Optimizing virtual collaboration of a company

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Abstract

The objective of this thesis is to offer insight into virtual work and the problem areas a company may face by providing a virtual workplace. The company described here was founded in Austria in 2003. It still has its headquarter in Austria. However, management and employees work from different locations and time zones. A need for professional technical solutions in regard to their collected work was required, due to business growth and thus, an increase in employees.

After delimitations have been given for commonly used terms, general insight into the area of virtual work will be provided. Reasons for and the advantages of this kind of cooperation are presented in order to clarify motives for the introduction of distributed workplaces. General issues about working in a virtual environment are specified as well.

The company will be analyzed and three problem fields concerning virtual work will be defined and described based on literature research. Thanks to the applications of System Engineering techniques, the problem fields will then be systematically handled and possible solutions will be elaborated upon.

The four resulting approaches will then be individually processed and solutions will be proposed.

The company will implement suggestions that created an impact on their way of working. Finally, these impacts will be described and conclusion will be presented.

Zusammenfassung

Das Ziel dieser Arbeit ist es einen Einblick in die Thematik des virtuellen Arbeitens zu geben, und Probleme eines virtuell arbeitenden Unternehmens zu lösen. Bei der in dieser Arbeit beschriebenen Firma handelt es sich um ein Unternehmen welches 2003 in Österreich gegründet wurde, und dort auch ihren Sitz hat. Mitarbeiter und Partner arbeiten jedoch aus verschiedensten Ländern und in unterschiedlichen Zeitzonen. Aufgrund des wirtschaftlichen Wachstums des Unternehmens, und des damit verbundenen Mitarbeiteranstieges, entstand ein Bedarf an professionellen technischen Lösungen in Verbindung mit vernetztem Arbeiten.

Nach einer Abgrenzung zwischen unterschiedlichen Begriffen im Bereich virtueller Zusammenarbeit, wird ein tieferer Einblick in die Thematik betreffender Arbeitsweisen gegeben. Gründe sowie Vorteile werden aufgezeigt um zu verdeutlichen, welche Beweggründe es für den Einsatz von virtuellen Arbeitsplätzen gibt. Es werden jedoch auch generelle Problematiken beschrieben die durch verteiltes Arbeiten entstehen können. Beispiele erfolgreicher Umsetzungen dieser virtuellen Modelle werden in Business Cases gegeben.

Auf Basis der Literaturrecherche wird danach die Unternehmung analysiert und drei Problemfelder betreffend virtueller Zusammenarbeit werden aufgegriffen. Mittels Anwendung der Techniken des System Engineerings werden die Problembereiche systematisch aufgearbeitet und Lösungswege ausgearbeitet. Die vier daraus resultierenden technischen Lösungswege werden einzeln bearbeitet, bewertet, und ein Lösungsvorschlag aufgezeigt.

Die Firma realisiert die Lösungsvorschläge, welche wiederum starke Auswirkungen auf die Arbeitsweisen des Unternehmens nach sich ziehen.

Zuletzt werden diese Auswirkungen beschrieben und in ein Endergebnis gefasst.

Contents

1 Introduction

Over the past few centuries, private communication has changed dramatically. Since the internet has become available to almost everyone, a new world of interaction has started. Most people recognize the benefits of this within their private lives, but they have not noticed a shift within business. The "on line world" not only provides new ways to interact with people all over the planet - it provides many new opportunities for companies and coworkers as well.

This work describes problems that may arise for a virtual collaborating company. Despite being a small business, this company works with colleagues all over the world. When the company's managers started working from abroad as well, many new challenges arose for its stakeholders. The objective of this thesis is to provide an overview of working aspects in such an environment and to solve the company's main challenges by implementing appropriate IT solutions.

1.1 About the company

TriVolos KG is an Austrian based trading and service company, which focuses on on line shopping. It was founded in 2003 in Graz, where its headquarters are still based. The three founders had the idea of creating a software that could handle multiple web shops with just one system. This means they would be able to build hundreds of such shops within a shorter period and without multiplying the setup and handling costs for the shops.
Actually, they use their system to launch their own web shops as well, and they offer the system as a service to business customers who do not or are not able to handle their on line business alone. Currently, there are about 200 web shops in ten different languages running on their system.

The company is organizationally divided into two parts: the IT department and the marketing department. TriVolos employs a total about ten coworkers - some of them work part time or are interns. When the company started to do business in foreign countries, they also started looking for native speaker employees or interns within those countries - this began in 2007. Since then, some of these students are still working for TriVolos on an hourly basis. Some partners and colleagues have never been to Austria and thus, have never met face-to-face.
Nevertheless, the company and its infrastructure is based in Graz. One or two of the partners started working from abroad. They moved to foreign countries for various reasons for shorter and longer trips, and worked from there. In 2009, one partner spent half of the year in Buenos Aires, while another was based in Mexico City and Canada.

The location where they work from changes the way they work. The challenge for their business is adjusting work flow and communication in order to establish a solid work frame for further developments.

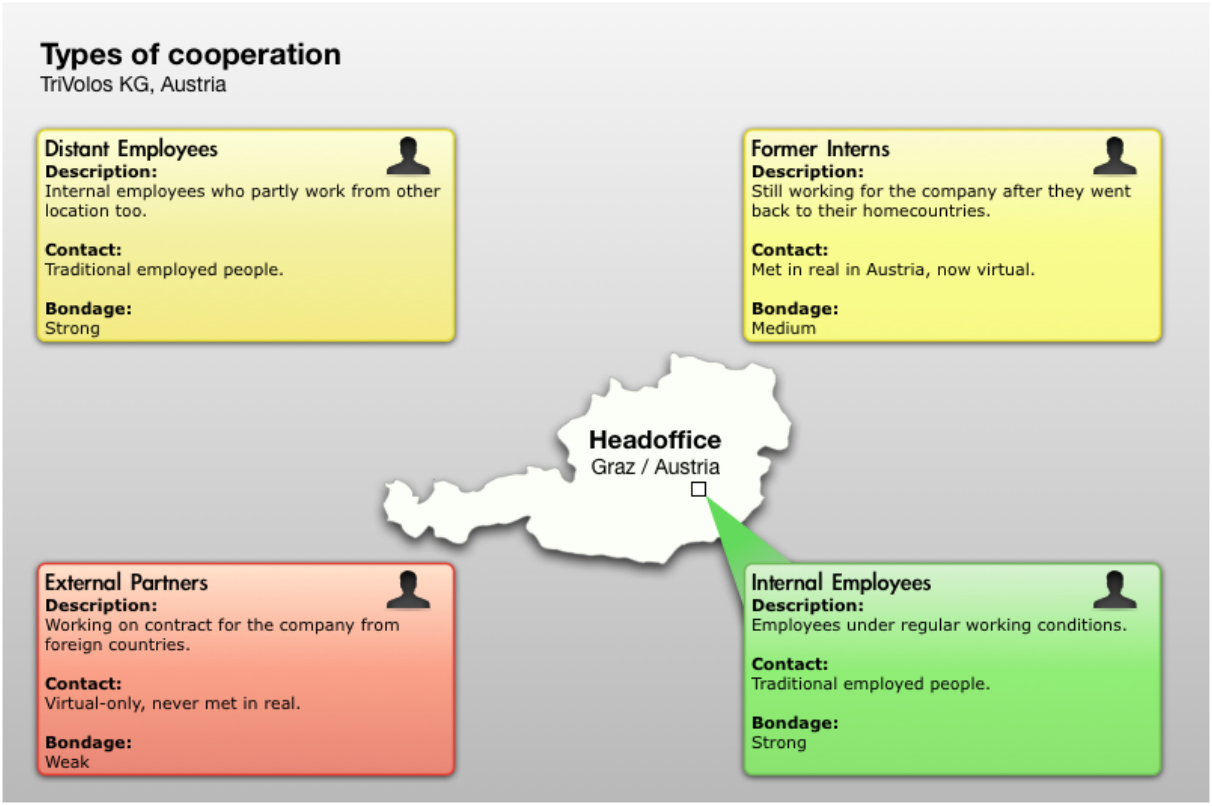

Figure 1: Types of cooperation within TriVolos

1.2 Actual situation

In early 2007, the company realized for the first time that growth without a suitable amount of employees to execute all tasks would not be possible. Because they were growing relatively fast, their task management became uncoordinated. All of the employees were working on any number of different tasks between the two main departments (IT and marketing). There was not any task management, nor was there a way to precisely monitor how many hours went into one task or project. Another problem that occurred was that people worked on tasks they were not trained for, which lead to an even bigger problem, because this caused motivation dropped rapidly.

Even though the company was managed in an unorganized manner, it still remained very successful during its first years. The company started employing foreign interns (which started at the end of 2007); unfortunately, this system was not very successful and it lead to more problems. During their stay in Austria, the interns worked in the office like any other employee - issues did not arise until went back to their countries and continued working for the company. Most of the interns worked on small projects, which were easy to handle, but communication overhead continued to increased.

The situation worsened when the first managers worked apart and communication within man-

agement was no longer face-to-face. Every since the early days of the company, the partners always traveled because of business matters as well as a personal fondness. Thanks to modern internet technology, the ability to travel and work eased with each technical advancement. With the addition of external employees, it was not necessary for the managers to stay in Austria any more. In 2009, all three partners were located on different continents and this is when they began to realize the challenges of managing the company from abroad and also their insufficient task handling issue.

At first, they held a workshop where they analyzed all of the issues. They gathered different issues and divided them into three main situations that needed improvement:

1. **Insufficient information:** Internal communication between members worsens when more people are working externally.
2. **Lack of knowledge management:** Knowledge is being kept by each individual and thus, is not being shared amongst the group.
3. **Poor task handling:** There is insufficient allocation of tasks to people - meaning there is not a system in place that defines who is doing what.

The next step was to describe these issues in a more precise manner in order to formulate objectives for solutions. Another session was organized to break down the objectives. The following information was provided by the company owners and the main employees who work out of the Graz office.

1.2.1 Insufficient information

Employees felt a big difference concerning the information flow between face-to-face working in the same office and working in a virtual environment. The real problem was not the manner in which communication occurred via the internet - it was the feeling of not being able to ask important questions immediately when information was needed. In addition, there was not an opportunity for employees to meet "publicly" like during a coffee break etc. as employees would who worked face-to-face in an office; thus, employees were unable to discuss private matters. This also meant that the employees knew that they were not involved in general work related topics, like how the company was performing or what project would come up next. This behavior reduced the employees feeling of being an important part of the company.

Employees working abroad were especially affected by this, in that they did not receive important information concerning daily business. Most information was gathered by email or by talking directly per phone - which meant that people who were not included in the call did not receive any of the knowledge procured.

In a more specific view, the missing information could be divided into two parts. The first part was general, it concerned current situations like the hiring of new employees, sick days, days off, vacation etc. The second part was related to projects or its tasks. This meant that the employees

current status was not communicated to every member of the project team in a reasonable way, in terms of time and manner. In addition, non-related coworkers were often interested in how projects were developing.

1.2.2 No knowledge management

Knowledge and all its related areas were not being managed efficiently. Therefore, project or task specific knowledge was only held by the people involved. This caused some greater problems for the company - and not just for external employees.
Actually, most knowledge did not exist in a standard written form. Each employee used their own kind of reminder and organizer in order to handle their own tasks - which also meant that if any employee left the company (regardless of reason) the knowledge went with them.

When knowledge is in someones head, this means it is not available for other people to us. So, if someone could not be reached (for example because of time differences) and information was needed in order to further process a task, this would not be possible, because it was not available in written form and the process would get delayed.
The company's IT employees were already a kind of web-based knowledge system. Information about technical-related domains were stored there, but the system was only accessible from within the company's network. The system was also considered too complicated to be used by all employees.

A sophisticated knowledge management would also improve the current training process for new employees. Since the company employs interns, employee turnover is not unusual - an average intern works for the company for about four to six months. Therefore, a lot of training is needed and this is done in face-to-face meetings. If a new employee had questions or problems about/with certain situations, then they would require an immediate response from their instructor. Again, the problem here was that both parties would have to deal with potential time differences.
Training for new employees is expensive, because it involves two parties - the new employee and a trainer. Every employee starts with the very basics and has to be trained by an instructor with knowledge about the domain. There was no way to check whether the trainer forgot something or if the trainer was going too fast - there was not any feedback about the learning process or learning material was not provided.

Knowledge handling is a costly process - thus, this is why it had been neglected for so long. Even if there were some systems in place, they did not meet requirements in terms of searchability, simply use and did not even provide access for different demands.

1.2.3 Poor task handling

Intelligent handling of tasks was a basic problem for the company when it started growing. When they began to work from abroad, these problems increased enormously.

The main problem seemed to be the lack of knowledge concerning which tasks or projects are actually running and what their status was. In addition, there was not any management for internal projects - so there were no deadlines or milestones. Manpower was not connected to tasks, which means that there was not any exact knowledge of the duration. This feature would enormously help in planning future projects and when hiring new employees with specific project-related knowledge. This would also reduce the problem that a lot of office work had to be done by people who were hired to process other task.

In addition to these handling issues, the external managers were also missing control in any form. Although the employees trusted each other, it was still a negative aspect to solve.

1.3 Formulation of objectives

This work should make it possible for the company's daily work routine to improve. This includes solving the challenges described in the previous chapter and letting the parties concerned in the company get an idea of the kind of organization they are working in. This awareness would be especially important, because many of their challenges were caused by the fact that their collaboration had changed so much over the past years without them recognizing the impacts these changes were making.

