively running today. In addition, there are ERP vendors that are continuing to profitably reap software maintenance fees from these systems, keeping a small support development crew to maintain these systems, at least for a few more years."*

Consequently, the traditional outsourced services here are: maintenance and support of on-premises ERP. In other hand, Garrehy (2013) point out that:

*"…the adoption rate for cloud ERP solutions increases year by year and while new system buys are predominantly falling to cloud ERP vendors, the replacement of on-premise ERP has not yet reached the tipping point and will not do so for several years."*

The cloud solutions mentioned by Garrehy (2013) refer to cloud ERP outsourcing services. One important point addressed by Garrehy (2013) is that on-premises skills will leave to better workplace or retire announcing that within ten years, the majority of ERP investments will be in the cloud. Consequently, all services that can be outsourced with the traditional ERP will be outsourced over the cloud, this has been confirmed by Theberge (2013) a cloud broker who helps clients to navigate cloud ERP options.

The idea that attracts my attention is the statement of Wessels (2012):

*"An outsourced ERP solution should always include as a first step a governance model, which clearly defines touch points between the customer and the outsource provider".*

This statement can be linked to the 4.3.3 as one way of establishing trust between customer and the outsource provider when each one knows his or her responsibilities and limits. This has to be established before starting the implementation of the ERP system over the cloud.

In the cloud or in-house implementation adopting an ERP system is a crucial step. Graham (2013) embraced the need of change, to avoid business stagnation, and quoted:

*"If you always do what you've always done, you'll always get what you've always had".*

This is true, Graham added that the major obstacle in ERP implementations is internal sabotage referring to resistance of some employees of using new system, which in my opinion will remain a problem that will arise whenever the company wants to acquire new technology or new ERP system. Bartoldson (2013) answered Graham (2013) by stressing on: *"the need of executive leadership to educate and inform ERP users about the importance of ERP"*. In other hand

Lehikoinen (2013) insisted that companies need to understand their business then think about what ERP can do to enhance their business. He agreed with Dalela (2013) who suggested that executive managers should know what they are looking for in the ERP implementations. By doing so, I believe that executive managers will have a clear idea about how ERP will improve their business activities and find out what ERP services to outsource over the cloud. Lehikoinen (2013) sees that outsourcing data center is one important aspect when dealing with cloud ERP, he added that: "*companies should know where their data is stored and make sure it will be available 24/7 and recovered if any disaster occur in term of data safety; this confirms data safety in section 4.2.7 to be sensible issue over the cloud*".

Based on interview held with Wessman (2013), he insisted that data recovery is an important aspect to take in consideration when thinking about outsourcing cloud ERP services. He gave an example about SAP ERP explaining that the data lost is the worst nightmare of SAP administrator. He added that SAP recovery process takes significant time and planning, adding to it the burden of the difficulties of testing it. When he was asked how to prevent the lost of data, he simply answered that: " *there are several solutions to overcome such data lost: SteelEye Protection Suite cloud edition for SAP cloud ERP that allows SAP administrator to quickly and easily resume operations in the event of a disaster with little to no data loss. SteelEye Protection Suite cloud edition is an integrated application and data protection which is scalable, flexible, highly reliable and extremely cost-effective*".

For third party application recovery on-top of ERP, Wessman (2013) affirmed with certainty that: "*SteelEye Protection Suite provides the user of ERP to protect SAP and it offers also protection to third party applications based on data replication ( in term of cascading failover configuration)*", as it shows in figure 6-1. So, here we can conclude that data recovery can be outsourced using for example a trustful third party.
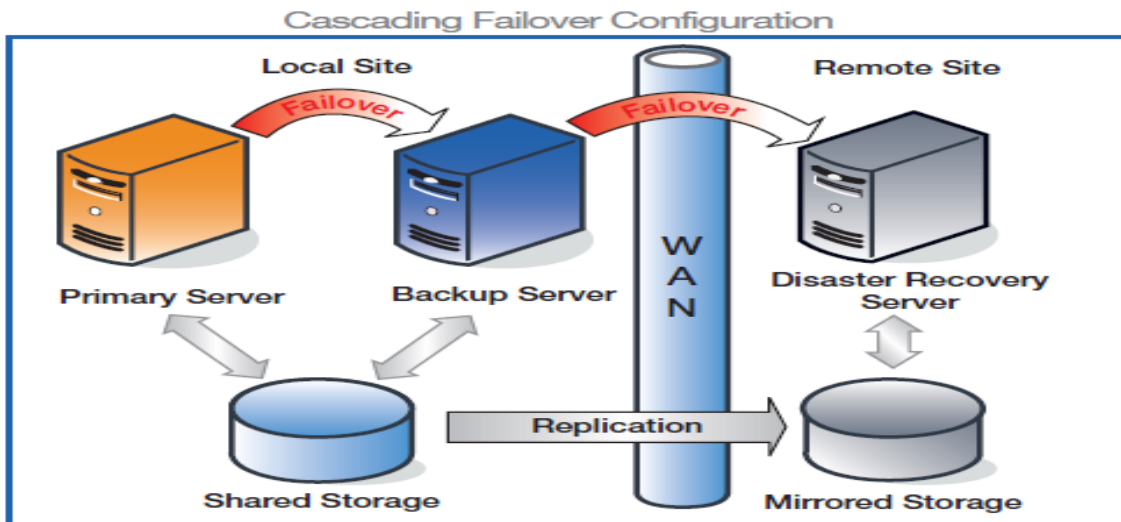
*Figure 6-1. Cascading failover configuration: data recovery over the cloud.* Source: SIOS (2013, 2)

Laiho (2013) explained that although manufacturing companies outsources all their cloud ERP modules activities, they have to know how to manage them and use them to boost their business activities. He described cloud ERP system or traditional ERP as a car, when a person buys (on-premises ERP) or rents (cloud ERP) a car either he or she drives it or hires a driver; still the person has to know how to use it to arrive to preferable destination.

The interview with ERP consultants Laiho (2013) , Lehikoinen (2013)  , Vanhanen (2013), Halonen (2013), Juhela (2013), Raitaniemi (2013), Väänänen (2013), Butt(2013)   , Dalela (2013), Sassi (2013), Lyytikäinen (2013)  and Muilu (2013) results in that all the precedent consultants have the same opinion that:

"*Small and midsized manufacturing companies should recognize their core businesses, they have to know what ERP on-premises or cloud ERP should do to improve their business processing activities. By doing so, it will be easy to identify what services to outsource over the cloud*".

 They all agree to outsource HR as first step or phase to understand the cloud ERP outsourcing services. Most of all ERP consultants that have been interviewed during this research see that cloud ERP service outsourcing can include:

"*Added developed applications on top of ERP, upgrading and maintaining ERP system, which is included the cloud ERP package*".

They see also that consulting services are a source of external knowledge that can often be outsourced in term of helping small and midsized manufacturing companies to optimize, update and configure their cloud ERP operation modules.

Woodie (2013) informed based on recent study by Panorama Consulting Solutions that the market share of cloud and SaaS based ERP systems grew from 6 percent in 2011 to 18 percent in 2012. IT jungle (2013) in return announced that cloud and SaaS based ERP systems:

"…*Spells trouble for traditional, tier-one ERP providers. That threefold increase is huge and it spells trouble for the traditional tier 1 ERP vendors*".

IT jungle (2013) in other hand stressed that:

"…*cloud ERP systems increasingly are becoming a very attractive choice for more companies and the dinosaurs of tier 1 ERP are soon to be outmaneuvered and outperformed by the more integrated cloud solutions*".

Rose (2013) who has over 20 years of experience providing management consulting and IT operations service, added that:

"*Manufacturing ERP software is all about a "solution in a box," where the box is replaced by the cloud. On-premises ERP solutions quickly are becoming a thing of the past. For any company looking to upgrade its ERP system, a cloud solution must be part of the evaluation*".

So this announcement from Rose (2013) made it clear that cloud solutions must be taken in consideration whenever a company will add any application or upgrade the existing ERP. Since IT related activities is not the core business of midsized and small business companies in manufacturing field, I believe they will be the first to pioneer and benefit from the cloud ERP outsourcing solutions over the cloud such as HR.

Wessels (2012) understood that ERP operations are not core strength for the majority of organizations especially manufacturing companies and the ERP environments can be enormously complex to run. He added that outsourcing of ERP operations services enables organizations to leverage or gain access to highly trained specialists with critical skills to modify the ERP applications to meet their businesses conditions.

Bellinson (2013) elaborated that: "cloud *ERP service outsourcing can be remotely upgrading and maintaining the ERP system*". Feldman (2013) agreed with (Bellinson, 2013) in such a way that

cloud ERP customer will make use of the economies of scale over the cloud and will reduce the local hardware requirements and longer upgrade cycles. Hence, here both Bellinson (2013) and Feldman (2013) suggest outsourcing hardware and upgrading cycles of cloud ERP over the cloud as one way of overcoming the burden of maintaining an ERP system.

Whenever a customer purchases an ERP system whether it is on cloud or in-house there will be a need for configuration and customization of the system. Henschen (2103) informed based on statement of CIO of Canadian heavy equipment supplier Toromont Industries, that:

 "*Configuration promises to be easier than customization because it's done through vendor-supplied menus and wizards that help companies set up applications to meet their specific needs*"

Henschen (2103) stressed that custom functionality is required if it will offer a competitive advantage to the company. Custom functionality here includes building added application from third party in order to meet special needs of business requirements. If the ERP is built in the cloud the services required for compatibilities with added application are to be outsourced usually to the firm or the third party who built the added applications.

Before outsourcing any ERP services over the cloud companies must use several consultancy services. Graham, Levy and Ferguson (2013) were asked how to become an ERP functional consultant, they answered based on Graham (2013) suggestions such as ERP consultant has to decide first, what area of ERP that attracts his or her interests, secondly he or she is recommended to get a minimum of five years experience in that area of interest. This shows how ERP consultants can be highly valuable in implementing ERP system over the cloud.  Graham (2013) insisted that:

"*ERP is not about software - it is about knowing how to solve business problems and, for that, you need comprehensive business experience, and theoretical knowledge alone is nowhere near enough. It is a long journey but very worthwhile. Take shortcuts and you will only be taking a shortcut to being a second rate consultant*".

According to this advice from Graham (2013), companies ought to find the first class consultants with comprehensive business experience combined with theoretical knowledge in field of both cloud ERP and on-premises ERP.

In dealing with existing ERP on-premises and migrating to cloud under cloud ERP, Barker (2013) predicted and responded to the combination of two tiers (ERP on-premises and cloud ERP) by suggesting a hybrid ERP approach. He added that:

"On-site *ERP should handle the manufacturing things that the cloud doesn't do well, and let the cloud ERP handle modules or processes like HR, or Finance that are more vanilla, and have proven advantage. Also, you should consider letting new acquisitions, overseas holdings, or un-integrated business units create their own cloud ERP instance"*.

I agree with Baker that HR can be a first step to take in outsourcing cloud ERP services over the cloud, as HR activities are not the core business of most midsized or small business companies operating in manufacturing field. For this reason most of companies have already outsourced their HR activities to specialized HR companies.

## 6.2 Midsized and small business companies

In an interview with (Jyrälä, 2013) a business intelligence specialist about cloud ERP services that can be outsourced over the cloud, he described that:

"*Cloud ERP to be immature, managers need to understand what services to outsource over the cloud by starting with services they have outsourced already such as back-office services."*

He pointed out that: "*when talking about cloud ERP system it can be seen as a traditional ERP that has location or resides in the cloud. The most important offering by ERP is the automation services such as payroll, organization planning, manufacturing, sales, marketing, finance and HR*". Except for manufacturing activities, most of other offer activities that can be outsourced over the cloud. Jyrälä added that: "*the security is the major obstacle that prevents companies from using ERP over the cloud. The reason behind it is securing data over the cloud is proven to be a complicated task*". He pointed out that: "*when handing data over the cloud it will involve third party or fourth party then responsibility will be hard to consign when unwanted disaster happens"*.

Jyrälä (2013) and Leminen (2013) stressed that: "*data and customers´ information have to be protected and owned only by the companies who created that data. Manufacturing and business processing secrets are the competition drivers of their companies, managers will not take risk and*

*move all sensitive data into the cloud*". Cloud ERP used by small and midsized manufacturing companies is less vulnerable compared to large corporation. Männikkö (2013), a cloud solution provider, elaborated that: *"hackers are honored to attack large corporations; for the reason that small and midsized companies are not well known worldwide. The cloud expert added that there are many well known cloud providers that provide strong security for data centers, such providers are: Tieto, Cisco, Logica etc"*.

Both Jyrälä (2013) and Leminen (2013) see that cloud ERP will not be a suitable solution for their companies due to their business area that is related to government activities. This was confirmed in an interview with (Männikkö, 2013) who said that:

*"Manufacturing companies that operate under government businesses will not adapt cloud ERP. Adding that private small and midsized manufacturing companies within Finland area are willing to adopt cloud ERP."*

Adopting cloud ERP is a possible choice in the future, when the cloud becomes more mature and rules are clearly defined, in sense of underlining responsibilities of everyone who is involved in the business activities (Männikkö, Jyrälä and Leminen, 2013). When both Jyrälä (2013) and Leminen (2013) were asked about cloud ERP services that can be outsourced over the cloud in the future, they answered:

*"First there has to be a trustful partner that can protect not only our secrets but his or her secrets as well."*

Leminen (2013) believed in possibility of outsourcing logistics services to their partner (Finnish defense army) who has own whole supply chain; in order to make sure that information will not flow outside to unwanted organization. Jyrälä (2013) saw that logistics and HR are possible services to outsource over the cloud to trustful partner. Hence, here we can see that partnership is an important concept when companies will think about outsourcing their cloud ERP services over the cloud.

## 6.3   Cloud ERP providers

This sub-chapter goal is to identify what services ERP providers can offer to their customers (small and midsized manufacturing companies) over the cloud. It will help to determine what services that can be outsourced over the cloud and reveal the implementation cost of on-premises ERP. The sub-chapter contains the information gathered based on interview with two cloud ERP and ERP on-premises providers. The third source of information was collected from ERP provider´s website. This sub-chapter deals essentially with cloud ERP services outsourcing from ERP provider point of view.

The selection of these three ERP providers are based on two leading ERP providers which will give a good idea or better understanding of  the global philosophy of cloud ERP services outsourcing. The third provider which is targeting or serving mainly Nordic countries and serves mostly (small and midsized companies from different industries will give another clear idea about cloud ERP.

### 6.3.1   SAP cloud ERP provider

In an interview with Mäkelä (2013), SAP senior solution advisor, regarding cloud ERP outsourcing services and traditional ERP, he showed the prices offer online of on-premises ERP for small and midsize companies. The price can be easily estimated based on online tool which is provided by SAP. The tool is called "SAP Solution Configurator".
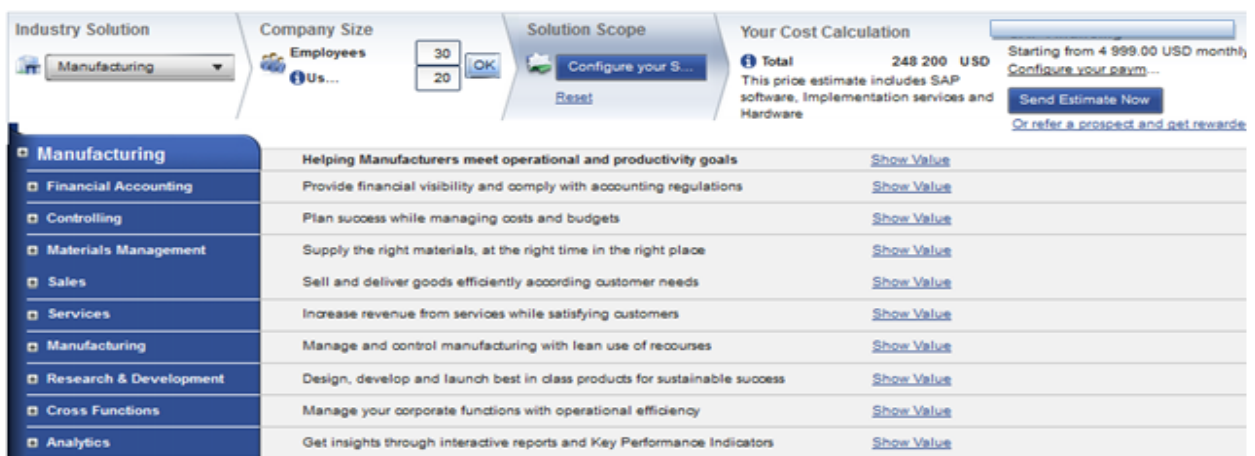


*Figure 6-2 . The price of SAP ERP on-premises system.* Source: SAP (2013)

The cost of on-premises ERP for small and midsize companies with 20 users is 248200 USD or 4999 USD as monthly fee that has to be paid for almost 50 months, (figure 6-2); the package offer includes SAP software, implementation services and hardware. From table 1 in section 3.3.2 based on Boyum IT (2013) prices, we have for 20 users the price of on-premises is 50000 Euros without implementation costs. Here we have the total price including implementation for 20 users for on-premises ERP is 248200 USD = 0, 7641*248200 =189649, 62 €, therefore the price of implementation according to this example is 189649, 62 € - 50000€ = 139649, 62€.

1USD = 0, 7641€ (in average), Kauppalehti (2013)

Consequently: (139649, 62/ 189649, 62) = 0,736 which is 73% of costs of  ERP on-premises is consumed by implementation of the system.

It was confirmed in an interview with Nyberg (2013) (who has long experience in implementing various ERP systems for several companies) that implementation absorbs considerable human resources and time due to the testing configuration, troubleshooting and customization of the ERP package to fit the needs of a particular firm. For this reason SAP has many partners or consultants who can implement ERP package with cheaper prices, here we can see that implementation services of ERP can be outsourced either on-premises or over the cloud.

Nyberg (2013) informed that IT people can customize any ERP system whether is it an ERP on-premises or cloud ERP. The price of customizations varies according to the solutions they ought to build, but in worse cases it might cause the budget overrun: this statement confirms what was shown in figure 3-3 section 3.2 Nyberg (2013) added that they are ready made modules by ERP provider if they fit the company´s business activities they can be used in short time, then the company will not pay any additional costs since the company will not need any major customizations. In this case the implementation might not be expensive, the customer is highly recommended to compare and negotiate the prices before hand.

Mäkelä (2013) explained that there are no difference between cloud ERP and on-premises ERP both will serve the customers need once these needs are identified. He added that cloud ERP is new product it is most suitable for small and midsized companies, but the major issue with cloud ERP is data security such as transaction data, data warehouse which can be handled by third party. Mäkelä

(2013) added that *numerous small and midsized companies are skeptical about cloud ERP, but there are signs that cloud services will grow in the upcoming years*.

Regarding the cloud ERP Mäkelä (2013) informed that *SAP software may often require extensive computing resources for maintaining, upgrading and configuring the ERP system, these resources might not be available in the house*. So to overcome these burdens, Mäkelä (2013) suggested using cloud ERP

According to Mäkelä (2013), cloud ERP is an affordable ERP package, easy to implement, it offers complete business management solutions. The package is designed especially for small and midsize companies. It is meant to help and ensure company growth by increasing profitability and control through an automated business processes for any manufacturing firm. Midsize companies may have subsidiaries in one or more countries. It is suitable to make great use of Cloud ERP for midsize companies that have an existing ERP on-premise. The company will easily use Cloud ERP in new subsidiaries since its implementation is less time consuming than SAP ERP that has been implemented in the parent company. The subsidiaries need ERP systems to deal with standards adoption and the ERP in the parent company will support the whole company´s complex business activities.

This explains the two tiers ERP: on-premises ERP in headquarter and cloud ERP on-demand for the subsidiaries. Nevertheless, some companies may still keep using only on-premises ERP (e.g. Millog Oy, Altia Oyj). Mäkelä (2013) pointed out that Cloud ERP is a cloud based ERP used usually in term of monthly fees; it contains a comprehensive user friendly functionally. It offers an advantage to be well integrated with the headquarter SAP ERP system answering both the subsidiaries' and the parent company´s functional requirements. Managers using cloud ERP can easily customize and configure the ERP package by purchasing add-ons online from SAP partners. Add-ons can be dashboard software or other suitable smart applications at very cheap prices. Here Mäkelä added that service outsourcing for manufacturing companies through cloud ERP can be done through SAP partners who offer suitable applications that can enhance the companies' businesses activities.  For instance, Bilot (2013) a SAP partner sees itself to be:

"…*SAP partner who is a customer oriented and innovative IT services company aiming to improve the usability of business applications, to improve business processes and to improve decision-making ability with better information*.

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*Bilot provides SAP Business Objects Dashboards as solutions on top of ERP, creating business value in three dimensions:*

- *Enabling better usability for business users*

- *Bring better information to decision makers*

- *Making  critical business processes run better"*

Similarly, in an interview with Raitaniemi (2013) Acando´s mobile solution director showed a demonstration of dashboard that is meant for managers. The dashboard was built with user friendly interface that can be easily integrated with SAP ERP. Raitaniemi (2013) explained that their dashboard will enable managers to take actions related to any critical business activities before it will occur.

SAP cloud ERP offers mobility solution and as well as integral business intelligence. Most of SAP partners talk about SAP HANA an in-memory data platform that is deployable as an on-premise appliance, or in the cloud.  It is a revolutionary platform that is best suited for performing real-time analytics, and developing and deploying real-time applications.SAP (2013)

According to Borchert (2013) (who has experience in the Information Management Industry, Business Intelligence and Data Warehousing) with the help of SAP HANA platform, in-memory database technology companies will gain scale, speed and productivity. Cloud ERP using SAP HANA will enable firms to gain faster insight into business operations and make decisions in real time based on accurate, up to date business data. Managers can therefore evaluate and catch opportunities and manage risks faster, Borchert (2013).

 Mäkelä (2012) noticed that: "*most of small business companies cannot afford to have own warehouse in different location*".  Thus, he suggested "*outsourcing also warehousing activities over the cloud ERP*". It can be done by sharing logistics modules between material supplier and retailer. In other word the small business company will have zero inventories.

Mäkelä (2013) referred to cloud ERP service outsourcing by explaining that: "*cloud ERP can be procured and implemented by SAP partners to fit the manufacturing needs of any small and midsized company. He added that logistics, payroll and accounting can be outsourced to third party*". For the material management Mäkelä (2013) used the notion "economies of scale" and suggest "*outsourcing material procurement to third party in order to gain price bargaining power*

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*through a specific giant partner of material supplier*". Based on Mäkelä´s (2013) suggestion it will be good idea to look at SAP cloud ERP business processes in order to understand what services to outsource over the cloud.
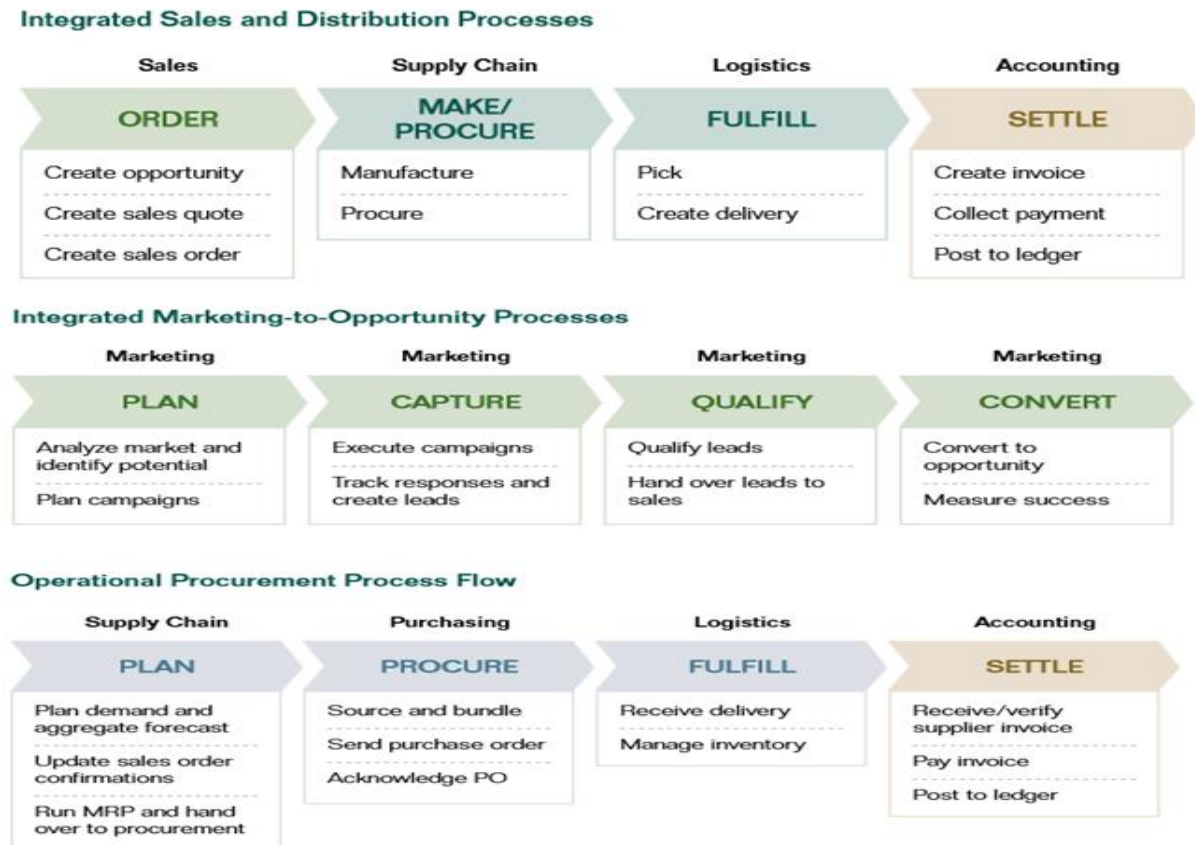


*Figure 6-3. Integrated Sales and Distribution Processes and integrated Marketing-to-Opportunity Processes as well as Operational Procurement Process Flow.* Source: SAP (2013)


By looking to cloud ERP business processes in the figure 6-3, it gives a clear idea about: integrated sales and distribution processes and integrated marketing-to-opportunity processes as well as operational procurement process flow. Therefore it appears that marketing can be another service that can be outsourced over the cloud as well as logistics, accounting and purchasing services.