1.3.1 Finding general solution patterns

One of the main objectives of this work is to find adequate literature in order to solve these challenges concerning the problematic being argued about the current situation. In correlation with this literature, patterns for general solutions should be recognized as well. Each of the three problem fields must be accompanied by specific literature matching the topic - however, the company's form of distributed collaboration must be respected. This will be the basis for finding appropriate IT solutions as the second objective.

1.3.2 Overlook possible IT solutions

After determining general solutions for the three problem fields, the technical part will begin with searching for applicable techniques and software to transform the solutions into real benefits for the company. Thereafter, an overview of actual available systems and appropriate solution patterns will be selected that fit the company's specifications.

1.3.3 Select and adapt solutions for the company

The final objective will be to implement adequate solutions of the found solution patterns. This also includes the behaviors and what effects are estimated by the stakeholders. There are also some general guidelines to follow for choosing software and services.

1.3.4 General guidelines of the company

The company's management defined general aspects in help with selecting IT solutions. These aspects should be kept in mind when comparing or choosing software or services:

Worldwide usable

Easy to use

Easy to administrate

Security mechanism

Future-orientated

A closer look at the company will be made in chapter 3 with a more detailed description of all problem fields and all other related information.

1.4 The approach

The first thing to do would be to get an overall idea about the company and how it works. This should be done to find out what kind of virtuality it matches in order to find appropriate literature for further theoretical findings.

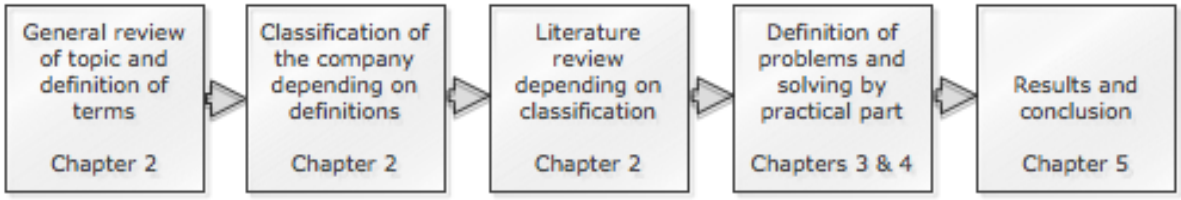

Figure 2: This works approach in five steps

After the literature research in chapter 2, the next step will be to define the challenges a virtual distributed company has to handle. The knowledge gained there should be used when solving the three main issues - it has to be considered at all times.

In chapter 3, the three problem fields will be analyzed and initial positions will be presented. Objectives for solutions will be defined there as well.

The literature will be used afterwards in chapter 4 to solve company-specific problems by looking for applicable patterns. Useful IT solutions will be provided under the directive of these patterns.

Finally, a real technical solution will be implemented for the company in chapter 5 to show how an optimized IT infrastructure for such a team would look.

1.5 Delimitations

After defining what this work's objectives are, it is also important to demarcate what its objectives are not. First of all, the solutions provided here may not be used for any other distributed team or company without adaptations.

In addition, this work does not cover social or cultural aspects of virtual teams - all provided solutions are related to technical issues.

2 Literature Review

After getting an idea about the company and compiling its changed way of working, the next step will be to get a theoretical overview of the subject matter. Collaboration and teamwork in a virtual environment is a very new subject matter, so literature about these subjects and its related areas have been developing over the past few years. Books or journals older than 20 years old are rare and they do not cover todays possibilities thanks to the internet.

Recent development in this area and the vastness of the topic implicate a great mixture of literary works. What makes it even more complicated are very different definitions being used in literature.
The following chapter offers an overview of the literary expression used in order to provide an introduction to the topic. Afterwards, the actual case study of the company will be analyzed in order to compare it with more specific literature.
In order to understand the demands of the given environment, this chapter will consider the historical evolution of companies that work in a virtual environment. This will be followed by the general challenges that had to be considered while working on the problem fields. The last three chapters describe the background of the company's issues and then solution patterns from literature are presented to solve them. A technical method to provide these patterns will also be presented.

2.1 Relevant definitions

In most cases, the definitions of corresponding literature match each other, which shows that there is a global understanding of specific terms. Concerning virtuality and virtual organizations, a significant difference in these definitions can be found. Therefore, this chapter provides a review of the vocabulary used, which can be found in the literature. Terms with several different definitions are quoted by their sources.
At the end, the case reference will be categorized by the given definitions, so deeper literature research can be done in relevant areas.

Virtuality and Virtual Teams

Lipnack and Stamps [2000, S.16] give three contemporary meanings for the term "virtual" - they conclude that in modern meanings virtual is used as a different realm of existence. When speaking of teams it means that those groups are real for its members, even though they do not exist at a physical location.

Townsend, DeMarie and Hendrickson [1998, S.18] give a more exact definition of their understanding concerning virtual teams. Due to their definition virtual teams consist of a group of geographically and/or organizationally dispersed coworkers which use a combination of telecommunication and information technologies to accomplish an organizational task.

Nemiro [2004, S.31] adds the characteristics of those teams. By interviewing members of related teams he found three crucial factors all members specified: common goals, the geographic separation of team members and that most of all communication within the team takes place without face-to-face meetings.
He also uses a more general definition for virtual team: "*A virtual team is first of all a team, characterized by interdependence, shared values, and common goals. Additionally, it is characterized by members who are geographically separated from one another, who communicate mostly through electronic means, and whose boundaries may be stretched by the inclusion of core and peripheral members, members from multiple departments, and smaller teams subsumed by larger teams.*"

Coleman and Levine [2008, S.131ff] generally divide virtual teams by their type of behavior. The traditional concept hereby is that the working "together" means physically close by - distributed teams however do not work in a face-to-face environment.

There are also other terms used for similar meanings concerning teams.
Multinational teams (MNT) refer to teams that are build over multinational companies and are also focused on different cultural aspects of team members. [Earley and Gardner, 2005, S.4]
Besides the concepts like MNT, multicultural teams (MCT) or transnational teams (TNT) Kumar, C. van Fenema and Von Glinow [2005, S.129] use the formulation of "globally distributed work team" (GDWT) which takes away the focus from cultural or national aspects to a general meaning of teams that do not work at the same place.

Virtual Organization

The term Virtual Organization is often used in different associations - therefore Grimshaw and Kwok [1998, S.46f] even gave examples of common misconceptions of the expression.

Camarinha-Matos, Afsarmanesh and Ollus [2005, S.12f] explain a virtual organization as a set of cooperating independent organizations which provide services to the outside world- acting as if they were one organization. Moreover its participants are semi-independent entities which work together to benefit of their different core competencies. Additionally they describe such organizations as temporary to establish a fulfill.

Heneman and Greenberger [2002, S.24ff] collect various used definitions in literature and list them in a pages-filling table. They then summarize the commonalities of those definitions. They explain that an ongoing relationship of the partners is salient as well as their common collocation in place - nevertheless a reliance is given which makes it almost impossible to survive in their absence.

Jackson [1998, S.75f] summarizes definitions and ends by looking into development aspects that run into virtual organizations. On the one hand companies change their organizational behavior

by outsourcing of tasks. On the other hand the development of internet based technology helped to simplify these processes.

Telecommuting and Teleworking

The two terms telecommuting and teleworking are defined very similar in literature.

Jackson [1998, S.22ff] tries to solve the problem of these different terms by dividing the meanings by different categories. He finally combines that teleworking might be divided into different subcategories which are for example electronic homework, flexiwork and telecommuting - so telecommuting as a subcategory of teleworking.
Teleworking hereby is supposed to focus on commuting problems and not among others on the idea of reducing transportation or pollution. Nevertheless he also argues that people use different terms for the same meaning and shows that the expression telecommuting is often used in a general manner.

Grimshaw and Kwok [1998, S.45f] also indicate that the term telework is used as a travel substitution and office-space cost-saver. Additionally it is utilized to bridge a family-work gap. Telecommuting in comparison is an alternative to commuting to a central workplace. Therefore it is described as working one or more days of the week from a place away from the main office. They even refer to the term "Computer Mediated Cooperative Work" (CMCW) which keeps the focus on teamworking.

Crandall and Wallace [1998, S.50ff] mention that telecommuters do not necessarily work from their home - to work from a satellite office or a telecommuting center for some days of the week also indicates this kind of incorporation. They describe telecommuters typically as employees who have worked in the company for a while and who choose telecommuting as a solution for their increase in flexibility.

Collaboration and Virtual Collaboration

Collaboration is defined by Beyerlein and Harris [2004, S.18] as "*the collective work of two or more individuals where the work is undertaken with a sense of shared purpose and direction, that is attentive and responsive to the environment.*" Beyerlein et al. [2002, S.13] define "Collaborative Work Systems" (CWS) as a solution to achieve a higher rate of collaboration in terms of knowledge sharing, mutual support and so on.

Nemiro [2008, S.32] describes three characteristics of collaboration. "*Collaboration occurs when individuals work together toward a shared goal, completing the work is dependent on relationships with a purpose, and individuals working together in purposeful ways toward a shared goal are committed to one another's success*".

In Coleman's and Levine's "Collaboration 2.0" [2008, S.17ff] they give some examples for easy definitions of collaboration (like the formula 1+1>2). They also divide collaboration by its relation to time. Synchronous collaboration occurs within five seconds, asynchronous collaboration does not limit the interaction by time - interactions that take place in-between are called semi-synchronous.
They also define differences between collaboration by the medium which is used to collaborate. Therefore collaboration 2.0 is defined by the usage of virtual environments and virtual platforms which support the incorporation - also called virtual collaboration. By adding a three dimensional aspect to this online variant they define this next step as collaboration 2.5.

Virtual Workplace

The main characteristics of a virtual workplace are the unboundedness of time and space where work is processed. The workplace exists like a platform where a virtual product or service is created. Where a traditional employee's work is attached to time and place these parameters are not mandatory anymore for virtual workplaces. [Crandall and Wallace, 1998, S.25f]
They also describe three different models of virtual workplaces. The "telecommuting model" enables traditionally employed individuals to work anywhere out of the office, the "front line model" shows employees who work at customers- or business-partners locations, while the "cyberlink workplace" means that more people around the globe take advantage of the time-lag to work on the same customer's issue almost 24 hours a day.

Brewer [2008, S.2] concludes that a couple of terms in literature are used in the same meaning instead of virtual workplaces. "Virtual office", "computer mediated communication" (CMC) or for example "computer-supported cooperative work" (CSCW) often refer to the same idea - depending on the author. Finally she argues that these terms seem to be changing: "*To a very real extent, we are trying to hit a moving target because products and processes change so quickly in response to technology and global distribution...*".

2.2 Case reference

The last chapter gave an overview of the common terms used in combination with working across time and space. As one may notice, there are some definitions for one term which are similar to definitions of other ideas. The next step will be to separate items that can be associated with the company TriVolos from concepts that do not match. Thereby, a matching term will be selected to proceed with the next steps, which will be research of the theoretical background.

There are two major concepts that fulfill the company's facts. The first one is the idea of virtual workplaces. That puts the focus on a workplace where work is not associated with the place it is processed. The constraints of cooperation hereby is not defined - thereby, virtual workplace is a very general definition.
The other concept is defined as telecommuting and concentrates more on the idea of working for

a company, but being locally (and temporally) separated. The type of collaboration here comes first and is the focus. The definition of telecommuting (as a part of teleworking) concentrates on employees who have already worked or are still working at the same place, but work from different locations as well.

By dividing the company's types of collaboration into four different categories, it becomes clear that three out of all four types associate a local connection to the head office in Graz. There is only one group of real external working partners who work per contract. Although only some of them are companies and other individual partners who work in a more vendor-customer orientated manner. There is not a deep connection to the company, neither in how they do their work nor in the way they are included in the company's strategy.
The solutions provided in this work do not really address those partners - it has not been planned, nor doe it exist that they will be included in any kind of shared knowledge management or task handling or any other technique in a direct way. The solutions that will be found are all focused on internal company processes, thus only including exactly those people who can be defined as telecommuters - people with a stronger connection to the company, yet work from different countries and timezones.

Therefore, the company's challenges are telecommuting issues and for this reason this work relies on the term telecommuting. Nevertheless, as telecommuting belongs to workplaces in a virtual world, the more general idea of virtual workplaces still seems relevant in some literature.

Another important definition references the interaction between the company's employees. "Virtual collaboration" hereby combines the traditional meaning of collaboration with the usage of modern IT systems in order to solve problems that arise from working away from the office. This virtual collaboration (and how to improve and optimize it) is an important part of every company's (that works in a virtual environment) problem solving skills. This type of collaboration must always be considered when working on concrete solutions for a telecommuting company. The solutions provided later should improve the actual way collaboration occurs on a day-to-day basis.

2.3 Background on Telecommuting and Virtual Collaboration

The past decades brought about big changes in the way people interact and communicate. This was initiated through immense progress in technology, in the field of telecommunication. Those changes did not only happen in people's private lives, but also in the business world.

2.3.1 Historical reflexion on Virtual Work

Evolution and further development is a general goal of mankind. Oftentimes throughout history, these developments made huge leaps by introducing and adapting new ways with novel technology. Henry Ford's invention of the assembly line for automobile manufacturing between 1908 and 1915

dramatically changed the way goods were produced. In a similar way, telecommunication and its possibilities are and will continue to change our daily lives - privately as well as in business manners. The following table shows the immense increase in the percentage of households that have access to the internet through broadband connections.

	2000	2001	2002	2003	2004	2005	2006	2007	2008
Korea	30,3	56,4	68,0	66,0	85,7	95,9	94,0	94,1	94,3
Iceland	..	..	..	..	45,4	63,5	72,1	76,1	83,2
Denmark	..	..	..	25,1	35,8	51,2	63,3	69,5	74,1
Netherlands	..	..	..	20,0	..	53,9	66,2	73,8	74,0
Norway	..	..	..	22,9	30,0	41,4	57,1	66,7	73,0
Sweden	..	..	..	..	..	40,2	51,0	66,6	70,7
Finland	..	..	..	12,4	21,3	36,1	52,9	62,9	66,1
Canada (2007)	..	21,6	29,3	35,5	44,1	50,1	57,9	64,2	..
Switzerland (2007)	..	..	..	..	..	..	52,8	63,0	..
United Kingdom	..	..	..	10,7	15,8	31,5	43,9	56,7	61,5
Japan	..	..	..	32,7	43,0	44,3	40,7	51,7	58,5
France	..	..	..	..	.. ..		30,3	42,9	57,1
Germany	..	..	..	9,3	18,0	23,2	33,5	49,6	54,9
Austria	..	..	..	10,3	15,9	23,1	33,1	46,1	54,5
United States (2007)	4,4	9,1	..	19,9	..	..	..	50,8	..

Figure 3: OECD statistic of households with broadband internet access between 2004-2008 in percentage. [OECD, 2010]

Thanks to international development in areas of globalization and computerization, the global economy has changed. New rules and business practices lead to a modernization in doing business, which has been called the new economy.

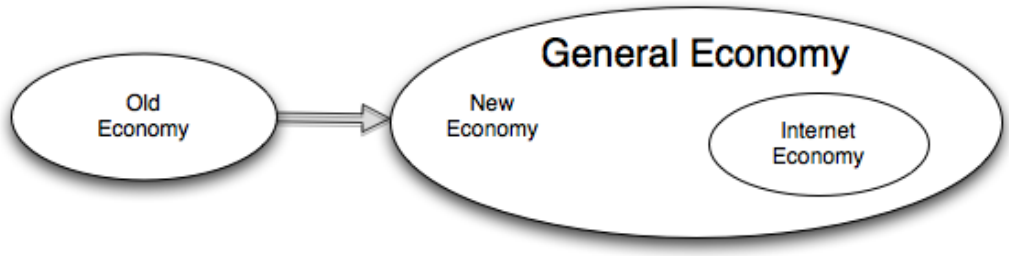

Figure 4: From “old” to “new” economy including the internet economy. [Burn et al., 2002, S.4]

Traditionally, we define work not only by the real activity we process, but also by the environment that is involved with the activity. This environment has always been associated to a cultural aspect of the company as well as hard facts like time and locality. Statements like “I go to work” (work is located at a specific physical place) or “I finish my work” (work is done when I leave the place where it is done) encourage this approach. In a conventional workspace, location and time are the two most relevant factors for doing a job. This changes for telecommuting employees.

[Donaldson and Weiss, 1998, S.25ff]

There are different reasons why telecommuting has become such an interesting topic over the past few years. Jackson [1998, S.23] summarizes three main developments that caused this increased interest.
Telecommuting and teleworking can be a result of an outsourcing process in companies - like sole employees who work on their own (often home-based) . This may be consultants, architects or a part time worker.
Another reason for telecommuting is to avoid expensive and long trips to customers or business partners. Techniques like video-communication-based interactions or remote working on client systems can be used in this field.
The third and last reason for the demand of telecommuting comes with the expansion of network accessibilities and the availability of devices that allow work to be done from everywhere - people have started to adopt them and take advantage of those possibilities.

New markets emerged with the introduction of the internet to every household. A whole new economy is now based on applications and services that are used thanks to internet technology and the possibilities therefrom. This so called "internet economy" works under different rules than traditional economy. Often, companies do not have daily based direct customer contact or distribute their products and services to the whole world 24 hours a day/seven days a week. Typical employees in internet companies are knowledge-based workers who do their job on computers and in networks. Once again, those employees are characterized as people who are appropriate to work from wherever they are - as long as they have a computer and an internet connection. As a result, those businesses are perfect examples of telecommuting companies.

Thanks to the development and acceptance of virtual work, the importance of conscious management of a changed collaborating world became the focus. People work from different countries and timezones for the same company or on the same project - without meeting in real life. Often those people did not even know each other before their common tasks were defined. This is an immense change in the way people work together. Not only the personal relationship between those partners differs from a common engagement, but also the tools needed for working together had to be adjusted. Virtual collaboration or Collaboration 2.0 are terms that are often used in this context in literature.
This revolution in how people interact in business was initiated by the necessity of the market. Email was introduced about 30 years ago, but newer technologies are needed to match modern duties.

Telecommuting is changing the way we work and we will work in the future. A next big step may be a change of student internships. Academic internships and other cooperative programs allow students to get an idea of how companies work in order to get initial working experience in the branch of their interest. These programs are often a necessary element of education in order

to receive a degree and to get the needed hours of credit.
Traditional internships are an organizational challenge - for students, the university and the company involved. Here, teleworking provides an interesting new way to fill a time gap. Depending on the field of study, students may work in different areas like programming software or writing papers. This experience fits into the demand for future leaders and managers with practical knowledge. [Edgell, 2008, S.544ff]

2.3.2 Detailed informations about Telecommuting

An actual study from December 2009 shows that about 45 million people worldwide use telecommuting at least once a week as their form of work - this tendency is increasing. In 2005, about 44 percent of surveyed US-based companies offered telecommuting to their employees - this was a 12 percent increase in comparison to 2001 (32 percent). Primarily small and mid-size businesses have broadened their offerings in virtual workplaces. [ITBusiness.ca, 2009]

What Virtual Work is about

As already mentioned before, telecommuting is used as a term for the type of distributed work. There are also other forms of work that refers to situations without sharing time or location where the activity is processed. Jackson divides these forms of collaboration into two dimensions: place and time. Telecommuting, as one of these, is hereby defined as work, which is processed at different places, but at the same time. Whereas, the "virtual office" stands for the most distributed version of collaboration: different place and different time.
For telecommuters this working at the same time does not necessarily mean match exactly to the companies timeline from wherever they act, but implies the importance for all employees to adopt the headquarters' timeline as their reference time. Thus, they are focused on project tasks that are mainly based and managed by coworkers from within the company's headquarters - some kind of dependence is provided here. [Jackson, 1998, S.69ff]

The aspect of working from different places and countries comes into focus for telecommuting. Lipnack and Stamps [1997, S.8ff] give a general rule about how the locational distance between people affects their relationship and their style of communication. Their 50-feet rule describes that there is a big chance, that people do not collaborate very often if they are more than 50 feet (around 15 meters) apart. They conclude that the benefit of working at the same office drops immediately when people are sitting and working outside this range.
The open question here is: What big differences it would make to work from further distances if collaboration within 15 meters is not possible? Especially teams of more than 10 to 15 people, who are likely to exceed this range just because of the required workspaces. The figure also shows that virtuality already starts by working outside of these 50 feet. Of course there may be differences

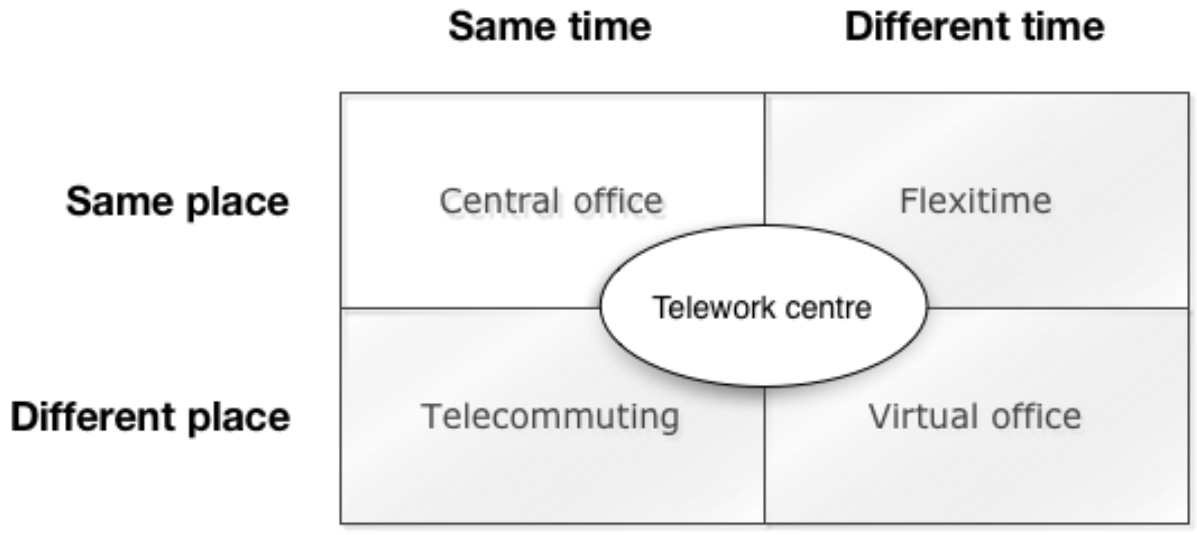

Figure 5: Virtual workplace arrangements. [Jackson, 1998, S.170]

for work flow between teams divided by continents and those divided by floors - but the general rules for working in a virtual collaboration apply to both situations. [Lipnack and Stamps, 1997, S.8ff]

The importance of Virtual Work

Employees often gain great benefits when their companies offer telecommuting workplaces. From a employee's point of view, private interests are often the reason to participate in such a program - so a better work-life balance is their goal when joining telecommuting. But, since they are somehow dependent on the company's intentions, there also has to be a benefit and reason for the company (besides more satisfied employee) to implement virtual workplaces. Telecommuting is becoming more and more important to companies and they are starting to integrate it into their business model.

For companies and especially for multi-national corporate groups, workplaces with the ability to work in a virtual environment has opened doors for internal teams to collaborate across the planet. The possibility to build such teams with local experts entail huge benefits and are one of the main reasons for those companies to establish virtual collaboration systems and techniques.

The increasing importance of global virtual teams can be seen with the multi-national corporate group IBM. They set the goal to build one huge team, including all of their about 360,000 employees. They implemented technical systems to help their workers collaborate with distant colleagues. All of them have access to a chat system and a unique market intelligence system that enables them to work on new product ideas concerning development and testing of new pro-

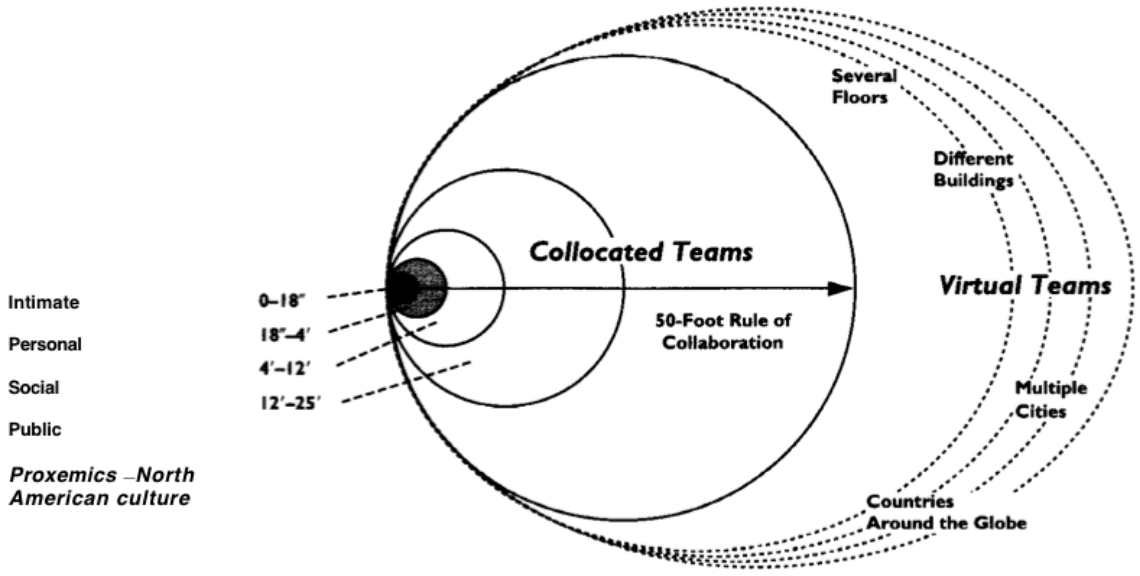

Figure 6: 50-feet rule for collocated work. [Lipnack and Stamps, 1997, S.9]

totypes. They are able to build a task force team within just 30 minutes thanks to this portal. [Cullen and Parboteeah, 2010, S.384f]

Virtual organizations and virtual teams require virtual workplaces. Nevertheless, most companies first think about financial savings when implementing virtual workplaces. In the end, costs are often higher than expected. Labor costs per employee are about 10 to 15 percent higher than they are under an equivalent traditional work design. Three aspects increase the total sum: higher wage costs, higher training and development costs and finally, sufficient slack in working schedules for allowing people to move around and gain new experiences. This shows that virtual workplaces are not a sufficient method to cut costs in a company. Increasing business performance would have to be the number one goal for companies that want to introduce virtual working. [Crandall and Wallace, 1998, S.209f]