The only services that cannot be outsourced over the cloud is know-how, such as how to make own products that embrace the company´s main core business. It can be plan of making specific machine or simply special recipe for making special type of food.

Social media is new platform that various companies use to interact with their customers. Based on van Breukelen (2013) (Solutions Adviser for SAP cloud ERP) presentation: 1.3 trillion USD annual

value can be unlocked using social technologies. He presented research which show that customers make their buying decisions before store has increased from 20% in 2001 to 80% in 2011 as it shows in Figure 6-4, this due to the use of different social media comment on such products or brands.

Van Breukelen (2013) explained that it is important to use social media to reach the customers' voice; he said that UK customers see social media to be new forum for recommendation and complaints. Companies have to take seriously complaints associated to their products and their competitors´ products to develop either their services or their products.

To make good use of social media, it will be suitable to outsource it to specialized third party in marketing. Consequently, the cloud ERP module that contains marketing can therefore be outsourced.
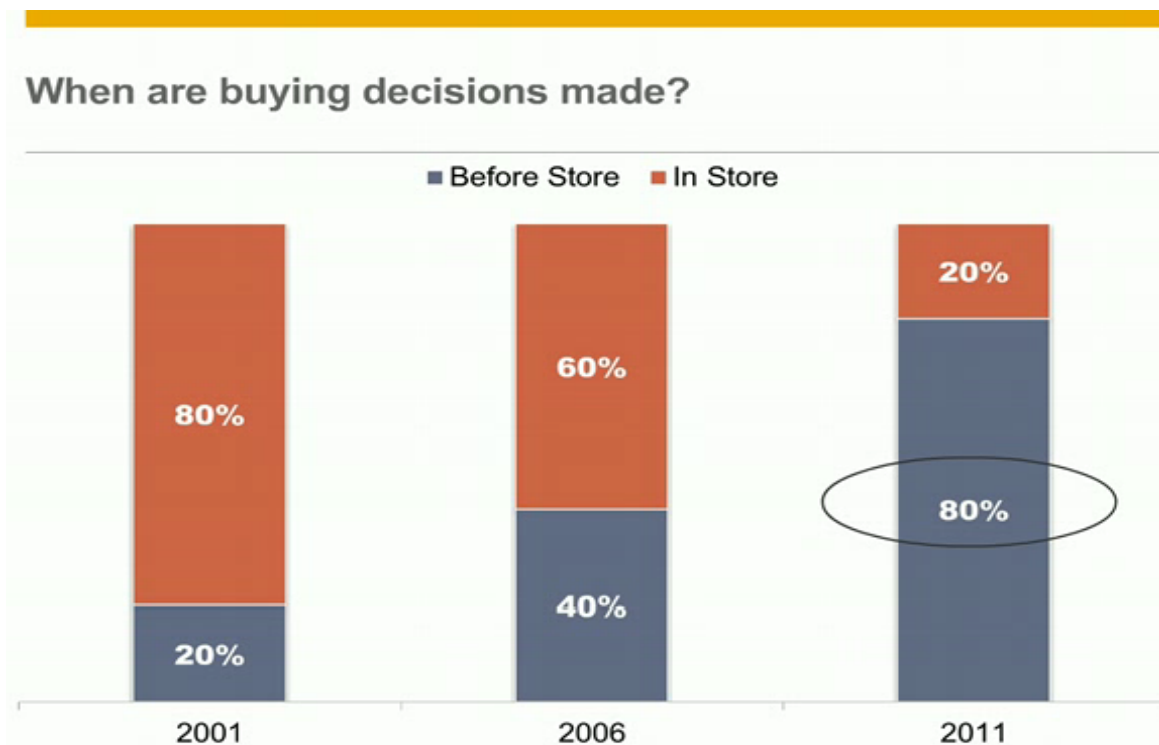


*Figure 6-4. Increasing in buying decisions before visiting store* Source: van Breukelen (2013)

### 6.3.2 Oracle cloud ERP

Oracle (Väänänen, 2013) offers on-premises and cloud ERP systems for manufacturing firms either they are small business, midsized firms or large companies. Väänänen (2013), "*Oracle offers cloud ERP as predictable pricing subscription based on SaaS deployment model. Oracle cloud ERP is more comprehensive, flexible, modern, reliable and secure; it runs faster with less upfront costs and investment risk in turbulent economics compared to the on-premises ERP. Small and midsized manufacturing companies can focus on innovation instead of maintaining the ERP system; they will be able to reduce IT costs and increase their agility or simply to go ahead of the market and gain competitive advantage in their core business*".

Oracle (2013) announced that their company:

"*...offers a broad portfolio of software and hardware products and services to enable public, private, and hybrid clouds, enabling customers to choose the right approach for them*".

According to Oracle (2013), the benefits of Oracle cloud ERP are:

- *"Get up and running faster with less upfront costs and investment risk*

- *Ensure consistent processes across all your locations around the world*

- *Make more informed and data-driven business decisions*

- *Boost user productivity and increase user adoption*

- *Eliminate the need for expensive customizations"*

Since this paper focuses on small business and midsized companies, in an interview with (Nygren, 2013) *"the private cloud is most safe step towards cloud for small business and midsized companies, adding that companies have just to find a trustful partner if they decide to use other partners than Oracle partners"*.

According TATA STEEL (2013):

"*The Oracle ERP cloud Service is an integrated suite that transforms companies´ back office into a collaborative, efficient, and intuitive hub. A rich set of financial and operational capabilities is married with the latest in social, mobile, and analytic technologies*".

This was discussed with Niilola (2013) who suggested that: *"companies can outsource several back office business activities such as payroll and accounting. He added that Oracle offers services such as social recruiting automation with Oracle Taleo Social Sourcing Cloud Service"*; he showed that in Oracle website:

*"Cloud Service is a referral recruiting tool integrated with leading social networks such as Facebook, LinkedIn, and Twitter"*.

Here again we can see that HR and social media activities can be outsourced even to the cloud ERP provider. This will help to fast circulate information about talented skills from social media right in front of the managers.

When a company has a cloud ERP it will need to store it in the cloud. The storage may need to be expanded as the manufacturing companies will grow. Oracle offers storage as an outsourced service that companies will use as they will grow. The Oracle (2013) storage services over the cloud offer these benefits:

- *"There is no software and hardware dependencies that users need to worry about.*

- *Businesses pay for just the storage used.*

- *Content can be accessed from anywhere, at anytime, and from any device.*

- *Single point of control for all business data and processes.*

- *Scale up or down to meet any deployment need."*

Figure 6-5 gives more clear idea about Oracle´s storage scalability, flexibility, accessibility and deployment.
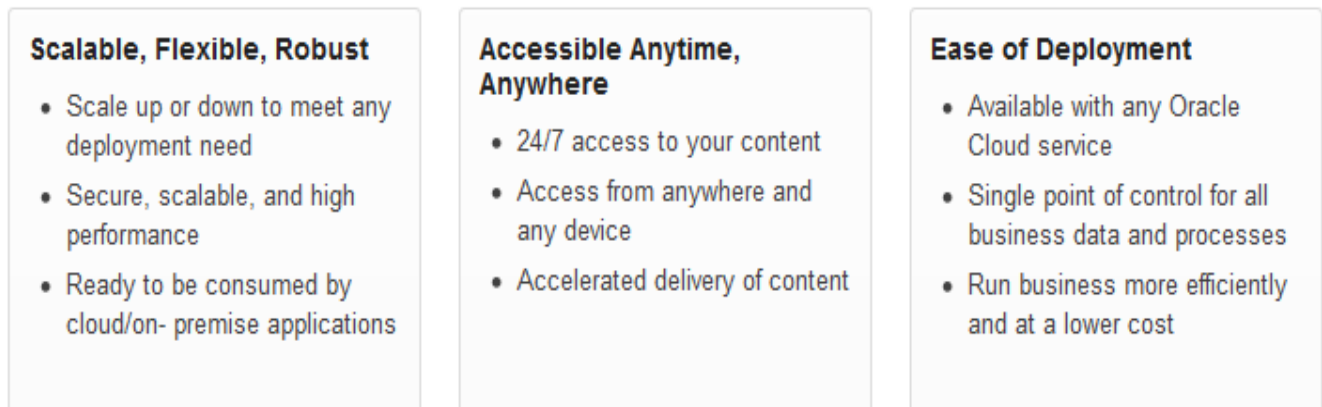
*Figure 6-5. Benefits of Oracle storage services over the cloud*. Source: Oracle (2013)

Overall, data security, as it was mentioned in sections 1.3 and 4.3.1 remain an important aspect to take in consideration which was strongly confirmed by Brenna and Männistö (2013) expert in data security at Oracle ERP provider. Brenna (2013) introduced numerous giant companies from different industries that have been under hack attacks or espionage such as: Sony Corporation, Twitter, Facebook, Apple, New York Times, Norwegian high-tech Power supply and Norwegian Oil & Gas industry, all these attacks have happened recently in February 2013. The Oracle´s data security expert presented so called:

"*Oracle Software Security Assurance to be set of industry leading standards, technologies, and practices aimed at:*

- *Fostering security innovations*

- *Reducing the incidence of security weaknesses in Oracle products*

- *Reducing the impact of security weaknesses in released products on customers*

- *Security built in, not bolted on*

- *Equal treatment of all customers*

- *Transparent security policies*

- *Predictable security patching schedule*

- *Formal security evaluations". (Brenna, 2013)*

So the security services can be outsourced to the cloud ERP provider in this case to Oracle using: "*Oracle Software Security Assurance*"

Männistö (2013) explained during the Oracle Database Security Roundtable that most security gaps are created internally. He explained that the companies´ computer users are using these machines for illegal activities or visiting unwanted websites. Similarly, Nyberg (2013) explained that: *"hackers can be malignant by persuading users to give up their password and user name. Usually this is done by creating disguising webpage that resembles exactly to the companies´ official webpage and send emails to users guiding them to reset their passwords"*. Hence here hackers have to get the right email of the users.  Companies' e-mails are found typically in their webpage in form of:  first name. family name (a) company.com.

Nevertheless*,* during my participation in Oracle Security Innovation Seminar Database Security Roundtable (2013), one of Oracle customers pointed out that: "*there is a gap in the latest patch of January 2013 of Oracle Software Security Assurance*". The customer suggested leaving out the latest patch and offered a private solution to the other customers who attended the seminar.  So, here we see that the cloud ERP provider cannot offer full secure services. This issue confirms Polyakov et al (2011) statement in section 4.3.1

"*The security in ERP field is wide and there are some areas still not well covered*".

 So it will be convenient to hire a consultant to find the right third party that offers a high quality security.

Overall security is an important issue that midsized or small manufacturing companies have to take in consideration when thinking about outsourcing cloud ERP services.

### 6.3.3   Visma cloud ERP

Similarly to SAP and Oracle, Visma offers almost same services in terms of cloud ERP. Visma launched Visma.net due to the high demand of end users who want to work from any mobile device connected to the net anywhere in term of availability. He concluded that the cloud is the only solution that can answer such demand, (Jensen, 2013)

Visma.net will help companies to boost their profits in four ways (Visma 2013):

*"1. No large investments upfront*

*All Visma.net services come fully integrated and ready to go. No costly and time consuming installations and integrations needed.*

*2. Flexibility to adjust to your demands*

*As a Visma.net subscriber you only pay for the services you desire and the amount of users you require.*

*Add services and users as your business grows – or scale down to adjust to market fluctuations. Say goodbye to expensive solutions that no longer meet your needs.*

*3. Reduce your IT costs*

*Servers, back-up routines and installations are managed safely by us in the cloud. This frees up resources currently tied up in IT management.*

*4. Faster time to value.*

*From the moment you have placed your order to your services are up and running we are talking minutes"*.

Visma (2013) understood that:

*"Medium-sized businesses have their own needs when it comes to efficiency solutions. They must correspond to the size and scale of operations, and must not be too costly to be efficient.*

*Visma´s solutions for the medium-sized market include software for*

- *Finance*
- *Logistics*
- *Payroll*
- *Accounting*
- *HR administration*
- *CRM*
- *electronic commerce*

*Visma´s ERP outsourcing services cover areas such as finance, accounting and payroll. In addition, Visma offer solutions within recruiting services, debt collection, purchasing, and training."*

Visma (2013) combines outsourcing of business processes with suitable software solutions. Visma (2013) offers access to their business process outsourcing experts and consultants as well as services that technology cannot deliver on its own. Visma´s customers therefore can gain opportunity to scale the use of services in a flexible way according to their needs which vary with the market change.

Visma (2013) offers another cloud ERP called Visma Severa solution package as SaaS which is available without installation. The company provides hosting, updates and backups of the ERP over the cloud including security service without the disruptions associated with on-premises ERP.

## 6.4  New ERP customers

Most of new manufacturing customers' of small and midsized businesses, (Bowtec OY, Rinotop Oy, Rauta Oy) are reluctant of whether to use ERP on-premises or cloud ERP. The reason behind it is they do not know about the product of ERP. They are using excel tools and few other software that answers the needs of the company regarding accounting, inventory management etc. The transportation of goods and other materials are outsourced in traditional way to specific partners.

There are several companies that have already implemented an ERP system and are satisfied of the services they get from their ERP providers.  Most of ERP providers informed during the interview that for small and midsized companies, it is easy to upgrade and customize in short time compared to the ERP that is meant for large corporations.

However, small and midsized manufacturing companies will adapt cloud ERP system only if the ERP provider will stop offering ERP system on-premises for new ERP customers. The task is not that easy at it seems, based on an interview with Tuominen (2013) who explained that generally, most of companies have different ERP systems. Outsourcing services to a partner with different ERP system will require an enormous work of ERP systems integration. Sending and receiving data from a partner who will take care of specific outsourced services will necessitate data

transformation in order that the ERP systems communicate with each other. He clarified that making a purchasing order, delivery order and sending an invoice are already three tasks that will require days of work.

Midsized companies that have already implemented ERP system in the house are willing to use cloud ERP in their subsidiaries. The reason behind it is that implementing a cloud ERP system is easy and fast with a monthly predictable cost.

Most of midsized companies' managers are worried about data security over the cloud. Here I see there is a lot of work to do by consultants and cloud ERP provider to convince the customers of the safety of the cloud under specific conditions. That can be done by launching more seminars and workshops about data security by involving managers from different manufacturing and security industries as well as other managers from other business fields.

## 6.5   Hidden patterns

The objectives of this sub-chapter is to use the gathered data used in sections 6.1, 6.2 and 6.3  to discover hidden patterns among the three target group in section 2.3. For this reason this data is used in form of text files related to cloud ERP and ERP on-premises. These text files are recent, no older than two years; they are issued between 2012 and 2013. The text files are divided into three categories using RapidMiner as tool to reveal the hidden patterns. The three categories are:

1) Companies documents: manufacturing companies that uses ERP on-premises or cloud ERP and new companies that are thinking to acquire new ERP (cloud ERP or on-premise ERP)

2) Consultants documents

3) ERP providers: SAP, Oracle and Visma documents

### 6.5.1   Tool

The tool used to analyze each category´s of text files is RapidMiner based on text mining technique. The text files are collected under one folder named according to each document category: companies, consultants and ERP providers. This will help to use "*process documents from files*" in text processing operator in RapidMiner. The tool offers plenty of operators that deal with text

mining, the following operators are used: tokenize, filter tokens (by length), stem (snowball), transform cases, generate n-grams (characters), filter stopwords (English), numerical to binominal, fp-growth and create association rules. The details of these operators are explained in the appendix 1. The procedure of using text mining in RapidMiner is carried on as follow:

First of all, the gathered data used in sections 6.1, 6.2 and 6.3 is converted to text files. Secondly the text files are inserted in RapidMiner software aiming to seek new hidden patterns.

RapidMiner with the predefined operators (figure 6-6 in the appendix 2) and data transformation operators (figure 6-7 in the appendix 3) has generated plenty of words related to cloud ERP and on-premises ERP services. Only terms with highest support values will be taken in consideration as it shows in red rectangles in the tables 6-1, 6-2 and 6-3 in the appendix 4. Term with highest value will be used to find new patterns. The objective of finding new patterns is extract new knowledge that is related to the services that can be outsourced over the cloud. The results of the hidden patterns are presented in the following section 6.5.2.

## 6.5.2  Results

This section contains the results of hidden patterns generated from each category (companies, consultants and cloud ERP providers). The results are generated using RapidMiner operators that have been introduced in section 6.5.1. Only the results related to ERP services with high support values are selected.  The results are shown in figures 6-8, 6-9 and 6-10 in the appendix 5.

For companies´ category, the highest supported value is 91, 7% with confidence level of 95, and 7% made the table 6-1 in the appendix 4. The results show that these terms are the most mentioned in the companies' category text files. The cloud ERP services or ERP services related terms are: management, service, time and solution as it shows inside red rectangle in table 6-1 in the appendix 4. The full map of other terms can be seen clearly in figure 6-8 in the appendix 5.

From the figure 6-8 in the appendix 5, we can see the full terms related to cloud ERP or traditional ERP services in manufacturing field: time, provider, industries, product, improvement, solution, plan, management, business, companies and process. These term are supported by 91, 7% and 83, 3% with confidence level of 95, 7 % (table 6-2 in the appendix 4). These terms will be used in

chapter seven to extract hidden patterns then suggest services that can be outsourced over cloud ERP in the manufacturing field.

For the consultants' category, the table 6-2 in the appendix 4 shows the service terms that are related to cloud ERP and ERP on-premises. The focus will be addressed only to the terms with high supported value as it shows in the red rectangle in table 6-2 in the appendix 4. These terms are therefore: business, service, management and customer. The other terms with slightly less supported value such as technology are presented in full map in figure 6-9 in the appendix 5.

From the figure 6-9 in the appendix 5, we see the terms that are related to ERP services are: management, system, technology, customer, software, business, cost, provider, services and companies. These terms will be used in chapter seven to extract hidden patterns then suggest services that can be outsourced over cloud ERP in the manufacturing field. The results extracted by RapidMiner from text files that are related to ERP providers' category are shown in table 6-3 in the appendix 4.

For the cloud ERP providers' category, the terms that are related to the cloud ERP with 94, 4% of supports of 100% confidence level (inside red rectangle) are: service, support, process, management and customer. The other terms are presented in full map in figure 6-10 in the appendix 5

From the figure 6-10 in the appendix 5, the other terms that are important and associated to services related to cloud ERP with support above 90% and 100% of confidence level are: system, solution, customer, information, companies, data, product, provider, management, time, application, including, base, process, change, support and requirement. These terms will be used in chapter seven to extract hidden patterns then suggest services that can be outsourced over cloud ERP in the manufacturing field.

## 6.6  Summary

The data gathering from different sources that are related to cloud ERP in this research shows the possibility of outsourcing several services over cloud ERP. HR is the first step that small and midsized manufacturing companies have to take in order to learn about the outsourcing over the cloud. Yet, all consultants that have been interviewed agree that companies should know what ERP can do to improve their businesses.

Cloud ERP is immature; managers need to understand what services to outsource over the cloud by starting with services they have outsourced already such as traditional back-office services.

In other hand consultants and cloud ERP providers see no main differences between Cloud ERP and on-premises ERP in terms of their modules. Having ERP in the cloud will require same skills of using on-premises ERP. When customer chooses to adapt Cloud ERP he or she automatically outsource hardware and upgrading cycles of the ERP system over the cloud.

Adapting a cloud ERP system is proven to be a complex task. The security and data safety is the major obstacle that prevents companies from using ERP over the cloud. There are numerous cloud ERP vendors but customers are highly recommended to use consultant services when choosing to adapt a cloud ERP system.

Nevertheless, small and midsized manufacturing companies might outsource these services: consulting services, HR, logistics, payroll, accounting, marketing, cloud storage, ERP security, server maintenance or other service related back-office activities.

The tool used to analyze the gathered data for this thesis is RapidMiner. The technique used is text mining; all the document files collected from three different categories (companies, consultants and cloud ERP providers) were converted to text files, then inserted to RapidMiner which generated results in figures: 6-8, 6-9 and 6-10 in the appendix 5. These results represent key words of hidden patterns that serve in finding possible services that can be outsourced over the cloud. These key words will be used deeply in the following section of findings analysis and discussions.

# 7 Findings and discussions

This section contains findings and discussions based on the result analysis of RapidMiner from section 6.5.2. The results are the frequent key words of hidden patterns extracted from the figures 6-8, 6-9 and 6-10 that can be found in the appendix 5. The key words are used to build patterns in order to find possible services that can be outsourced over the cloud. It will help to answer the main question of this research paper by suggesting first the services that can be outsourced over the cloud using cloud ERP.

## 7.1 Companies

For cloud ERP in manufacturing field, based on figure 6-8 in the appendix 5, the finding key words related to ERP services with 95, 7% confidence level (table 6-1 appendix 2) are: time, provider, industries, product, improvement, solution, plan, management, business, companies and process. From these terms we can build hidden service patterns in order to reveal new knowledge about the companies´ behavior related to cloud ERP. The hidden patterns can be built as sentences such as:

- *Solution to manage business processes time*

- *Improving business process time*

- *Solution for product improvement*

- *Planning and managing business process*

- *Solutions from other industries*

- *Plan and solution from provider*

- *Business and time management*

This paper focuses on small and midsized manufacturing companies; most of manufacturing companies do not necessary have high experienced IT skills in the house to take care of their ERP systems in the cloud. The production or product improvement is the main core business of the

majority of manufacturing companies. In order that the core business of the manufacturing companies runs smoothly, cheaper and fast the companies are recommended to outsource some of their back office activities to third parties in countries with cheaper rent and lower labor costs. Based on discovered hidden patterns: *"improving business process time*, *planning and managing business process and business and time management''* I suggest that companies ought either to educate their workers to take care of their daily business process or outsource it to third party. Consequently companies ought to outsource several ERP business processes and planning of ERP over the cloud. These services processing that can be outsourced are: payroll, accounting and HR in similar way that was suggested in section 6.2 and section 4.1.

The planning of cloud ERP is a crucial phase that should be done carefully and preferably with ERP provider and third party, this is an important phase if the companies need special solution on top of their cloud ERP. It can be translated in the discovered hidden pattern: *"solutions from other industries, plan and solution from provider"*. The third parties usually offer other business solutions from other industries that help to improve business processes by saving costs and time. The third parties can offer for example a dashboard add-on as it was mentioned in section 4.2.4 or other business intelligence tools to help managers to make a knowledgeable decision in short time.

The manufacturing companies may outsource the production of their products parts to different third parties. The third parties are selected based on cheaper cost and high quality. For the discovered hidden pattern *"solution for product improvement",* companies typically outsource part of their productions to third parties. As example Icare the Finnish midsized manufacturing company specialized instruments for measuring intra ocular pressure uses cloud ERP and outsourced most of its products parts to several third parties (Tuominen, 2013). Here the use of cloud ERP in outsourcing can be beneficial for both manufacturing companies and third parties in dealing with sales and purchase transactions and update the inventories. The other back office activities that can be outsourced over the cloud are: invoices, receipts, reports etc.