Working as a team in a Virtual Workplace

As virtual work is often used for processing more ambitious tasks, utilization of teams seems to be an adequate working model. The virtual version of teamwork is done by so called online collaborative teams (OCT). Such teams may or may not work above the limits of companies - the concept always stays similar. There is a high likelihood for those teams to fail at their main objective, because of additional complexity to stay in touch and keep the focus on the team's objective.
Online collaborative teams need some extra attention in order to stay on track. Literature shows different areas of practices that are important for virtual teams. The most important part may be the organizational structures that build the basis for successful team-play in virtual environments. Beside the parts the company has to provide, the managing position of the team is required as well to handle it. This kind of collaboration requires it. Last but not least, the team members

themselves are important - virtual work needs greater communication skills and motivation than normal teamwork requires. Preparing all three needed parts for virtual work is one of the most important responsibilities and not paying attention to this may lead to failing online collaborating teams. [Martins and Ferro, 2008, S.1112ff]

Significance of a Virtual Community

In the past, a community was defined by a social group that was interested in a common goal or shared a common interest - often restricted by geographical borders. Virtual communities eliminated any location based borders by using information technology - so a shift away from geographic ties to common interest ties. This was done by technical infrastructures that provided some kind of "place" in a virtual way. Those systems generally provided different ways to communicate. Systems must integrate techniques in order to chat live (synchronous) or to save messages in content related form, so that asynchronous conversations and discussions can take place. Often a moderator role is installed to keep track of specific topics. [Ridings, 2005, S.116ff]

The next improvement in communities was the step into mobility for virtual communities. Mobile communities are considered the natural evolution of virtual communities. This was made possible through immense developments in mobile and wireless devices to access those virtual places. Mobile platforms offer enhanced communication servers for users - to be connected anywhere and anytime, opened new possibilities for business processes. Various applications for such communities exist - especially workflow management and mobile learning are developing into important businesses. [Ferreira et al., 2008, S.944ff]

Impacts on workflow management

A set of activities within a process that are connected to reach a common goal are defined as a workflow. A process activity is the description for one processed action that is required to fulfill the accomplishment of a process. [Dogac, 1998, S.2]
The management of such processes has an important impact on achieving the common goal of the workflow. Special software that supports the management activity is called workflow management system (WFMS). Workflow management systems are used to ensure that the right information is available at the right time for the right person - so systems do not perform just any process of the workflow, but support the communication and connection of every step. [Aalst and Hee, 2002, S.XIIIff]

For virtual working companies, intelligent workflow management is an important part of their daily work. "*...WFMS help to manage knowledge that is vital for enabling virtual workplaces: the knowledge of what is done (business processes and workflows), how it is done (activities and flow*

of work between activities), by whom it is done (participating human and automated actors) and by what means it is done (tools). " [Amberg and Zimmermann, 1998, S.111]
Workflow management systems are generally applicable for any kind of enterprise - no matter what size or kind. WFMS use IT based platforms to enable collaborative networking as interaction between the workers or automated systems through the workflow process. [Amberg and Zimmermann, 1998, S.111f]

Management of the workflow across time and space is one of the important challenges for virtual working businesses. This can be fulfilled by using an appropriate software system to handle process and task management issues.

Knowledge management and training

In addition to the use of workflow management systems, knowledge has to be managed in a way that serves the purposes of telecommuting companies as well.
Personal and organizational knowledge are two important aspects for virtual companies - the exchange of these is the most significant competitive factor. The exchange of knowledge enables employees to process their tasks and projects in the most efficient way possible regardless from where they work. Franke [2002, S.31] describes shared knowledge as the "glue" that holds virtual acting organizations together. The use of appropriate technology is the fundamental part here.

The challenges for information spreading systems are multiple and are often discussed in literature. One aspect related to virtual collaboration is the problem of multiple access to the same resource. The problem here appears whenever more people want to edit the same source - which is a common data communication issue. Shared data needs some extra services in order to manage requests in an appropriate way, especially since the employees (the users of the data) have to trust a knowledge management system. Sharing knowledge is always a critical situation for employees - even more than normal for companies where employees do not have the possibility to meet in real life. [Fong, 2005, S.5f]

In addition to the sharing of information and knowledge, the way in which training and learning is executed differs from traditional companies as well.
The usage of artificial intelligence (AI) can be a solution for trainings in a virtual environment. In this case, the trainee completes predefined scenarios. This method allows optimal multiplicity of trainings - a trainer designs a case and plenty of trainees can be coached with the same quality. Of course AI trainings are only possible when low human interaction scenarios are presented. [Ehmannn Powers and Hewett, 2008, S.258ff]

When automated services are not applicable, other interaction systems have to be used for instructing employees. Communication options have to be divided into two different schemes, because of the distance between trainer and trainee.

Synchronous communication means that all participants are only separated by location and not by time - so the communication is "live" for all of them. In this situation conferencing tools can be used to broadcast information from the sender (trainer) to the receivers (trainees). Video conferencing systems, instant messaging or other online meeting techniques may be useful in this case.
In contrast to synchronous forms of communication, there is also a asynchronous form of communication. This form is used when they players are widely dispersed in different time zones or when "live" communication is not possible. Here the content has to be stored in a static manner - so regardless of when a trainee requires access to the information, it is available for use. [Fong, 2005, S.6]

2.4 Reasons for Telecommuting

As already mentioned, teleworking was pushed by employees in the earlier days. They tried to convince their employers that it would be possible to do some work from home without great drawbacks on their output. So, at first, advantages for the workers were the initial reasons for virtual work.
Advantages for employees are often obvious:

Flexible work hours: Often tasks can be accomplished with a flexible schedule, which means that the worker is able to handle the time line for processing tasks. Especially in projects where people work independent of each other, and milestones are the only limit in time, the teleworker can manage his/her working hours in a more flexible manner. This may also become a disadvantage when people get into stressful situations, because they are less bound to office working hours.

Flexible work hours are mainly the number one reason for employees - not only because it allows them to handle their private life in a way that would not be possible without working from home.

Easier access for handicapped: People with disabilities now have access to new options by working from their homes where they often have their needed infrastructure. This is a very interesting chance for companies and employees as well - specifically when the job allows for all work to be performed within the employees own infrastructure.

Less restrictions for "place to life": An interesting new development has started where people have begun to think about their living place in relation to their working place. Employees are used to the fact that they often have to move because of career changes. This is not always easy because social issues have a great influence on people's decisions.

By providing virtual workplaces, the company provides the option of working from remote places. This means that it could also be possible for telecommuters

to change their place of residence and move to other areas, but still work for the same company - so without quitting the job. The opportunities are enormous and will change a lot in companies and in peoples minds.

In addition to the reasons stated by employees, companies started realizing the benefits of this as well. The advantages for business may even be more interesting for future developments, because by already installing the infrastructure for virtual work, the effort they would expend to offer more activities to be done by telecommuters would decrease enormously.

In 2008, the company "SUN" did an internal research after they implemented virtual workplaces. They found that the advantages far outweighed the disadvantages and they benefited in many ways.
Here is the exact list of advantages from a company's point of view [Sun, 2008, S.1f]:

Wider pool of available workers. Hiring the best regardless of where they live gives organizations tremendous flexibility.

24x7 availability. The ability to conduct three-shift working around the globe gives organizations true around-the-clock coverage.

Improved efficiency. Studies prove that home-based workers tend to be more productive. Sun's Open Work employees typically give Sun 60% of the commute time saved through flexible and home options.

Improved performance. Sun employees who work at home score higher on performance ratings than their counterparts.

Reduced need for real estate. Avoid the costs of opening offices in distant places. Plus, using a network of workplaces allows companies to accommodate more workers within the same office footprint.

Increased recruitment. Leverage virtual work to attract top talent. In the annual Sun all employee survey, the Open Work program is listed as the number one reason for an employee to recommend Sun as a great place to work.

Improved employee retention. Sun's multi-year employee survey found out that home-assigned employees have a significantly lower turnover rate and higher satisfaction ratings than other employees.

Greater accountability. In a virtual organization, employees are judged by results, unlike in the office, where one can "look like one is working". With the right controls in place, it's impossible to "fake it" remotely.

Greater business agility. Flexible work practices allow enterprises to respond quickly to changing business conditions.

Reduced infrastructure costs. For example, Sun's home-assigned employees' initial and annual workplace expenses are about 70% less then fixed-office employees.

Smaller carbon footprint. On average, Sun employees involved in our Open Work program save 160 hours per year in avoided commute time.

Financial savings for employees. Avoiding the commute results in real savings for employees. Each Open Work employee saves 125 gallons (about 473 liters) of gasoline a year.

The whitepaper shows the enthusiasm of Sun's so called "Open Work" project. Nevertheless, virtual working also implicates some possible negative issues that have to be considered.

2.5 Challenges of Virtual Working

In addition to big advantages that worldwide collaboration implicates, there are some serious problem areas as well. Issues of modern virtual collaborating companies cannot be resolved by traditional business solutions. Therefore, the focus of this chapter is on general challenges first and closes by discussing two more specific issues.

All telecommuting companies have to find solutions in order to handle their personal infrastructure in an appropriate manner; however, for companies with so called "knowledge workers" there are some extra areas where problems may arise. Intelligent management of knowledge is a key factor for successful collaboration and becomes even more important for dispersed knowledge workers. Another interesting domain for distributed work is creative work. Creativity is often an important area of work for knowledge workers and thus, has to be considered as a special need within virtual collaboration.

2.5.1 General Virtual Working challenges

Lipnack and Stamps [2000, S.28] write that successful collaborative work requires 90 percent people and 10 percent technology. Therefore, potential problems for virtual companies discussed here are more likely social problems than they are in terms of technical fields.

Besides the normal tasks associated to management, virtual companies have to handle some extra issues. Gaps between tasks assigned to conventional management and virtual management are formulated by Franke [2002, S.39ff] as follows:

Skills gap: Management in virtual organizations requires new skills which means that these new skills need to compliment existing skills. The major requirements here are skills in the area of knowledge management and relationship management.

Network gap: An organizational design approach is required in order to fulfill a flexible virtual network that differs to relatively static structures in traditional companies.

Knowledge gap: Knowledge is a core asset of organizations in general, but becomes even more important for virtual businesses. Where traditionally companies often live without an explicit management system, this is required for their virtual

counterparts. Since this is a complex issue in the virtual world, it will be discussed in more detail later.

Boundaries gap: Since virtual organizations do not have as strict boundaries as would normally be required, they need more planning and reporting. It is important to define when to include and when to exclude people from specific information.

Direction and control gap: Traditionally, companies work either top-down or bottom-up. This is often not appropriate for people who are work on virtual teams that tend to be more "flat".

Franke argues that virtual organization forms are not entirely different from traditional companies, and so do not need a completely new model of management. Instead, he thinks that by adding four additional tasks is an enhancement to handling the virtual aspects.

Additional tasks for virtual organization forms by Franke [2002, S.40f] :

Communication The flow of information and its management works as a "linker" in every organization. An increased need for well designed communication paths must be solved by using new technology.

Assessment Virtual organizations are dynamic and flexible, but their capabilities must adhere to the organization's objectives. Instead of planing resources once and accepting them as static, a management function should provide an appropriate tool to handle the company's demand.

Learning Learning as a part of knowledge management ensures the creation and acquisition of new knowledge. The sharing of knowledge - and so learning for and from other coworkers - is a critical task for telecommuting employees. This subject will be closer analyzed later.

Valuation This is a continuous task of comparison between present and future values for the business. Again, not only because of the dynamic of virtual work, but valuation measures require adjustment as well.

A virtual manager will have to combine qualities in those four areas in order to handle the new challenges which go hand in hand when virtuality is offered.

2.5.2 The importance of trust

According to literature, there is one large threat that has to be mastered when introducing virtual work to a company's employees. Trust is the greatest issue for employees to handle.
People who trust one another are more likely to work more effectively than their counterparts. They communicate more and are more open, and collaborate freely and in a more innovative manner. When tasks require such characteristics like strong communication or collaboration skills,

trust is a key factor for success. [Nemiro, 2008, S.153f]

Reina and Reina [1999, S.10] define four C's of trust that have to be granted:

Capacity for trust: people's readiness to trust

Contractual trust: trust of character

Communication trust: trust of disclosure

Competence trust: trust of capability

Where three of those four do not relate specifically to telecommuting people (because usually a strong boundary before they start working abroad already exists), the manner of communication is different when not working face-to-face. The manner in which we communicate is influenced by trust, and so trust influences our communication. It sets norms for the flow of information, how knowledge and information is shared, and how feedback is given. [Nemiro, 2008, S.159f]

A study analyzed by Kimble and Li [2005, S.158] shows that the most challenging aspect of virtual working is trust. In the study, the companies had to share their work-in-progress electronically, which did not work as expected. It shows that, independent of whether the coworkers were software developers, consultants or researchers, they were often unwilling to share half-finished work.
When they used "Communities of Practice" (CoP) methods in another study, results differed strongly. CoP means nothing more than sharing one greater issue or goal together, so no one feels excluded because everyone is stuck in the same situation. This system is also used in self-help groups and can be applied as a possibility for the area of virtual trusting as well.
In the second study, the people collaborating had a personal relationship to each other, which was done by meeting in person every six months and maintained communication via different channels. [Kimble and Li, 2005, S.158]

Telecommuting employees have usually already worked directly in the company, so some type of CoP already took place. Nevertheless, time goes by and this basis of trust has to be maintained. Another important situation for telecommuters who work externally for a longer period of time are new employees in the office or virtually. Since they do not have the same strength of boundary like the people they have met personally, methods to increase trust are needed in order to maintain successful virtual teamwork.

2.5.3 Issues concerning knowledge sharing

The awareness of knowledge and its significance in daily business increases even if distributed employees require access to internal information and knowledge.
Chen, Tarn and Razi [2008, S.138f] refer to four critical points to be aware of in combination with sharing of knowledge:

Incomplete information: The target person in the knowledge flow does not know if the information matches the need.

Knowledge distributed unfairly: As knowledge belongs to a specific person or group, a controlling mechanism to distribute the information would provide safety.

Localization of knowledge: Telecommuters do not have direct contact to their corresponding partners, which may lead to unwillingness to distribute knowledge.

Human barrier: The last barrier is the human factor itself. Knowledge holders may not be willing to share their information, because of personal or social differences between possible receivers and themselves.

2.5.4 Creativity in Virtual Collaboration

Traditional face-to-face collaboration often implicates some tasks or activities that we are not aware of when we think about the advantages of a traditional work-life. A lot of important ideas or inventions have simply "came up" while talking in a relaxed atmosphere or while having breaks together. Creativity is often an important matter for companies to develop new products or just stay in business. Since telecommuters do not share as much time as their local counterparts, they are more likely to seem less creative or they just do not participate in creative processes because of their non-presence.

Three main components are required for creative production:

- Domain-relevant skills and knowledge
- Creativity-relevant skills and appropriate cognitive styles
- Task motivation and self-perception for the task

Higher levels of each component indicate a higher potential for creativity.

The stages of creating an idea differ between traditional teams and virtual teams. After the idea has been generated, the development of solution patterns follows. When a workable solution occurs, the next step is the finalization and the closure phase where everything is prepared before implementation. Evaluation is the last step where the completed implementation is discussed and evaluated. [Nemiro, 2004, S.8ff]

Nemiro [2004, S.12] comes to the conclusion that some of the previously defined four processes differ between virtual and traditional teams. The generation of ideas is mostly given as an impact from outside - so from clients or managers - which eliminates the need for protracted work on finding problems. He also argues that because of the electronically transmitted information exchange, the traditional linear approach of the four steps may not be plausible. After all, the boundaries of the four stages are more likely to become blurred.

To get an idea of how virtual teamwork can look, the next chapter shows an actual business

case study. Of course the presented case study is not representative of all the issues a virtual company may face, but it should help in understanding what issues a company may get involved in, when introducing virtual collaboration.

2.6 Telecommuting business cases

As already mentioned, working from home was primarily a request initiated by employees. When the first companies started to offer virtual workplaces to telecommute, they did this because they wanted to increase employee satisfaction. Additionally, their interests were also focused on the company's performance. They had to keep knowledge about the impacts such changes brought with them, and if this would be a new way for other employees to work as well.

There are many business reports about a company's introduction to virtual work and what effect it had. In general, those reports were written by team leaders who had introduced telecommuting; thus, the results presented were mainly positive. However, a lot of companies really forced virtual work as a model and integrated appropriate tools to further increase the number of such work places.
One early adopter was the North American telecommunication company AT&T.

2.6.1 AT&T [ECaTT, 1999]

AT&T began the first preliminary study on telecommuting in the 1980s and then had a pilot project in the early 1990s. At that time they were the world's largest telecommunication services provider with more than 90 million customers and they employed about 126, 000 people. They operated in more than 280 countries around the world, with customers in the business, private, as well as government sector.

They started an initiative for teleworking primarily to meet provisions of the United States federal Clean Air Act, which started in some US states with pilot projects. Their first step was to train about 200 employees in telecommuting technology, and they then allowed them to work from home once a week. After six months, a survey showed positive results, but not just by reducing commute mileage. Productivity and the morale of the participating workers increased, which led to a company-wide telecommuting policy.

AT&T's next step was to build a task force consisting of representatives from all the company-wide parties involved, which ended in 1992. They started an educational initiative for telecommuting and announced a company-wide Employee Telecommute Day on September 20, 1994. From this point on, they provided their employees the opportunity to get into the program if their job would allow. Finally, even their chairman started to telecommute from home and in 1999 at least half of AT&T's management and professional employees had telework arrangements.

Their conclusions were: [ECaTT, 1999]

- Clear productivity gains by telecommuting employees
- Increased employee retention
- $3,000 to $5,000 per person reduced demand for office space
- Aid to recruiting
- Higher employee satisfaction
- Community benefits (decreased traffic, air pollution)

In 1998, a survey of the participating employees showed major advantages of telework: [ECaTT, 1999]

- It allows employees to balance work and family needs better (83%)
- It shows the company cares about employees and their families (76%)
- It helps to improve productivity (75%)

Employees major or minor disadvantages were: [ECaTT, 1999]

- Loss of camaraderie, sense of being part of the team (major: 25%; minor: 43%)
- Reduced visibility / less recognition (major: 22%; minor: 42%)
- Isolation from business, sense of being out of touch (major: 21%, minor: 42%)
- Do not have equipment required at home (major: 18%, minor 38%)

AT&T is still participating in same external initiatives to force telecommuting and to help reduce traffic and other transportation-related problems.

2.6.2 JDB Associates, Virginia [telework!va, 2004]

With the starting success of virtual work and the impacts on the community, governments started to support businesses by offering aid or money for offering telecommuting work places.
The state of Virginia from the United States did this as well. An association was founded in 2002 under the name of "telework!va" (www.teleworkva.org) which supports companies on their way to virtual work. They also present some successfully implemented examples on their website.

JDB Associates Ltd. is a small travel agency in Virginia, which brokers oversees four and five star hotels to American travel agencies. They operated a call center in Virginia with almost twenty people and the demand for more employees. As their call center environment could not accommodate any more people, they started to look for some other options. The company had no knowledge of telecommuting and so, in 2002, they hired a consulting company. The consultants helped them examine what they needed to do to become successful. Together, they worked out an exactly defined agreement on how to change their business into a company with employees working from home.

After their successful implementation, they grew to 31 employees in 2004. 28 of the employees were participating in full time teleworking, this was increased from three employees when the program started. This number also includes the company's owner. One of the employees even moved to Albany, New York without any change in the collaboration. The entire headquarters now only made up of hotel stations - so when an agent comes in, the individual chooses their working place.

Chris Baer [telework!va, 2004] found the solutions that made this transformation successful: "*Information sharing is the key to overcoming the lack of communication and information exchange. They are currently building an intranet for real time information and a portal for formalized information. A chat room will be open to employees during their business work hours, where they will be able to talk about recommendations for hotels, flights, etc.* ".

3 Definition and orientation of problem fields

The objective of the practical part of this work is to analyze and optimize the company's situation on its way to becoming a virtual working company. Since the progress of working from different places (and in different timezones as well) was never processed as a conscious step, because the company's management style was still in business, this led to different types of serious problems. Their new challenges led to a new demand for solutions that support virtual work. The IT infrastructure used previously was not appropriate any more. They noticed a need for systems and solutions that work across the local borders of the office.

A raw view of the company and its challenges in regard to telecommuting has already been discussed in the first chapter. Now I will take a closer look at the business itself and what it should do about collaboration. This not only includes issues that have already emerged, but also future plans for business expansion.

3.1 Approach for problem solving

There are several approaches available for solving complex problems. This includes the Systems Engineering (SE) model.
Systems engineering is a methodology that can be used in almost any problem solving environment. It works as a framework for ideas, guidelines and activities in order to handle common areas of project management. The processes of Systems Engineering described here are defined by Haberfellner, Nagel and Becker [2002]

The so called "SE Action Model" consists of four basic ideas about how an assignment or problem could be structured and processed. The components are:

Top down approach: the general proceeding from top to bottom - so from a general aspect to a particular one.

Building variants: instead of being satisfied with one possible matching solution, different variants should be figured out to provide alternatives.

Structuring into project phases: the historical course of actions should be organized into different project phases in order to stay focused on what to do next.

Using "Problem Solving Cycles": problems should be processed through a cycle of thinking logic to find matching solutions.

Figure 7 shows the four components and their relations to each other.

The four ideas of the SE model can be used in a flexible manner, which means they can be adjusted for different problem fields and situations. The top-down approach, where one starts at the highest level and separates the process down into smaller parts, should be kept in any case.

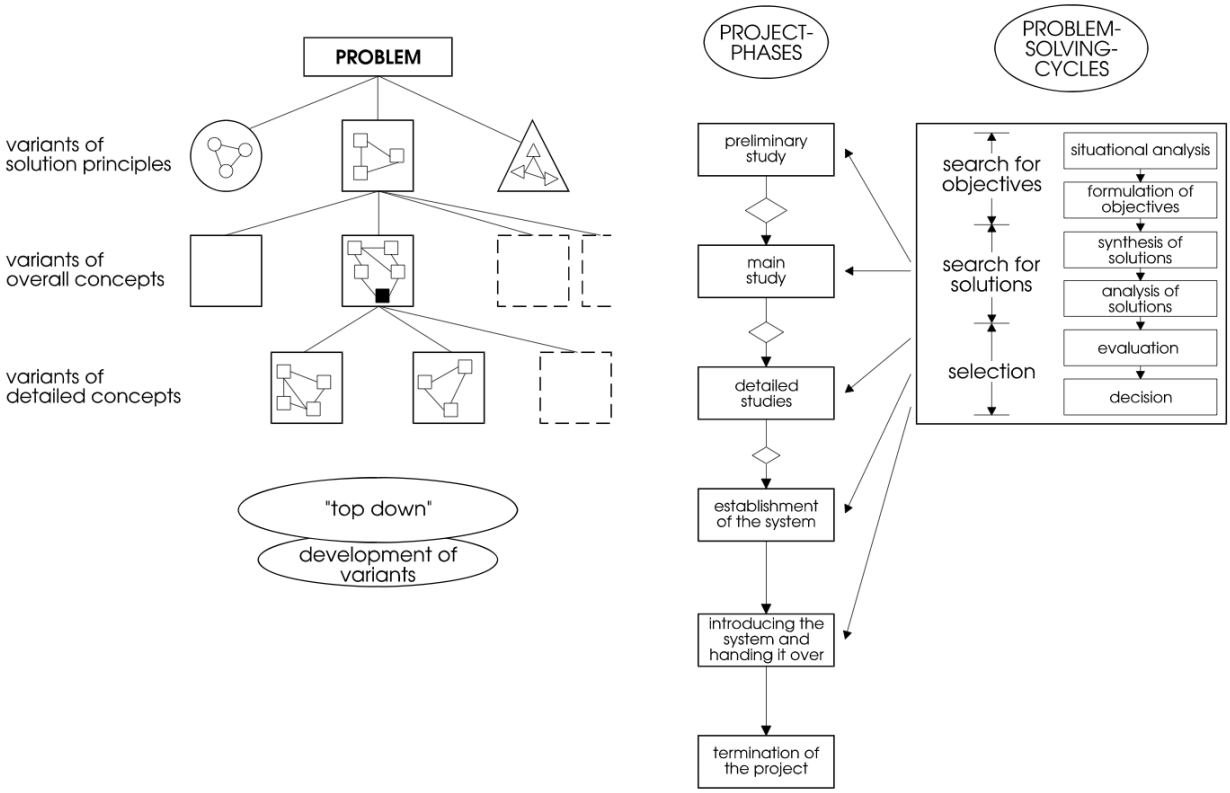

Figure 7: Four action model components of systems engineering. [Haberfellner et al., 2002]

Every project should be divided into different project phases. Different levels of studies could be done here, which result into different solutions variants for every phase. In every one of these study-phases the "Problem Solving Cycle" PSC could be used as a general guideline for solving problems.

The first two studies of the phases model had already been executed by the company before. In a first phase, they had to decide about their general continued handling of virtual work. Differences in the way the company collaborated between internal employees and external employees caused social problems. External employees had more rights in terms of flexible work hours than internal ones did. Management had to decide which way they wanted to go - whether they wanted to strictly separate collaboration between both parties or if they wanted a general virtual work environment where all employees could participate.

When they chose to extend their virtuality, they knew that technical solutions would be required to fulfill their new needs. In this second phase, their variants were to either look for one general solution or to implement various individual solutions for every need. Individual solutions had two major benefits. General virtual company solutions provided a lot of functionality the company did not realize was needed. It would be much easier and also less expensive to only look for solutions for individual problems. The other benefit would be that smaller systems would be

easier to handle and it would take less effort to train employees.

Baschab and Piot [2007, S.43] explains the relation between costs and satisfaction of software. While a general solution for all virtual working issues would be categorized in quadrant number 3, the company was looking for a solution in the area of quadrant 2. The goal was to find an appropriate way of managing without producing additional costs. The solutions did not need to be "the perfect solution" - they should do the job without high costs.