In the companies' categories, we find out that companies are seeking to speed up their business process (*improving business process time*) by outsourcing some cloud ERP activities over the cloud to the third party. But outsourcing to the third party will take time to find the right partner. To save time, manufacturing companies are highly recommended to use a consultants firm to find not only the right partner but the right cloud ERP system and all other possible service partners as well.

## 7.2 Consultants

In this section we will look at consultants as bridge between companies and cloud ERP providers. From the figure 6-9 in the appendix 5, we see the terms that are related ERP services: management, system, technology, customer, software, business, cost, provider, services and companies at 92, 6 % confidence level (table 6-2 in the appendix 4).

The key word technology occurs in consultants' text files. It supports the idea of the consultants to be the ones who looks for the new technologies aiming to speed business processing and find new solutions. From the key words in the figure 6-9 in the appendix 5 we can build hidden services patterns to reveal new knowledge about the consultants´ behavior related to cloud ERP. These hidden services patterns can be built as sentences such as:

- *Managing system technology*

- *Software for customer service*

- *Managing business costs*

- *System service provider*

- *Managing companies business*

- *Cost service provider*

- *Software service provider*

- *Technology cost service*

- *Customer service*

- *Technology management*

- *Cost service management*

These discovered hidden patterns: *"Managing system technology, technology cost service and technology management"* support the idea that the consultants are known to be expert on latest cloud technologies and business processing tools over the cloud; they have talent and skills to solve

any business enigma. Without doubt this finding supports the suggestion made in previous section of using consultants' services when implementing cloud ERP.

The discovered service patterns of "*technology cost service, software services, managing business cost and other customer service*" related software are to be used based on SaaS model this was discussed in sections 3.3 and 4.2.2, all these services are offered over the cloud. Based on these hidden patterns "*Software for customer service, technology cost service, software services, managing business cost, System service provider and other customer service",* I suggest that manufacturing companies to outsource cloud ERP system implementation to well known consultants firm. The task of application that needs to be added on top of the cloud ERP such as add-on other smart applications (as it was mentioned in interview with several consultants in section 6.1) has to be carried in presence of expertise consultant (s). Accordingly, manufacturing companies ought to cooperate with consultants who are expert in cloud business. The following discovered hidden patterns: *managing business costs, cost service management, cost service provider and managing companies business proves that* show that consultants are known with their capabilities of finding the cheapest and most reliable software service provider, as well as helping the manufacturing companies to manage their business at least costs.

The revealed patterns: *software for customer service, technology management and software service provider* suggest outsourcing cloud ERP services related to ERP provider. Several cloud ERP providers do not offer cloud storage where the actual cloud ERP resides. This service is the most crucial part of cloud ERP outsourcing. The manufacturing companies have to know where their Cloud ERP and their data is stored (sections: 3.3.1 4.2.7, 4.3.2) due to the security issues (sections: 1.3, 4.3.1, 6.2, 6.3.1, 6.3.2, 6.3.3, 6.4). Here the role of consultants comes to be vital. Consultants will help companies to make sure that the location of data center is absolutely in country where the legislation gives the full right only to the data owner. Companies have to make sure that the data is available and accessible 24/7. Here I suggest outsourcing the cloud storage to local provider by virtue of small and midsized companies will not need large space storage in the cloud. The data that is related to core business of manufacturing companies such as new product designs that are not patented yet should unquestionably remain in the companies' premises.

## 7.3 Cloud ERP providers

From the figure 6-10 in the appendix 5, we see the terms that are related ERP services: service, system, solution, customer, information, companies, data, product, provider, management, time, application, including, base, process, change, support and requirement at 100% of confidence level (table 6-3 in the appendix 4).

From these terms we can build services patterns to reveal new knowledge about the ERP provider behavior related to cloud ERP. The services patterns can be built as sentences or combined terms such as:

- *Managing system software (technology)*

- *Application (Software) for customer service*

- *System service provider*

- *Managing companies  product (business)*

- *Application (Software)  service provider*

- *Customer information including product data and application process*

- *Managing change and solution*

- *System support requirement*

- *Time management*

- *Data service management*

- *Product service solution based on customer´s or companies' data*

- *Application support requirement*

- *Data solution requirement*

- *Provider requirement*

- *Application service provider*

- *Processes solution support*

- *Product support solutions*

- *Customer requirement solutions*

- *Managing customer´s applications*

- *Managing process changes*

- *Information system management*

- *Customer information management*

- *Data processing*

Technology, application and software are interchangeable terms that can mean same thing. Consequently, first five service patterns founded in the category of ERP providers text files, { 1)*Managing system software (technology)* , 2) *Application (Software) for customer service,* 3) *System service provider,* 4) *Managing companies  product (business),* 5) *Application (Software) service provider*}, they were already discovered in the category of consultants text files. This is another real finding that consultants are the expert of ERP technology services and other external application related to ERP. So the consultants are the bridge between ERP providers, manufacturing companies and third parties. The third parties can be cloud providers, added applications providers or other business industries. Keeping this in mind outsourcing of cloud ERP services has to be carried through expert consultants who are aware of pitfalls and lurking failures.

The discovered service patterns from ERP providers' text files: "*managing process changes, managing customer´s applications, customer information management and information system management*" suggest outsourcing number of services automatically to the ERP provider such as: managing change of cloud ERP system over the cloud and specific customers' application these services usually are included in the pre-installed cloud ERP package. Managing process changes and customer´s applications are related to upgrading and maintaining of the ERP system this is also offered based on SaaS model ( sections: 3.3.1,  4.2.2,  4.2.3,   4.4,  6.3.1,  6.3.2,  6.3.3).

The revealed hidden patterns: "*data processing, data service management, data solution* requirement, *customer requirement solutions and application service provider*" illustrate that ERP providers are aware of their customer data issues; they often have their own partners that can handle cloud ERP storages safety. For the issues in section 6.3.3, ERP provider provides hosting, updates

and backups of the ERP over the cloud including security service. Consequently, the security can be outsourced to ERP providers as well as hosting of the ERP over the cloud, (Case of Visma cloud ERP provider in section 6.3.3).

In section 6.3.2 cloud is described to be more reliable and secure under specific conditions in the hands of the cloud provider. From other discovered patterns under cloud ERP providers these service can be outsourced over the cloud to cloud provider or third reliable party:

1) *"Data service management"* which can contain data solution requirement: The provider will ensure the data safety, control, availability, server maintenance, accessibility 24/7 and makes sure that data is owned by the customer of cloud ERP only. The data has to be masked or encrypted, no leak of data outside of the cloud storage even if it is masked or encrypted.

2) "*System support requirement":* This can be updating, customizing of the cloud ERP system over the cloud. This service is already included in the cloud ERP.

3) "*Managing change and solution":* offer innovative solutions that can keep companies competitive regardless of the market changes, the provider of cloud ERP may improve the speed and efficiency of the ERP system or find third party to provide added application on top of the cloud ERP in order to answer the customers' business specific requirement.

4) *"Product service solution based on customer´s or companies´ data*": Most of cloud ERP providers have a history data of their customers, this data can be different solutions offered to different customers. So this data can be used to offer other services that are related to the companies´ products such as logistics services that can be outsourced to third party using same cloud ERP. I learned that cloud ERP providers can offer same ERP system to several small and midsized companies each company has own authentication credentials, Tuominen (2013) explained that companies using same ERP system in the cloud will not notice any difference, everything happens in the cloud each company will have own ERP system in the cloud. The benefits of it are that such system is easy to implement and use it within 24 hours.

5) *"Applications support requirement or customer requirement solutions*": These applications can be dashboards that enable production managers to gain a hand on customer information management. Applications can help managers to trace raw material goods and products movement towards retailers in real time.

6) "*Information system management*": Enable companies to use cloud ERP to manage their business departments efficiently and effectively. It will help companies to manage their data in order to facilitate their businesses strategies and their operational processes activities. Managing information is proven to be essential in fast changing business environment. This will help all managers, in particular top management to make knowledgeable decision in right time. For these reason many third party companies offer a smart application on top of cloud ERP dedicated to top management.

Typically, the services 1), 2), 3) and 4) are included in the package of cloud ERP offered by the provider. This means that using cloud ERP manufacturing companies will eventually outsource automatically predefined services such as: hardware, software, maintenance and upgrading.

The services 5) and 6) can be outsourced to third party that can offer smart applications such as dashboard. Some services 1) are not usually offered by the cloud ERP provider such as data safety or server maintenance. These services can be outsourced to a suitable third part. But overall, manufacturing companies are highly recommended to use consultancy services whenever they decide to outsource any services over cloud ERP.

All the ERP outsourced services over the cloud are presented in the conclusion section 8.1 as part of summarization of this research.

## 7.4 Summary

Small and midsized manufacturing companies are recommended to outsource several ERP business processes and planning over the cloud. These services are: payroll, accounting and HR in similar way as it was suggested in sections 6.2 and 4.1. The discovered hidden patterns show that companies are aware of the importance of the planning phase when adapting cloud ERP. Companies acknowledged that outsourcing services using cloud ERP to the third party will consume a considerable time. To save time, manufacturing companies are highly recommended to use a consultants firm to find not only the right partner but the right cloud ERP system and all other possible service partners as well.

The result analysis shows that consultants are the first who look for the new technologies to speed business processing and find new solutions. That is why small and midsized manufacturing companies are recommended to outsource cloud ERP system implementation to well known consultant firm. Small and midsized manufacturing companies ought to cooperate with consultants

who are expert in cloud business and will find the cheapest and the most reliable software service provider.

The findings show that managing system software (technology), application (software) for customer service, system service provider, managing companies' product (business) and application (software) service provider to be the main common concern of cloud ERP providers and consultants. Cloud ERP providers can help their customers to outsource: cloud storage, security, and data center.

The interesting finding is that implementation absorbs over 70% of on-premises ERP system which was extracted from figure 6-2 and table 3-1. This makes consultancy services highly appreciated in order to reduce cost of implementing an ERP system.

The other important finding is that consultants are the bridge between ERP providers, manufacturing companies and third parties; this is because consultants are proven to be the expert of ERP technology services and other external application related to cloud ERP.

The answer of the main question in this thesis and other two sub-questions are summarized in the following conclusion chapter.

# 8 Conclusion

This chapter forms the conclusion of this thesis. It answers the three questions that were introduced in section 1.4. The chapter is divided into six sub-sections. The first sub section will summarize the answer to the main question of this research and present a map view (figure 9-1) of the suggested cloud ERP outsourced services. The second and third sub-section will answer the second and third sub-questions of this thesis accordingly. The third sub-section will contain also some suggestions about security solutions for cloud ERP. The fourth section presents the reflection on earlier research; the fifth section contains the limitation of this thesis study. Last sub-section introduces opening for new ideas for further researches.

## 8.1 What are ERP services that can be outsourced over the cloud?

According to interviews conducted with several consultants of major ERP systems and other manufacturing companies; there are no main differences between cloud ERP and on-premises ERP; both will serve the customers need once these needs are identified.

Most of small and midsized manufacturing companies are still reluctant in moving ERP to the cloud by purchasing cloud ERP as SaaS. Nevertheless, there are already several companies which have adapted cloud ERP as transition from on-premises to the cloud. Some other companies prefer to remain on-premises style. The other firms have decided to use both on-premises and cloud ERP, the on-premises usually is installed in headquarter of the parent company; this occurs when the company has several subsidiaries in other locations.

For new companies that will adapt or have adapted cloud ERP, they are recommended to take service outsourcing in steps avoiding outsourcing cloud ERP services at once. Since cloud ERP and ERP on-premises have same modules. Manufacturing companies may outsource any services when they need specific expertise than their own workforce cannot provide. Therefore, the

following services can be outsourced over cloud ERP accordingly to sections 4.1, 6.1, 6.2 and 6.3.1.

**HR activities**: I suggest outsourcing HR module as first step toward outsourcing to the third party (section 6.1). Most of companies need either to hire new employees as their existing ones retire or simply leave for vacation. Finding the right skills and talented employees is hard task, it consumes time and resources. In other hand, manufacturing companies ought to find their employees in right time before retirements or to fill temporary open positions which can be due to sick or maternity leave. By outsourcing HR over the cloud ERP the companies will have an opportunity to hire the needed capabilities in short time. By taking this first step, the manufacturing companies will have an idea how the outsourcing is performed over the cloud. This HR step will be the learning step towards outsourcing other ERP modules services over the cloud.