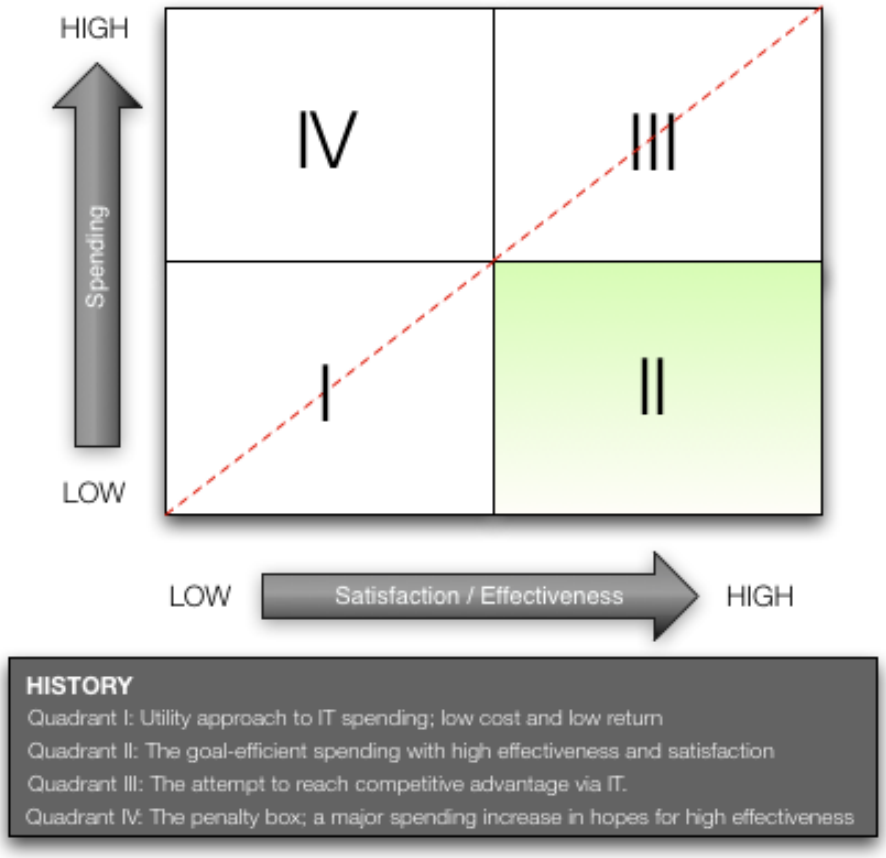

Figure 8: Classification between IT spendings and its effectiveness by Baschab and Piot [2007, S.43]

Application of problem solving model

The first step to optimizing the infrastructure is to understand the individual problem areas. Management as well as the employees have to define what in their opinion has to be optimized. This goes hand-in-hand with the definition of future target specifications, which they want to fulfill with the newly implemented infrastructure. Dividing these suggestions into specific technical problem areas should be possible in order to begin with the next step.

After objectives for every problem area have been defined, possible solutions then have to be found. There is often more than one possible solution to solve a problem - so, by looking at different approaches, the quality of the result should be higher.

The third step is to analyze the solutions found. It is also important to filter out all solutions that do not fulfill the mandatory requirements a solution has to match. This step may also result in the need for changing some objectives because of interdependences or the fact that some of these mandatory requirements cannot be achieved.

The most appropriate approaches have to be selected out of the filtered ones, and because there are different methods of how selection can be done, an adequate one should be chosen. Finally, the implementation process can begin.

Figure 9 shows the order of events of all steps.

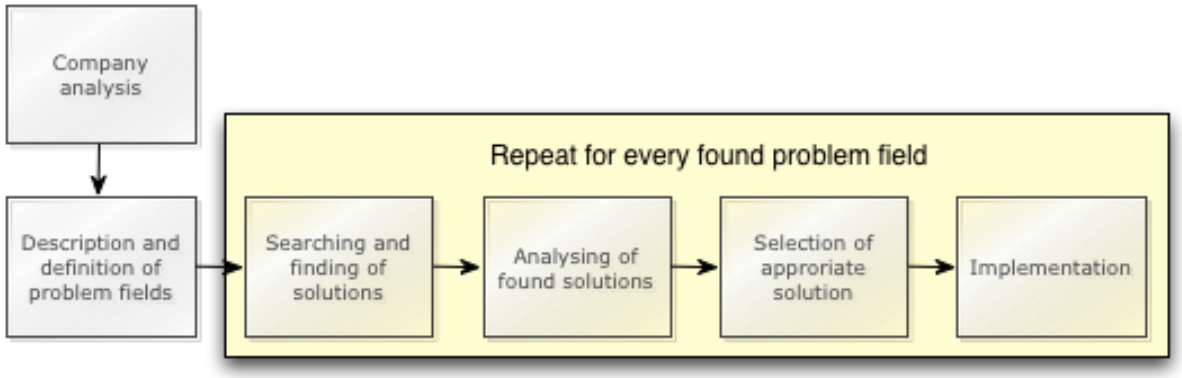

Figure 9: Order of events from company analyses to implementation of solutions.

3.2 Closer look at the company

As discussed in the first chapter, the company could primarily be divided into four different types of workers. In addition to employees working from within the company's infrastructure, there are also highly integrated employees who work externally. These employees may only work externally for a short time span, i. e. a single day or for a much longer period, i. e. a couple of months.
Another group of connected people are former interns. Usually the company employs two or three interns who oftentimes come from foreign countries. Some of them continue to work for the company after they go back to their home countries. This is really interesting when they come from a country where TriVolos is already operating or plans to do business in the future.
The last of the four types of employees are partners that have no direct relationship to the headquarters and have never worked there. These "partners" include normal business partners and contracted employees.

The company's business model

When TriVolos was founded in Graz in 2003, their main focus was on creating different online shops and gaining revenue by selling products online. The company was a classic trading company without any business outside of the internet. All customer and supplier contact and support was done online. Their delivery warehouse was formerly located in Graz as well, but since there largest customer base was in Germany, they selected a warehouse partner in Germany.

Since about 2007, they used their self-developed shopping system to extend their business model. They started to offer their technology as a service to other companies that needed online shopping systems or other services associated with online shopping. They also began to develop other software solutions related to online shopping. In addition to their main business of trading goods online, they also acted as a service provider.

Tasks processed within the company can be separated into project-based tasks and recurring tasks. Because of their trading business, they defined standard activities as processing orders or handling customer support. However, projects required a more flexible way of handling related activities.

Different views on the company

To get an idea how the company and its employees collaborate, different points of view were generated. The first view shows the structure of the company in a traditional organizational diagram, as can be seen in figure 10.

to show the hierarchical structure of the company. Management represents the decision-makers of the company who are also the company's founders. One of the two business sectors is the traditional trading market, which they started first. The tasks within the trading business can be separated into tasks to maintain their activities (like order handling) and activities related to new businesses. They work on the development of new business ideas and implementation.
The next business sector is a project oriented service business. They build project teams to work on specific activities as a service for business customers, as well as on their own interests. The amount of coexistent active projects ranges from one to four. People are mainly assigned to just one project at a time.
The last sectors should be seen as a staff function - i. e. a center for services used within the company. This is required, because most projects (and the trading sector) need to establish tools or other services. The two areas in this sector are design (especially web design) and software development.

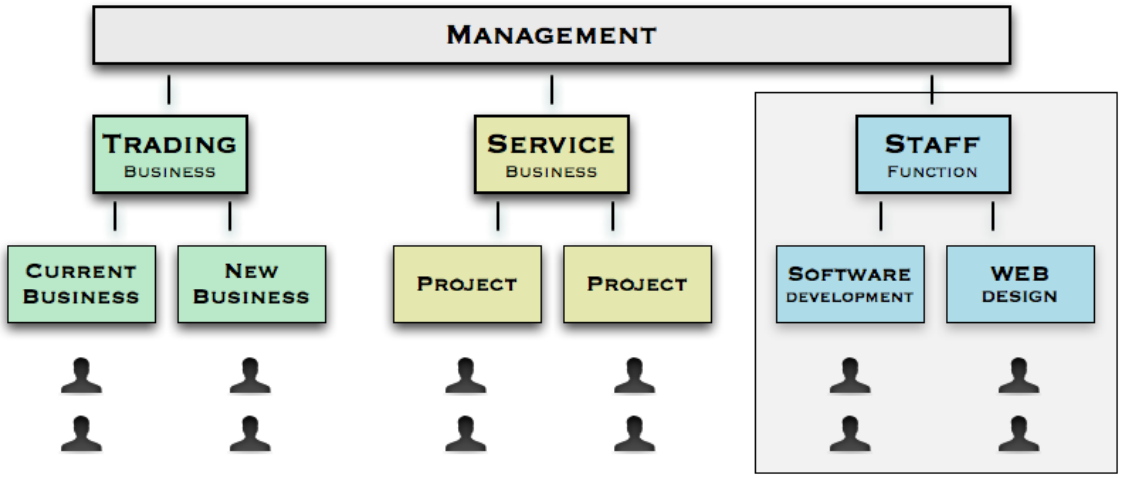

Figure 10: Company analysis: Organizational diagram of main departments.

A collaboration view was created in order to see how the employees communicate within the company. Figure 11 shows this with the example of two active projects.

Once again, the figures shows that most employees are assigned to one sector only. Only a few workers act as an interface between these sectors - project managers are normally not assigned to one project only, but the internal staff function often operates between different projects while they are in progress as well.
Each section is relatively isolated from the others, so an easy exchange of employees or knowledge could not be provided. The effort to re-skill an employee from one sector to another is often as difficult as training a new employee. This also shows the strong boundaries each sector has, even if the company is small, with small manageable teams.

Summary of information flow

After looking at these two different aspects, the next step was to display all of the major problem areas in one graph in order to recognize possible connections. The goal was to show which paths of communication were influenced by switching to virtual work. Some of the collaboration interchanges did not change since virtual working employees were involved - others did.

Figure 12 shows the new situation with its boundaries and its ways of interchanging. The document system and especially the knowledge base only existed in a very rudimentary way.

The figure shows important new awarenesses that have to be considered when designing a general solution concept. There are two different types of external partners. They differ by their need for shared knowledge within the company and their level of communication with employees.

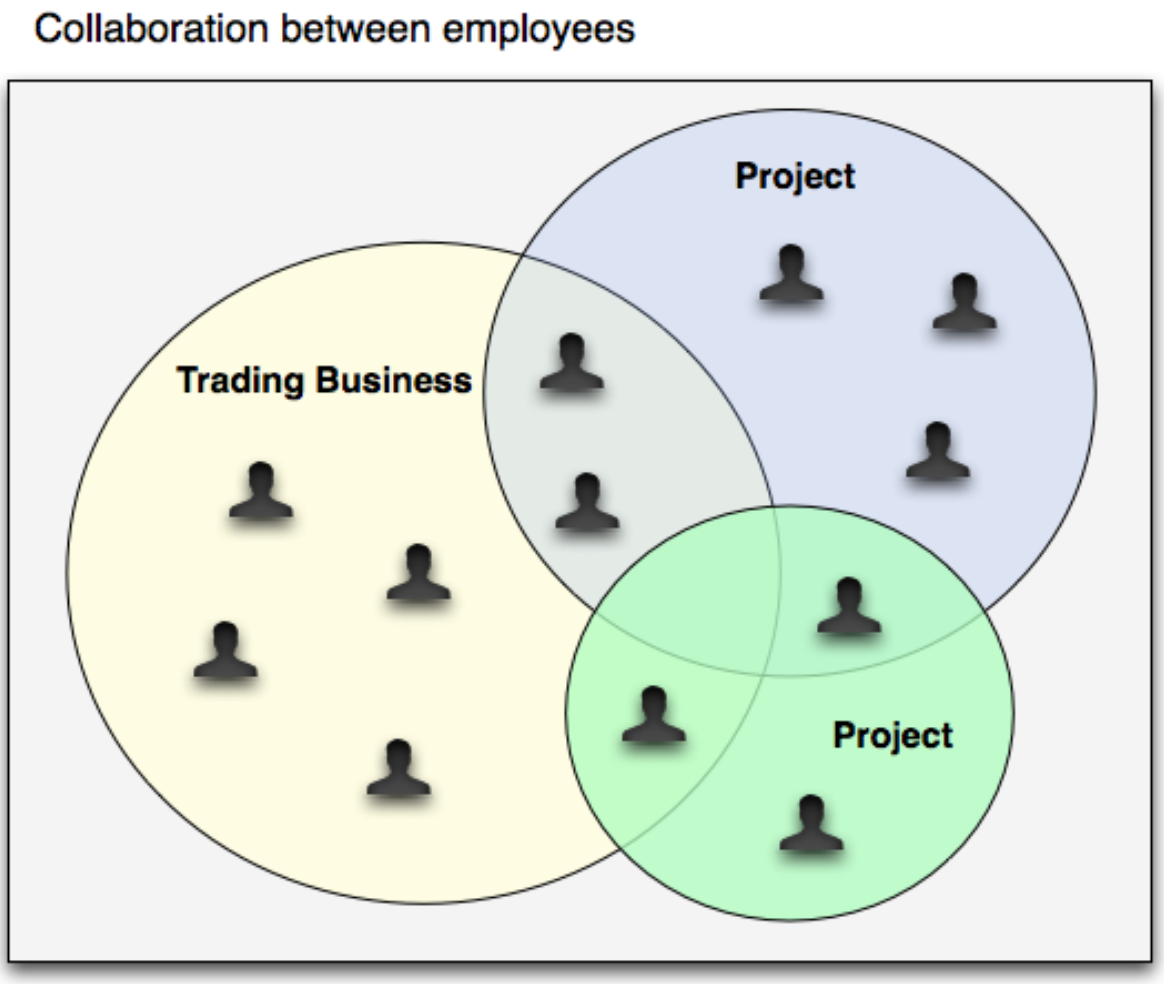

Figure 11: Company analysis: Collaboration boundaries between employees.

Those partners are called integrated external partners, because of their higher level of integration. These partners all work on contract and are payed on a per hour basis. Therefore, the company is interested in optimizing and controlling their processes and activities.
There are also external partners that work independently of the company. Those partners are typically larger supply companies without integrated process in TriVolos. They are mostly payed for a delivered product or service, and therefore efficiency is not important for the invoiced company.
Independent of their type of partnership, the communication between TriVolos and the partner works through defined communication paths. Every external partner is assigned to one or two internal employees who handle all correspondance with them.

Internal employees are more integrated than external partners. They are the company's foundation and have other needs and demands than their external counterparts. As already described, some integrated external employees require access to a shared knowledge base. While this is only

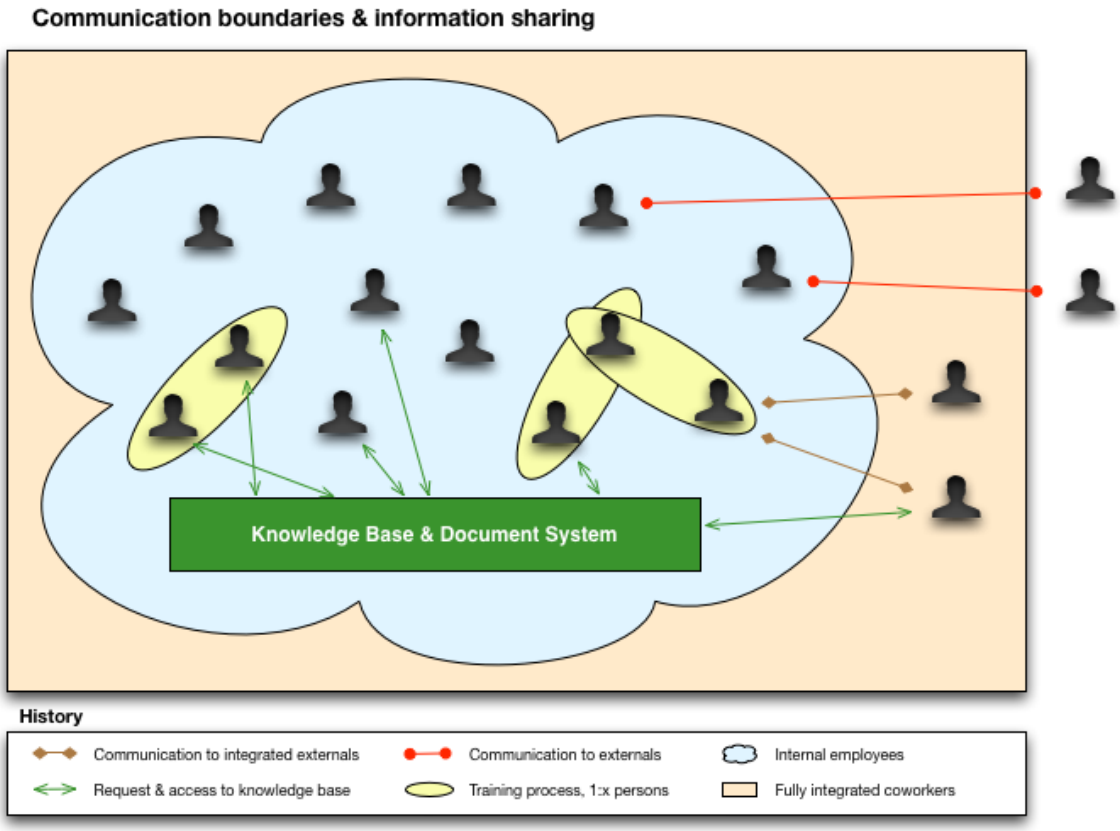

Figure 12: Company analysis: Communication boundaries and information sharing.

true for some of them and in a limited form, all internal employees need this shared base of knowledge for their daily work.
Internal employees need permanent access to a knowledge management system as well as access to a system that stores produced documents in different formats. Spreadsheets, presentations and other forms of documentation are created while working on projects and tasks. These files have to be stored in an appropriate way in order to keep them structured and accessible. Both are essential systems for collaborating employees.

The last important fact that was realized is related to training and learning. The typical training process took place between two or three people, where one operated as the trainer and the other(s) as trainee(s). This only occurred with internal employees - external employees did not receive training in a narrower sense. External employees were introduced to systems or schemes, but did not receive additional information. Internal employees received different trainings concerning their fields of work. Training always took place live and, therefore, assumed the presence of all involved parties. Often knowledge and documents had to be accessible for learning purposes, which means that all people had to have the ability to access existing resources.

3.3 General guidelines for finding solutions

In order to evaluate possible future solutions, the company defined some general guidelines concerning them.
There are three different objective types for guidelines:

Mandatory objective Mandatory objectives have to be fulfilled. Solutions that do not match have to be eliminated, because these cannot be implemented.

Requested objective These objectives are very important and therefore have high impact in the decision making process.

Desirable objective Desirable objectives are less critical than requested ones, but are also objectives that are intended by the management.

The definition of general guidelines is very important because of the company's future expansion plans. This includes possible new countries for trading businesses - which would lead to new virtual employees working from those countries.
As already defined in the first company review, the company had some ideas about how solutions should look.

Worldwide usable All systems have to provide full virtuality in a way that it would not negatively impact the location were the employee works from.

Easy to use Since the company works with a lot of different people (also temporary employees like interns), the training time for the new systems should be as short as possible.

Easy to administrate The company does not employ a technical administrator, so all systems should be easy to administrate for employees with a technical background.

Security mechanism An adequate security system is especially important, because data will be shared through the internet. Not every employee should receive equal rights on systems.

Future-orientated Solutions should be based on modern technology in order to ensure that the solution will last for as long as possible.

Depending on the problem field, other different aspects may be used to distinguish possible ideas.

Another important factor is cost. No exact maximum budget was given, but money is a very important factor when comparing solutions. All of the points presented above are also related to expenses as well - either directly or indirectly.
Generally, IT solutions can be divided into cost forms that are either a one-time fee for purchasing a product/license or other forms that are periodically billed systems. The latter are often easier to finance for smaller companies. Nevertheless, in both cases the system has to be maintained.

Maintenance costs are even more important for the company because they are hard to calculate and the process of maintenance requires manpower that they generally do not want to employ.

3.4 Prearrangements for Virtual Collaboration

Lipnack and Stamps [2000, S.102] wrote "it is 90 percent people and 10 percent technology" - meaning the success factors for implementing virtual working environments. In addition to the technical tools needed to build a base for virtual collaboration, the human factor is very important as well. That is why this chapter shows relevant impacts referring to future system users.

3.4.1 Successful migration

A common purpose is a very important requirement in all networking actions. A strong requirement for a common goal is the success factor for this purpose. The human impact is essential here and requires the person to adopt the goals and purposes gradually. [Camarinha-Matos et al., 2005, S. 192f]

In research, trust is often said to be the most critical part when implementing virtual work. Without trust and respect for employees, the team would not be able to work together. Meetings and discussions would be less effective and innovations would suffer. [Fong, 2005, S. 145ff]

Fong [2005, S.47ff] names five key success factors for virtual collaboration:

Trust Foundation for human relationships.

Purpose and commitment Members are committed to purpose and goals.

Identity and group affiliation Every team member takes a role within the team.

Team style Rules, standards and team values define the way people are interacting with each other.

Communication Interaction itself is important.

Fong then did research based on these five critical factors. Team members were asked about their situation in a virtual team.

Table 1: Survey in a virtual team about key success factors

Key factor	Strongly required	Required
Trust	69%	20%
Purpose and commitment	61%	33%
Identity and group affiliation	68%	26%
Team style	51%	40%
Communication	40%	48%

The results shown identify the first four factors as the most important; whereas, communication does not seem to be so critical.

Fong [2005, S.50ff] also gives advices about how team leaders should interact with their team members. The suggestions are again divided by the five criteria above.

Trust Trust becomes more important the more virtual a team is organized. An open flow of information helps to provide a trusting relationship. Judging should only be done based on output, not the process of work. Leadership building and face-to-face meetings should be organized in order to maintain relationships. Above all, the principle of leading by example is an effective way to establish trust.

Purpose and commitment Leaders should establish a vision and communicate it to its members. This also includes the way to go, and how to reach the goals.

Identity and group affiliation Starting with real world interactions like face-to-face meetings or team-building exercises help to build a base for a relationship. By making the whole team transparent to every member, they would be able to maintain an image as a whole. Providing additional information, in addition to directly work-based, is helpful. This should act as a virtual water cooler for sharing private as well as task-orientated news.

Team style Methods to amplify energy within the team, help with motivation. Celebrating accomplishments is also an important part of teamwork and should be done in virtual spaces as well. An internal style way of how the team deals with problems (also personal ones) should be established.

Communication Continuous communication from leader to member is important in order to not lose them. Paths of communication should be defined and rules made to help maintain them.

All the above mentioned points are mandatory for implementing virtual workplaces. It is the responsibility of the management team to permute them in their daily work-life.

3.4.2 Using digital media

A basic requirement for virtual work is that the task to process itself could be accomplished virtually. For knowledge workers this should normally not be a problem, but often exact boundaries between virtual tasks and real world activities are not clear. A lot of tasks need the office infrastructure and thereby, have to be processed by a local person.
A goal for the company should be to allow as much work to be done without the office infrastructure as possible.
This should be done for two major reasons:

Less diversity between local and non-local work to integrate foreign working employees in the same way as local ones. The place where the tasks are processed should be as unimportant as possible.

Equality for as many employees as possible concerning their chances to work from home or other places. People who require a local presences in the office may envious, because of their disadvantages in matters of balancing private life and work.

The company's activities can be separated into two different businesses - the project business as well as the trading business. This is where the projects generally allow more virtual work because of the knowledge related work, the trading business also involves some traditional office work. This includes a lot of paperwork, like sending and receiving letters, using the fax machine, handling incoming invoices and much more.

The goal has to be to digitize as early as possible and work in digital form as long as possible. Data should be created in digital form and maintained this way. This is an important step for every company that starts virtual collaboration. By keeping information digital, the necessity of local presence becomes less important. Digital media can be transported and multiplied with much less effort and that's how it enables external employees to work as if in an office spatiality. [Lipnack and Stamps, 2000, S. 111f]

3.5 Description and definition of problem fields

After presenting a general view of collaboration in the company, the next step was to rethink the three challenges described in the introduction. This should be done by analyzing the actual situation of each problem area separately. Afterwards, the company had to describe their objectives for every domain. By analyzing these objectives, technical problem fields showed up. Every "weak spot" found will then be processed separately in order to find appropriate solutions.

3.5.1 Information distribution

Communication is an important foundation for teamwork and collaboration. Therefore, every company is interested in controlled distribution of company related information. This includes information about general company facts as well as information concerning the employee's involved projects or activities.
Information distribution is an elementary concern for every virtual working company and thus, one of the areas the company needed to improve.

Situational analysis

The company began to work virtually around 2008 when their managers started to work from abroad and the first interns returned to their home countries. From then on, the amount of tasks virtually processed increased continuously. The company and its employees suffered the consequences of coworkers not being in the office when working abroad. This was caused by the fact that all company related information was transmitted in an uncoordinated way without any strict rules about what and how and to whom information should flow.

As already mentioned in the first chapter, the information could be divided into information concerning general news related to the company and information related to a specific project or task an employee is working on.

General news and informations about the company were usually distributed in casual situations. This is known as the water cooler effect, which means that a lot of communication is done when people just share a common behavior by chatting at a local central point in the office. The company also used to go out for lunch together where they did some information exchange. During leisure times and casual situations, they talked about things going on around the company. This communication was only processed between the people present - which already led to problems for those not present. There was not a defined path for the flow of information either. The situation came up that some employees thought that others had the same information level as themselves. This was not only a problem for virtual employees, but local employees as well that worked a flexible work time. E. g. people thought that some tasks they were waiting on would be completed by a fixed day, not knowing that the colleague who was supposed to process it was ill and could not finish it on time.

Project related information was requested more often by employees, than actively distributed by managers. At that time, the company seldom had projects involving more than two employees, but expansion required changes. Project communication was not as complicated as sharing general news was - they only suffered from situations where colleagues were not available when information was needed.

On the one hand this demotivated employees abroad and it also made them feel excluded, because they were unable to participate in these “casual meetings”, situations like having lunch or a coffee break together.

Solution requirements

Management had no exact idea of how a possible solution should look.
Their main objectives were to

- **equate local and virtual working employees.** At that time, the possibility of working abroad was limited because of actual missing information flow.

Table 2: Objectives for information spreading

Objective	Mandatory	Requested	Desirable
Equation of all employees	x	-	-
Access for every employee	x	-	-
Restrictions for externals	-	x	-
Easy Handling	-	-	x

- allow everyone to access information. A global working communication system was required no matter what role an internal employee fulfilled.

These objectives were mandatory.