**Outsourcing data storage and server maintenance**: Since this paper focuses on small and midsized manufacturing companies, the cloud ERP service that can be outsourced should not be part of the manufacturing activities, such as production in terms of know-how that give a competitive advantage for the company over their competitors ( sections 1.3, 6.3.2 and 7.3). However, using cloud ERP based on SaaS model will require in special cases to purchase cloud ERP storage where the actual ERP will take place, in other words the cloud ERP provider may offer cloud storage as well. The storage over the cloud can be purchased from ERP provider or from various cloud providers. But here, cloud storage will contain companies data and will require server maintenance which can be outsourced as service in addition. Nevertheless, outsourcing data storage can be in other countries which have different laws than the home country of manufacturing companies. The worrying issue is that the majority of companies do not necessary know where their data is stored although the provider is in same country of the manufacturing company. Cloud providers do not necessary own the cloud. Small and midsized companies have to know the place of their data storage, preferably in same country where the law is well established. The law has to protect customers' data ownership.

**Outsourcing payroll functions**: this can be under business processes and planning services, payroll outsourcing practice has been experienced already from several other companies and it

has been proven to be a cost reduction (sections 6.2 and 6.3.2). The manufacturing companies can outsource payroll using cloud ERP under finance module. The companies with the help of new technologies and using the consultants' touches can link their cloud ERP to specialized third party. This will enable the manufacturing companies to avoid having payroll trained employees in their houses as well as saving the costs of the software licenses needed to process payroll activities. Adding to that payroll outsourcing can shift the burden of tax calculations and other legal rules that can be complicated to third party who can maintain fulfillment with the legislation changes.

**Logistics activities:** numerous activities in logistics are required to facilitate the flow of manufacturing product from point of origin (raw material) to point of consumption (end user). Cloud ERP contains module that is reserved to logistics activities. Most of manufacturing companies do not have own transportation vehicles to transport their raw materials and products. Therefore, outsourcing this activity over the cloud can be more beneficial in terms of time and cost saving (sections 3.1 and 6.2). The other activity that can be outsourced within logistics modules is the inventory management including warehouses and raw material storage. By doing so, the manufacturing companies can benefits from raw material, fuel and market price forecasting. The forecasting can be build in cloud ERP in sort of added application and can be embedded in dashboard that enable visual real time information for managers. The real time information can be shown in dashboard, like material availability from different suppliers, locations, prices discount offers.

**Marketing**: cloud ERP has marketing module. As it was mentioned in section 4.1, marketing activities will help manufacturing companies to get feedback from their existing customers, reach new customers and new ideas on how to be innovative. Innovation can be: improving existing products and services or inventing new products and services. Therefore manufacturing companies can outsource marketing services over cloud ERP.

The third party marketing is typically expert in social media platforms which are rich of customers´ information. The information can be: customers´ expectations, judgments, complaints about the company´s or competitors products, new ideas for new invention; we are living in era where customers drive changes through social network platforms. All this information can be

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crucial in shaping the manufacturing companies competitive advantage. But the riddle here is: how can manufacturing companies pick the right marketing partner? Special business consultants may solve this riddle.

**Data service management:** This occurs usually when cloud ERP vendor offer only ERP system over the cloud. It will necessitate protecting data over the cloud from third party. The third party provider will ensure the data safety, control, availability, accessibility 24/7 and data ownership similarly to what was mentioned in sections 4.2.7 and 4.3.1. The data has been masked or encrypted, no leak of data outside of the cloud storage although it is masked or encrypted.

**Added applications**: the added applications can be the extra tools that are not included in the cloud ERP (sections 4.2.4 and 4.3.4). Not all small and midsized manufacturing companies will utilize same cloud ERP modules with same ingredients; each one practices its own manufacturing processes differently although they might produce similar or identical products. One example of these added applications can be dashboards with user friendly interfaces that enable managers to access real time information.

All these outsourcing services findings over the cloud ERP appear quite complicated. Since cloud ERP is based on SaaS model (section 3.3.1), the cloud ERP users need only the internet connection and computer or any internet device that enables users to log-in with their ID´s or usernames and passwords. Location does not matter here, so the third party service provider will have their own ID´s and passwords. They can use ID´s and passwords only for the task they ought to perform. Exactly, just like the on-premise ERP users from different departments have their own ID´s and passwords.

Users can enter ERP modules according to their business functions. HR modules will be handled with HR expert, logistics will be handled with logistics experts and so on. None of these will interfere with other activities, users will not necessary know each other.

ERP systems integrations have to be taken in consideration; it will require great work to transform data to be compatible with all different ERP systems. Therefore before outsourcing services, companies are recommended to select the right cloud ERP that will be compatible with their partners ERP systems (Tuominen, 2013).  It would be easy if the partners create alliances

that use same ERP system that allows them to avoid the burden of ERP system integration that might consume a considerable time and human resources.
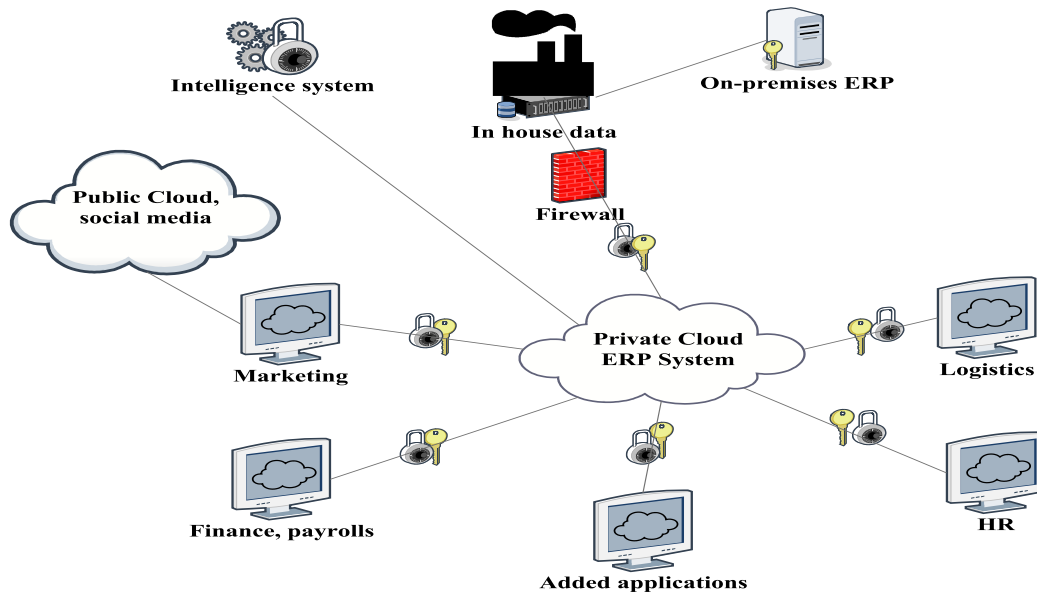


*Figure 8-1. Map view of the suggested cloud ERP outsourced services*. Adopted from the finding of this thesis

In the figure 8-1, the keys and locks shows that each user from different third party has own ID and password that allow him or her to log in the cloud ERP system. All the data will remain in private cloud of the manufacturing companies. The intelligence system will monitor all cloud ERP users in order to ensure the safety of the whole system in the cloud.

## 8.2 What ERP data can be kept on premise and what can be moved to the cloud?

Without any doubt, cloud is the hype of nowadays information system management (ISM) researchers. The ISM researchers understood that the cloud is misunderstood technology but still it gained attraction from different industries. Nevertheless, the cloud notion is new concept for numerous small and midsized manufacturing companies. Most of small and midsized

manufacturing companies see that moving data to cloud is and will be a confusing, challenging and worrying task.

➢ The following data is suggested to remain in the companies premises:

**Core business data**:  This type of data is the most sensitive data. The majority of all small and midsized manufacturing companies will agree that manufacturing secrets must remain in the house. These secrets (section 6.2) consist of the manufacturing of products or spare parts and services related to them. The secrets can be designs, clandestine insights of know-how, cheaper raw material source, skills and own dynamic capabilities who carry the actual tacit knowledge. All these manufacturing secrets constitute the companies´ core businesses and competitive advantage drivers.

**Transaction data**: Transaction data is another sensitive data (section 6.3.1). It contains data that supports the daily operations of manufacturing companies. This data is generated automatically by cloud or on-premises ERP´s application systems or other in house applications. Since most of transactions are made online, I see that there is a fear of losing this data, provided that there are well established security platforms.

**Contracts data**: This data consists of suppliers, third party, employees' contracts and legal related activities (section 4.2.1). For the employees ´contracts it should be kept in-house. Previously, I suggested to outsource HR over the cloud, the role of HR here is just to find the right person for the company; the contract step will be performed and will be kept in-house.

The data related to suppliers and third party contracts that contains legal duties of each part, should remain in house of each part involved in companies' businesses activities. Here all parts involved as partners should protect each other's information for any leak to the outsiders.

All these types of data and their traffic will need to be managed between all cloud ERP modules. That is why companies have to master data risk management. The next sub section will tackle this issue.

➢ The following data is suggested to be moved to the cloud:

**Customers´ data**: customers' data encloses information about the companies´ customers (section 6.2); it should be protected when it will be moved to the cloud due to confidentiality and ethical reasons. Usually, customers´ data contains customers´ names, addresses, purchase history. Not all customers accept that their information will be available for public use or used by other unknown parties. All the customers´ information should be protected by the companies and their third parties. That is why small and midsized manufacturing companies are recommended to use Private cloud for their cloud ERPs.

**Employees' data can be moved into the cloud under strict conditions:** this data can be related to the companies´ dynamic capabilities. It was suggested that the manufacturing companies should outsource HR and payrolls activities to third party; this will force the company to send information about their existing employees and new required ones to the third party. As a result, the companies here must build a trustful relationship with their third party partners, especially HR partners. This is possible by setting special rules that will prevent the leak of information from one company to the other through employees' movements. This may occur when an employee decides to join workforce of the competitor for better salary. In well developed countries there are rules that protect companies' rights in such cases.

**Data warehouse**: This type of data contains historical data resulted from transaction data and other source of data (section 6.3.1). Therefore, data warehouse is updated regularly through online transaction processing. Data warehouse is uploaded from different ERP system modules; this type of data might be moved to the cloud only in case if the ***cloud is strictly private*** (section 6.3.2). I suggested to small and midsized manufacturing companies to use only private cloud, the data warehouse can be moved to cloud as well.

## 8.3 How safe is cloud ERP compared to on-premises ERP?

Using cloud ERP is similar to moving on-premises ERP to the cloud. Consequently, before starting data migration process from on-premises to the cloud, manufacturers have to think about what will happen to their data centers and its repositories in the cloud. The most perturbing issue

that kept numerous companies from migrating to the cloud is safety of the cloud. There is a lot of evidence of companies that have been attacked before the cloud notion born. Cyber attacks or Cyber warfare recorded plenty of in-house data leaks that belong to large companies. The data has been either destroyed or exposed to public. These attacks may cripple the manufacturing network with their partners causing major damages such as sending products or raw materials to wrong location or simply delay an important business processing transaction. This was brought up by Mather et al (2009), Krutz and Vines (2010) in section 1.3 and Herath and Kishore (2009) Polyakov et al (2011) in section 4.3.1.

During the interviews with few manufacturing companies, IT ERP consultants and ERP providers, I concluded that the security issue is the priority of their businesses. Several cloud ERP providers offer only the ERP system without cloud or security related to it. But they have their partners who can offer either cloud or security or both as it was pointed out in section 4.2.1. Other cloud ERP providers offer almost everything what small and midsized manufacturing companies need (Case of Visma cloud ERP provider section 6.3.3). The safety of the cloud ERP compared to on-premises ERP can be tackled under what is called: Data risk management.

According to this research paper the data risk management involves not only the manufacturing companies, but all their partners who take care of the non-core business services. These partners are connected to the manufacturing companies through cloud ERP models according to their outsourced businesses they suppose to offer. Companies and their partners have to protect all data traffic that will occur in the cloud ERP modules. Security of data is the responsibility of the manufacturing companies and all partners who facilitate their businesses.

Data risk management involves: data control, data recovery, accessibility, availability and flexibility. The data control consists of the ownership of data. The owner must have a full control of his or her data. In this case the manufacturing companies will have the administrative data control in the cloud ERP, for the reason that the cloud ERP belongs to manufacturing companies.

Since the data risk management involves the third parties responsibility, the cloud provider has to offer data recovery in case of unwanted disaster similarly to what Wessman (2013) suggested in section 6.1. Cloud provider has to make data accessible from right owner (including data

protection) and available all the time for the users of the manufacturing companies. The most important point is that companies have to ensure the availability of the cloud provider. In worst case, if the cloud provider decides to shut down his or her business or went bankruptcy: in this case companies and cloud provider have to make sure that their cloud ERP and data related to it is save and can be moved to other provider.

The safety sometimes is related to local legislation, defining the cloud provider and cloud location is crucial aspect to take in consideration when the companies will outsource cloud storage. Laws in other countries may not protect the companies' rights. For this vital reason companies ought to have cloud provider and cloud storage location in countries where the law protects their rights.

Related to data safety over the cloud here are several suggestions of protecting own data. In order to secure data over the cloud, manufacturing companies are recommended to create misleading or false data. Once the hacker tries to get the false data the system sends warning to third party who is taking care of security then they will have to take the necessary precautions. The false data might contain real Id and passwords that allow intruders to get access to false data after hard work. The false data will be used as fence to protect the real data. The security for real data must be very high, using new techniques of data protection. The technique protections must remain top secret.

The characteristics of cloud ERP are to be accessible from anywhere, here the manufacturing companies are recommended to build an intelligent system warning that can recognize ERP users' behavior. In other words, the intelligent system will recognize users' access according to time and locations. If a company user gets access to cloud ERP, let's say: from Finland, Helsinki and he will log off from the cloud ERP system after he or she finish his or her task. After short time,  with the same ID and password another user gets access to the cloud ERP system from location that is far away from Finland, let's say: Far East or Australia. So, it does not make sense that the user from Finland will move fast in short time to Far East or Australia, consequently the intelligence system will automatically cancel the user´s ID and password. The intelligence system will be built based on time, geographical locations and optimization movements of users

from their last access to the ERP system.  In case of cloud ERP users will move from their habitual location they must inform the responsible for administrative authentication rights.

Nevertheless, the safety of cloud ERP compared to on-premises ERP seems to be more vulnerable due to all parts involved in it. But with new sophisticated technologies there are systems that can monitor the internal ERP users' behavior and external users' attacks which answers to Männistö (2013) concerns in section 6.3.1.  The security of cloud ERP must be handed to special experts in security field. Installing the most pre-eminent traditional security software is not enough to guarantee the safety of the cloud ERP system.

As it was suggested here that the manufacturing companies should have their cloud ERP installed in private cloud, but still the companies need to secure the traffic of the information and data circulation from and to different ERP modules; bearing in mind that this information and data comes from different outsourced partners. The outsourcing partner may not have similar ERP as the small and midsized manufacturing companies; this will require data integration between different ERP systems.


## 8.4   Reflections to earlier research


The research findings of this thesis are aligned with the earlier research presented in chapter three and four. Most of earlier researchers have focused heavily on cloud computing service outsourcing mainly in term of Software as a Service (SaaS).  Similarly, cloud ERP is based on SaaS business model. The use of cloud ERP confirms the benefits that were already found in the earlier studies. Nevertheless, this thesis has narrowed the field of cloud computing to be focused on services that can be outsourced when adapting cloud ERP system. The outsourcing through cloud computing gave a good idea about services that might be outsourced using cloud ERP.
In other hand this thesis showed the trade-off between cloud ERP and ERP in the companies' premises based on cloud outsourcing services, focusing on small and midsized manufacturing companies.

The earlier studies have expected cloud computing growth at least five years ago, yet, cloud ERP is seen to be immature due to unawareness and fear of getting lost in the cloud. Adding to that the current long lasting economic recession has halted the growth of cloud ERP among small and midsized manufacturing companies.

## 8.5   Limitations of the study

*Validity*: Not all studies are perfect; this study also has its limitations. The limitation of this study concerns the number that constitutes the three categories involved in this study: companies, IT consultants and ERP providers. The validity of empirical study would have been higher, if the study would be carried with more members of each category, it would have increased the validity and reliability of this research.

The amount of the research material was vast for this study. The tool (RapidMiner text mining) used in this study is proven to be acceptable and powerful in various statistical studies. Although the data used for this study was relatively large, the finding of this study should be considered as suggestive only, especially when it comes to the generalizations of the main findings.

This study does not favor any ERP product, all the ERP providers used for this study stand as example only.  Nevertheless, companies that plan to change or purchase an ERP system must consult special expert in this field.

*Reliability*: The empirical study was based on interviews and recent literature reviews that contain material not older than five years. The respondents speak freely, without constraints; they were very open to answer questions related to this study. Several respondents have given permission to mention their names in this research, others preferred to remain anonymous. Since the respondents have a long history in ERP field either as providers, customers, consultant or users of ERP, their answers were more reliable, this research is objective without recommending any product or services. The focus was restrained only to services that can be outsourced over the cloud using cloud ERP. If the study is to be carried out with same people, with the same material during the same time frame, the results will most probably be identical.

## 8.6 Suggestion for further research

Cloud ERP and on-premise ERP basically have similar modules and functions. The cloud is predicted to grow in the upcoming years. The fear and the economic recession have halted the speed of cloud deployment. It will be interesting to perform researches in case of ERP providers that will offer only cloud ERP systems.

The research therefore should focus on manufacturing companies or other industries behaviors and their reactions. New alliances will be formed, especially in field of security field and ERP systems in order to overcome the burden of ERP systems integrations and security issues. The service outsourcing will be reshaped; the laws related to cloud outsourcing will be developed as well.

The research can be carried out with people from different study backgrounds. Researchers can be law students, technical engineering students and business oriented students.

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# APPENDICES

## Appendix 1- RapidMiner´s  used operators in this thesis.

**Tokenize :***"This operator splits the text of a document into a sequence of tokens.  There are several options how to specify the splitting points. Either you may use all non-letter character, what is the default setting. This will result in tokens consisting of one single word, what's the most appropriate option before finally building the word vector. Or if you are going to build windows of tokens or something like that, you will probably split complete sentences, this is possible by setting the split mode to specify character and enter all splitting characters. The third option let's you define regular expressions and is the most flexible for very special cases. Each non-letter character is used as separator. As a result, each word in the text is represented by a single token". (RapidMiner,2013).* Tokenizing simply means: splitting a text file into separate words without dashes, apostrophes, single letters, spaces...

**Filter tokens (by Length):***"This operator filters tokens based on their length (i.e. the number of characters they contain)". (RapidMiner, 2013)*

**Stem (Snowball):***"This operator stems words by applying stemming algorithms written for the Snowball language. Various stemming algorithms for different languages can be chosen". (RapidMiner,2013).*  Stem means that operator picks the root of the word; the language for this research paper is English.

**Transform cases:** *"This operator transforms all characters in a document to either lower case or upper case, respectively". (RapidMiner, 2013),* in this paper I chose lower cases.

**Generate n-grams (Characters):***"This operator creates all possible n-Grams of each token in a document. A character n-Gram is defined as a series of characters of length n. The n-Grams of a token generated by this operator consist of all series of characters of this token which have length n. If a token is shorter than the specified length n, the token itself is kept in the resulting document". (RapidMiner, 2013)*

**Filter stopwords (English):***"This operator filters English stopwords from a document by removing every token which equals a stopword from the built-in stopword list. Please note that, for this operator to work properly, every token should represent a single English word only. To*

*obtain a document with each token representing a single word, you may tokenize a <u>document by</u> <u>applying the Tokenize operator beforehand</u>". (RapidMiner, 2013)*

Stopword means: removing overly common words such as: about, above, across, again, also etc.

**Numerical to binominal:** *"Converts all numerical attributes to binary ones. If the value of an attribute is between the specified minimal and maximal value, it becomes false, otherwise true. If the value is missing, the new value will be missing. The default boundaries are both set to 0, thus only 0.0 is mapped to false and all other values are mapped to true". (RapidMiner, 2013)*

**FP-growth:***"This operator calculates all frequent items sets from a data set by building a FPTree data structure on the transaction data base. This is a very compressed copy of the data which in many cases fits into main memory even for large data bases. From this FPTree all frequent item set are derived. A major advantage of FPGrowth compared to Apriori is that it uses only 2 data scans and is therefore often applicable even on large data sets". (RapidMiner, 2013)*

*"Please note that the given data set is only allowed to contain binominal attributes, i.e. nominal attributes with only two different values. Simply use the provided preprocessing operators in order to transform your data set. The necessary operators are the discretization operators for changing the value types of numerical attributes to nominal and the operator Nominal2Binominal for transforming nominal attributes into binominal / binary ones". (RapidMiner, 2013) "The frequent item sets are mined for the positive entries in your data base, i.e. for those nominal values which are defined as positive in your data base. If you use an attribute description file (.aml) for the ExampleSource operator this corresponds to the second value which is defined via the classes attribute or inner value tags". (RapidMiner, 2013) "If your data does not specify the positive entries correctly, you may set them using the parameter positive_value. This only works if all your attributes contain this value! ". (RapidMiner, 2013) "This operator has two basic working modes: finding at least the specified number of item sets with highest support without taking the min_support into account (default) or finding all item sets with a support large than min_support". (RapidMiner, 2013)*

**Create association rules:** *"Last operator to use for this analysis is: "generates association rules from frequent item sets. In RapidMiner, the process of frequent item set mining is divided into two parts: first, the generation of frequent item sets and second, the generation of association rules from these sets".* (RapidMiner, 2013)

*"For the generation of frequent item sets, you can use for example the operator FPGrowth. The result will be a set of frequent item sets which could be used as input for this operator".* (RapidMiner, 2013)

## Appendix 2 - RapidMiner with the predefined operators

The overall picture of the operators used after uploading text tiles in RapidMiner is shown in figure 6-6:
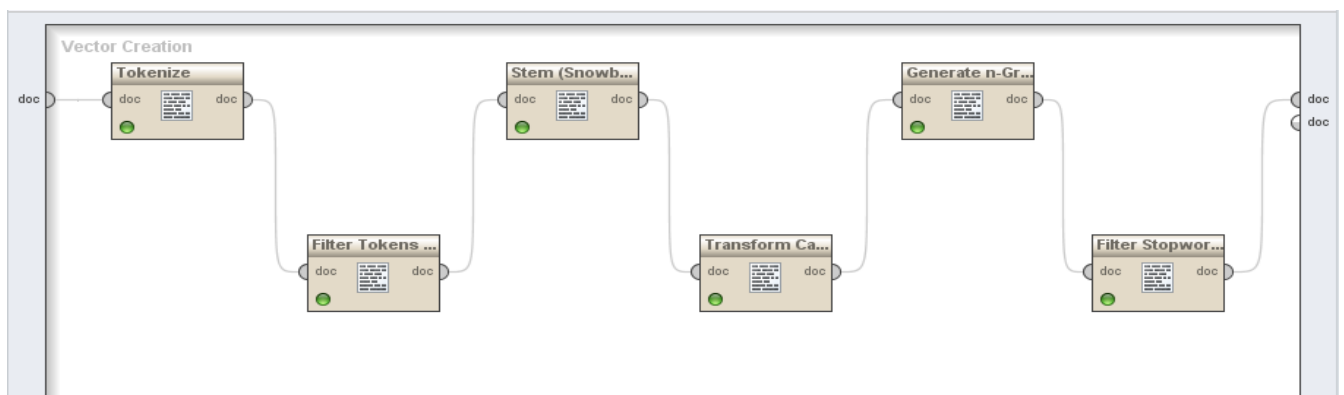


*Figure 6-6. RapidMiner used text mining operators.* Source: RapidMiner (2013)

## Appendix 3- transformation and processing of data
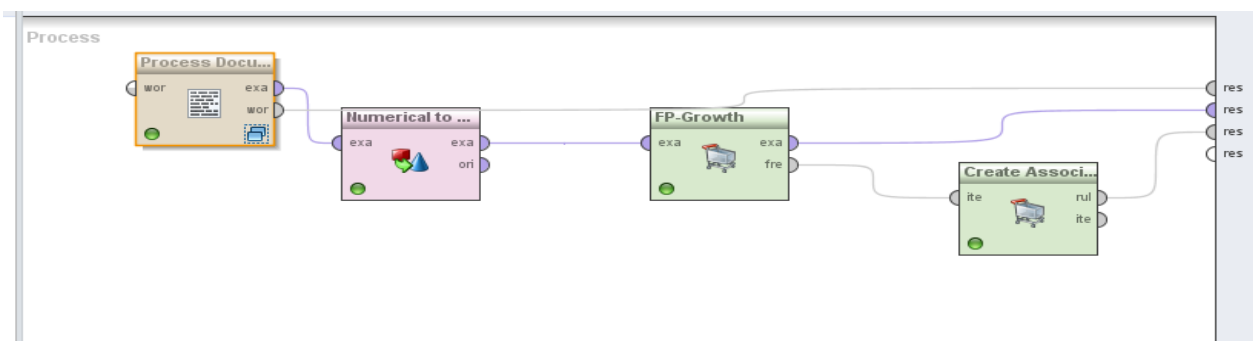


*Figure 6-7. Transformation and processing of data in RapidMiner.* Source: RapidMiner (2013)

# Appendix 4 - Terms with highest support values that are associated to cloud ERP and on-premises ERP services

*Table 6-1. Results extracted from text files of companies´ category generated by RapidMiner 2013.*



*Table 6-2. Results extracted from text files of consultants´ category generated by RapidMiner 2013*

*Table 6-3. Results extracted from text files of ERP providers´ category generated by RapidMiner 2013.*



| No. | Premises | Conclusion | Support | Confidence |
|---|---|---|---|---|
| 28661 | support, process | servic | 0.944 | 1 |
| 29353 | support, process | manag, servic | 0.944 | 1 |
| 29354 | manag, support, process | servic | 0.944 | 1 |
| 29966 | support, process | custom, servic | 0.944 | 1 |
| 29967 | custom, support, process | servic | 0.944 | 1 |
| 31163 | support, process | manag, custom, servic | 0.944 | 1 |
| 31164 | manag, support, process | custom, servic | 0.944 | 1 |
| 31165 | custom, support, process | manag, servic | 0.944 | 1 |
| 31166 | manag, custom, support, process | servic | 0.944 | 1 |
| 28666 | support, time | servic | 0.931 | 1 |
| 29367 | support, time | manag, servic | 0.931 | 1 |
| 29368 | manag, support, time | servic | 0.931 | 1 |
| 29980 | support, time | custom, servic | 0.931 | 1 |
| 29981 | custom, support, time | servic | 0.931 | 1 |
| 30522 | support, inform, process | servic | 0.931 | 1 |
| 30529 | support, time | inform, servic | 0.931 | 1 |
| 30530 | support, inform, time | servic | 0.931 | 1 |
| 30575 | support, busi, process | servic | 0.931 | 1 |
| 31195 | support, time | manag, custom, servic | 0.931 | 1 |
| 31196 | manag, support, time | custom, servic | 0.931 | 1 |
| 31197 | custom, support, time | manag, servic | 0.931 | 1 |
| 31198 | manag, custom, support, time | servic | 0.931 | 1 |
| 32621 | support, inform, process | manag, servic | 0.931 | 1 |
| 32622 | manag, support, inform, process | servic | 0.931 | 1 |
| 32639 | support, time | manag, inform, servic | 0.931 | 1 |
| 32640 | manag, support, time | inform, servic | 0.931 | 1 |
| 32641 | support, inform, time | manag, servic | 0.931 | 1 |
| 32642 | manag, support, inform, time | servic | 0.931 | 1 |
| 32781 | support, busi, process | manag, servic | 0.931 | 1 |
| 32782 | manag, support, busi, process | servic | 0.931 | 1 |
| 33859 | support, inform, process | custom, servic | 0.931 | 1 |

## Appendix 5 - the results of hidden patterns generated from each category :companies, consultants and cloud ERP providers
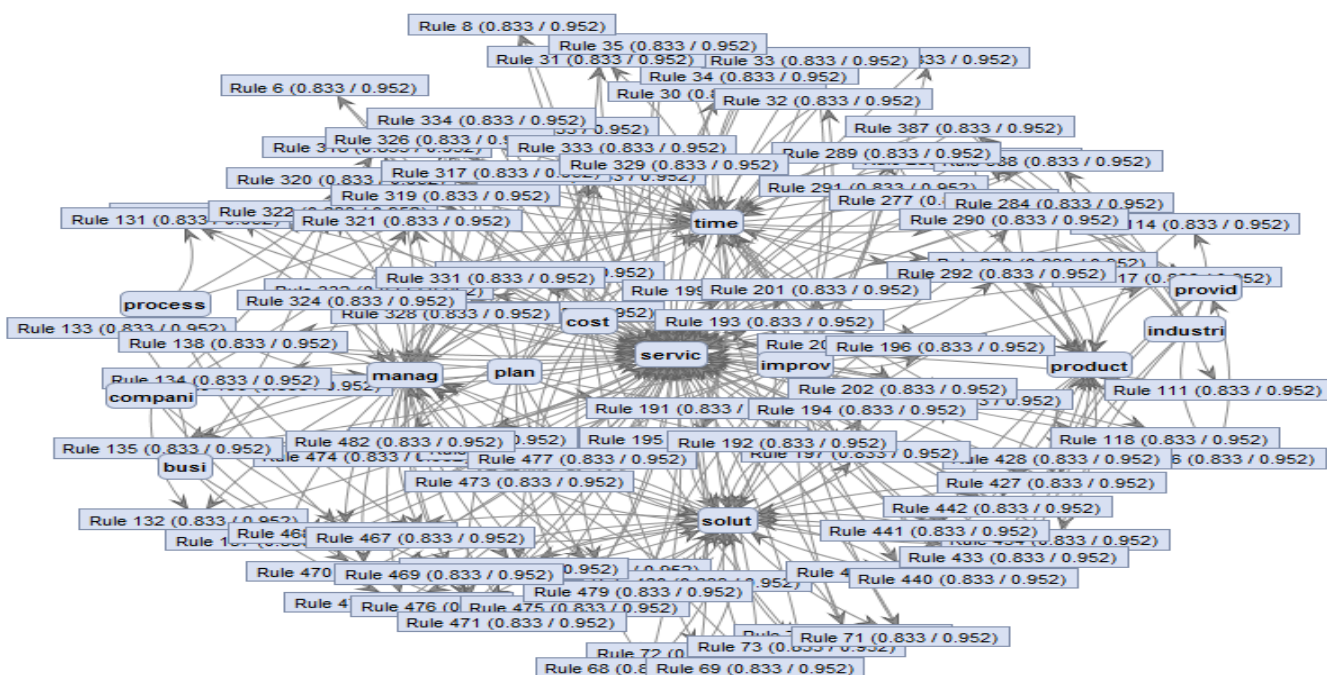
*Figure 6-8. Full map of ERP services related terms in companies´ category.* Source: generated by RapidMiner 2013
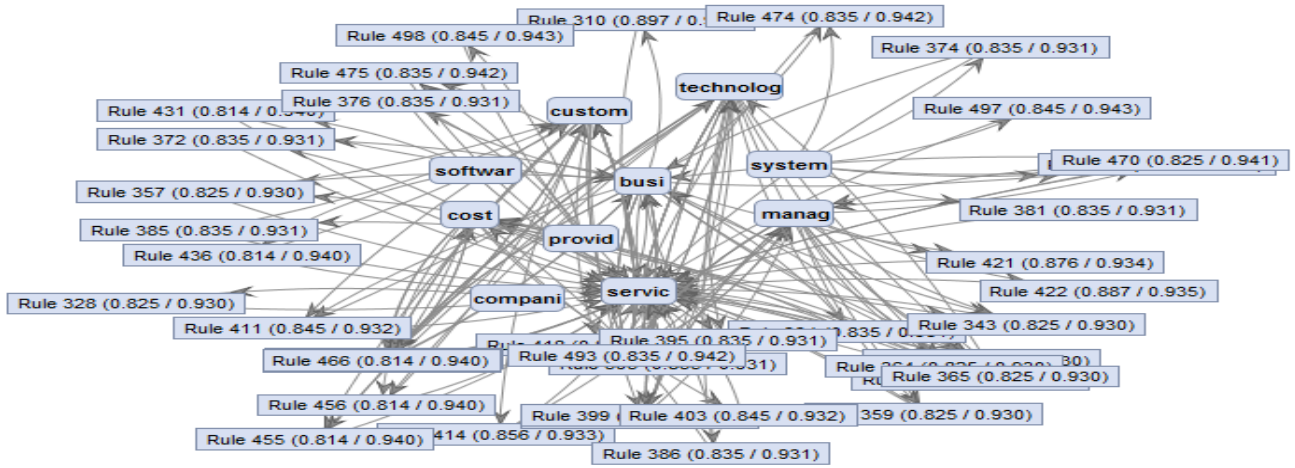
*Figure 6-9. Full map of ERP services related terms in consultants´ category.* Source: generated using RapidMiner 2013
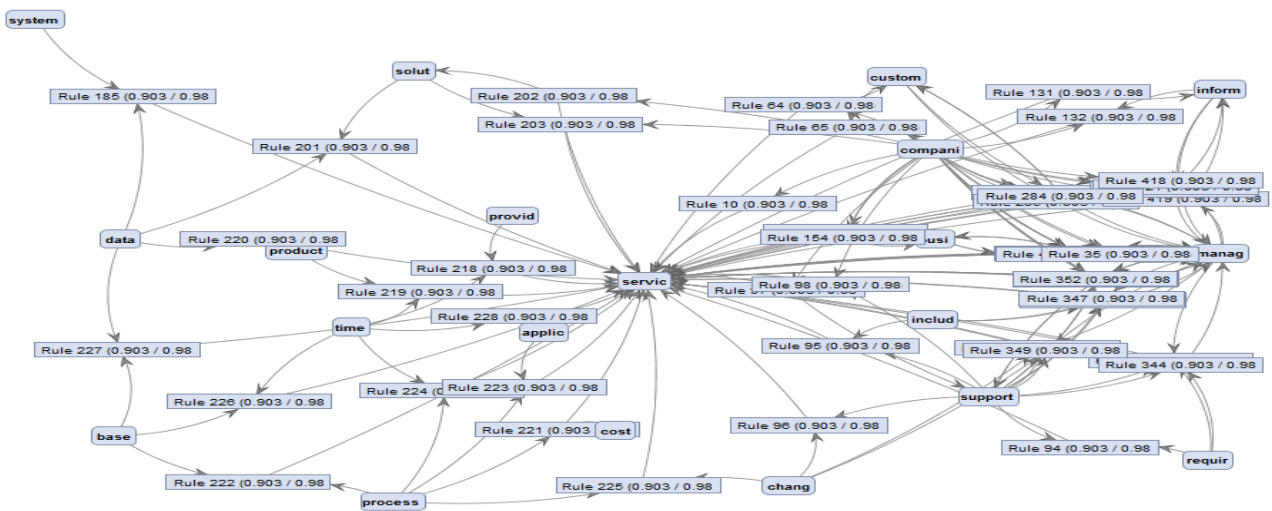
*Figure 6-10. Full map of ERP services related terms in ERP providers´ category.* Source: generated using RapidMiner 2013

# Appendix 6 - Interview questions

**Manufacturing companies: small and midsized business firms**

Do you plan to use ERP system? Yes/No

If, yes, which one of the ERPs you are planning to adapt? Cloud ERP or on-premises ERP?

What do you think about ERP as SaaS?

Which services you are going to outsource over the cloud?

Is it safe to use cloud ERP?

Please feel free and make any comment about the cloud?

**Consultants**

All these questions are related to manufacturing companies: small and midsized business firms

What are the differences between cloud ERP and on-premises ERP?

What is your role in dealing with ERP provider and their customers who use ERP?

What are the risks associated in implementing cloud ERP?

What are possible services that can be outsourced using cloud ERP?

How can you help, cloud provider and cloud ERP customers to build the trust?

Is it safe to use cloud ERP?

What are the trends regarding the adaptation of cloud ERP in the future?

Please feel free and make any comment about the cloud?

**Cloud ERP provider**

All these questions are related to manufacturing companies: small and midsized business firms.

Do you offer a cloud ERP for manufacturing small and midsized companies?

What are the differences between cloud ERP and on-premises ERP?

Do you inform the customer about the cloud ERP location?

From where do you get cloud storage?

Do you help the customer to get cloud storage through your cloud provider partners?

Who is responsible to look after data over the cloud?

How safe is the cloud?

What are non core business services that can be outsourced over the cloud, in case of manufacturing companies?

How do help customers to customize the cloud ERP over the cloud?

How do you see cloud ERP in the future, after this economic recession is over?

How long it takes to implement a cloud ERP system?

Is it safe to use cloud ERP?

Please feel free and make any comment about the cloud?