General company information also needed a closed environment to protect content from third parties who should not have access to it. Therefore, access to information had to be managed and restricted.
The last requirement was to distribute news in a simple way so every employee could join the system without needing complex introductions to the system. This includes an easy way to multiply information from one host to all employees with little effort.

3.5.2 Knowledge management

When the company was founded, attention was not given to knowledge or information management. This topic started to become more interesting when they had their first employees and they realized that knowledge, gained in the company, had great value. Knowledge related matters started to increase especially when the company began to work virtually.

There is close connection between data, information and knowledge. Where data is raw facts out of context, information uses data in correlation to organizational aspects like people or technology. Knowledge combines information with other personal attributes like experience, beliefs and insights.
The combination of these three have to be considered in virtual working companies. First, distribution across borders has to be ensured. Next the motivation to share information is needed and has to be encouraged. At last, the aspect of knowledge sharing as a dynamic process should be considered. [Fulk et al., 2005, S. 158ff]

Kimiz [2005, S.50ff] shows different models of knowledge processing and management in theory. All of these knowledge management cycles have three steps in common that need technical support: storing knowledge, finding knowledge and updating knowledge.

Situational analysis

The company had no real working knowledge management system, nor did they have defined workflow for gaining knowledge. They were testing a web based system where coworkers could enter text and afterwards edit and search for the content. The system had a basic access management feature, but because of the complexity, the program was used by the technicians only.
Most often the employees stored the information they needed on their local computer for their own use. Therefore, when someone was searching for some information, there was a high likelihood that even if a colleague did already have relevant knowledge no connection was built. This led to additional search time and thus to extra costs. Another problem was the loss of knowledge when an employee left the company.

The existing system, which was partially used, brought benefits for participating employees. Since it was only used by technicians, IT and software developing processes were supported by a shared knowledge solution. The system, however, had no version control. Any changes that were already made were lost, so only the actual information was available.
In order to access documents (like presentations or spreadsheets), which should be shared between team members, the files were stored locally on a server in the office. This server allowed access for employees that worked abroad, but simultaneous multiple modifications were not possible.

The second important part of handling knowledge was the transmission between sender and receiver. Trainings were only conducted face-to-face in the office and between two people. The training process was not documented in any way, which means that the same process was done whenever a new employee had to be trained. This was time consuming and also led to the problem that the information holder had to be present to answer questions or give instructions.

Solution requirements

The objectives for managing knowledge were separated into two different technical needs. First, a system to store, find and edit information was required. Second, they way the (virtual) training is done should be optimized.

Kimiz [2005, S.50ff] formerly defined three basic components of handling knowledge by a technical system had to be considered - so saving, finding and editing. A system should be found that could be used by every employee in the company. This implied a system where all kinds of documents could be handled. When a set of data is updated, older versions of the information should still be accessible.

The training process could not be defined in the same restricted way. The general objective was to find an appropriate style for virtual training.

Table 3: Objectives for knowledge management system

Objective	Mandatory	Requested	Desirable
Version control	x	-	-
Easy textual content handling	x	-	-
Document management integrated	x	-	-
Search in textual content and documents	-	x	-
Single user management	-	x	-
Access control	-	x	-
Linking mechanism within the system	-	-	x

Table 4: Objectives for training system

Objective	Mandatory	Requested	Desirable
Sharing same view (desktop)	x	-	-
Slow internet bandwidth usage	x	-	-
Independent on operating system	x	-	-
Integrated audio channel	-	x	-
Recording functionality	-	-	x
Ability of one-to-more trainings	-	-	x

3.5.3 Task handling

The way in which people collaborate changes when their colleagues are distributed around the globe. The management and handling of internal activities becomes the focus and thus more important.
Workflow management systems are instruments to model and execute workflows by using computerized support. Such systems are used to handle which task is done by whom, where, when and how. Workflow management systems can be used by any company size or organizational form. Virtual working companies especially benefit from implementing a management system to keep control of all tasks. [Amberg and Zimmermann, 1998, S. 108ff]

Activities are often subtasks for achieving a greater goal - thus, there are projects for other projects and tasks. This top-down approach has to be handled and coordinated and this leads to task accomplishments. Negotiations between local and virtual teams are required, so all involved tasks become summarized within the greater project. These activity and sub-activity relationships are also part of virtual project models and need to be represented in a solution that supports distributed collaboration. [Martiin et al., 2004, S. 92ff]

Drucker [1985, S.83] puts it this way: “Productivity is a difficult concept, but it is central. Without productivity objectives, a business does not have direction. Without productivity mea-

surements, it does not have control."

Situational analysis

The company divided their activities into two main categories: routine tasks and project-related tasks. This was done because normally every employee could be assigned to either one of them.

Employees working on routine tasks (like order and mail processing) did their work without any supporting IT system. There was a general understanding of how long a task should last and how many employees were needed to keep the business running. Since there was not any planning, potential work often seemed uncoordinated and employees actually allocated to project work had to help out. Other times, when business was slower, the people working on routine tasks were underemployed.

The company needed a system for working on projects that was able to plan activities and monitor the current status. So they introduced a simple project management software, including charts and resource planning. The next step was to keep control over the time spent on a task within a project, so they were able to keep track of whether they were still on schedule. Since the software they were using did not have this kind of functionality, they implemented their own tool to import tracked times into the project software. The functionality of the tool was simple: an online website showed all tasks previously (in the other software) created with a field to enter the amount of time worked on that particular task. Since it took some effort to synchronize the collected data with this software combination, only a rough structure of tasks was mapped. A lot of smaller tasks were summarized into a greater one and then integrated.

Only because of this software, partners were able to work abroad without losing complete track of the actual status. Even though it was not perfect, it was a first step to working virtual. Nevertheless, there were some points where these solutions were problematic.
Because of the roughly integrated task structure, monitoring employees was not possible. Therefore, employee virtual work was based on trust. There also was not any real task management so priorities or deadlines could be organized. The self-developed tool had some issues as well. Statistics were only available through the project management software - and then the numbers were inaccurate. The program also had some bugs and was not convenient for use by every employee.

Finally, the weekly worked hours of every employee were written down on a sheet of paper in the office and once a week transcribed into a spreadsheet application. Virtual working employees (and partners) used the project management software to submit their hours.

Solution requirements

This was the main part of the practical chapter. Where knowledge/document management and a global communication are standard problems for many traditional and virtual companies. Task

Table 5: Objectives for task handling system

Objective	Mandatory	Requested	Desirable
Usable for routine tasks	x	-	-
Usable for project related tasks	x	-	-
Simple project management functionalities	-	x	-
Exact measurement of processing times	-	x	-
Allocation of tasks to employees	-	x	-
Structuring of tasks and projects	x	-	-
Detailed statistics on tasks and employees	-	-	x
Live tracking of tasks	-	x	-
Live view of actual processed tasks	-	-	x
Intelligent access control	x	-	-
Marginal extra effort	x	-	-
Output of weekly/monthly employee work hours	-	x	-
Basic human resource functionality	-	-	x
Error and manipulation detection	x	-	-
Notification system	-	-	x
Cost calculations	-	-	x

management is much more complicated in a virtual working environment. Especially here, the company already had some experience with IT solutions and developed a tool just to fulfill the main assignment. Because of their knowledge and experience, they had a more detailed idea of how the solutions should later look and what they should be capable of.

The major objective was to combine all employees into one system. This was also important because the strict separation between routine tasks and project work was not appropriate any more.

A completely new solution had to be found that integrated aspects of project management and time tracking, as well as planning and controlling mechanism. There was also a long list of requested and desired objectives that would help to reduce the effort of managing employee related activities.

Usable for routine & project related tasks

The system has to handle some fixed routine tasks as well as tasks that are part of projects and thus, be processed just once. Activities need some extra attributes, especially when working on projects. Some simple project management properties would be helpful. Therefore, it should be possible to mark tasks with actual status information e. g. “in progress” or “completed”. Also deadlines are important for projects as well as tasks. In addition, projects often include activities that depend on each other somehow or need to be subsequently processed.

On the other hand, routine tasks are more open - so different people may process one and even the same task at the same time.
Level of importance: mandatory

Simple project management functionalities
The company usually worked in small groups of people without any resources other than manpower. As already mentioned in the first objective (usability), projects and their tasks require some additional project-related attributes for appropriate representation by a computer system. Dependencies, deadlines and assigned employees are important for teamwork and therefore are required in every project management system. Those three attributes should be implemented and be represented in a project.
Level of importance: requested

Exact measurement of processing times
When the managers began working from abroad, they had no real knowledge about what was going on in the company in Graz. This was also a trust issue and led to mistrust between employees and managers. The new system should support both parties by collecting information about who did what and for how long. This should be done in an exact way - so everyone involved are able to trust the work hour numbers.
Level of importance: requested

Allocation of tasks to employees
The next important feature of project related work is the ability to allocate a specific task to an individual team member. This implies being able to set "to dos" for individual employees that then have to be processed by priority. Routine tasks should be allocated to more than one employee.
Level of importance: requested

Structuring of tasks and projects
One feature specifically for project work is the ability to structure its tasks and sub-projects. Projects often are structured into sub-projects and so on - the top level approach. This feature is mandatory and should allow an infinite depth of containing sub-elements. Special features are copy and move functionality to reallocate tasks into other sub-projects or to use them as a template. Templates could be useful when projects containing the same tasks are needed more often - like installing a new online shop with all its tasks.
Level of importance: mandatory

Detailed statistics on tasks and employees

Different views on the collected data could be used to show information about how the progress of a project looks. Also statistics about what kind of tasks were processed by the entire company, and how many hours of work were spent for a specific project could be useful. This feature was classified as desirable, because if all the collected data is already available, then views generated by a spreadsheet program would initially work.
Level of importance: desirable

Live tracking of tasks

One of the most important features of the software should be to track time on tasks. The tracked time data could be used to view statistics and other information for all parties involved. The tracking itself should happen live - so time should be tracked at the moment when the task is processed. Another option would be to enter the information after a working day or once a week but this would need a second method of protocoling hours used. Besides only live tracking would ensure that no misusage (entering wrong data) could happen.
Level of importance: requested

Live view of actual processed tasks

A favorite feature of management was to see what tasks employees were currently working on. A live output of every actual running activity would provide management with more trust about what is going on in the company when they work from abroad. This feature could also be used to see if an colleague working abroad is actually working or if they are taking a break.
Level of importance: desirable

Intelligent access control

The software should be used by every involved member of the company. Therefore, every employee has to have access to it. Management wanted some more features that would not be accessible to external employees or even internal employees. Especially, project or task costs should not be accessible to every employee. This feature is also important because the system should be as easy as possible to use and therefore all unnecessary information or functionality should be faded out.
Level of importance: mandatory

Marginal extra effort

One of the first named objectives when talking about an additional task handling system was the simplicity of the system. After introduction, no additional time should be spent entering data or get wasted by"usage" of the system. Of course it would not be possible to reach a "no more effort"

goal, but in comparison to the time needed to build spreadsheets manually, the time used for live tracking should be less. Especially the permanent action of switching a running task should be optimized so that only little time is needed.
Level of importance: mandatory

Output of weekly/monthly employee work hours

Not only the management should benefit from the introduction of such a system, but also all employees. Since all data would be collected automatically, the system could also be used to inform coworkers about their actual hours worked per week. This is very convenient, because almost all employees have a contract based on their weekly worked hours. By implementing statistics about weekly and monthly processed hours, it would be much easier for them to plan their weeks. The company generally accepts flexible work time and so, without such a tool, it was almost impossible to plan times.
Level of importance: mandatory

Basic human resource functionality

Not only could work hours be tracked by the system, but also all other hours and days that occur in relation to employees. Employee's days off, general holidays and sick days could be entered and managed. This would significantly reduce the required time of calculating it manually for the payroll department. The problem here is to handle different holidays in different countries as well as different kinds of contracts between the company and its employees.
Level of importance: desirable

Error and manipulation detection

The system should build trust and so the entered data has to be correct at any rate. Two major impacts could break this trust: errors in the system and purposeful manipulation. It is crucial for every party to be able to rely on the system's information. Errors in the software and "back doors" have to be avoided as well as the possibility to enter incorrect data. Changing data should not be possible without manager authorization.
Level of importance: mandatory

Notification system

As already explained, a notification system for manipulating data should be implemented. Manipulating data does not necessarily mean that someone wanted to "cheat" the system. Authorized changes should be noted through a notification mechanism. Other important forms of notifications are task or project related. This feature is important to keep in touch - especially if the manager works along side their team.

Messages about when a task is completed or a project is finished would ease collaboration
Level of importance: desirable

Cost calculations
An interesting feature would be to be able to calculate project costs directly in the software. Calculation of employee costs related to a task or for a time period would be a benefit of such a solution as well. In order to calculate such costs, hourly rates of all employees have to be entered.
Level of importance: desirable

A company analysis for TriVolos was completed and three problem areas (communication, knowledge management and task handling) were defined. Each of these problem areas required a different solution in order to optimize the current situation. The objectives of each were defined and categorized.

The original challenges were met by finding appropriate solutions for each separate area:

Insufficient information: A simple **information distribution system** was requested where one sender could easily transport news to multiple receivers.

No knowledge management: The knowledge management issues were separated into two required technical solutions, because after defining the objectives, they were easily divided.
First a **system to store, manipulate and search for knowledge** had to be implemented. This system would act as a database for all kinds of information including documents.
Second an **application to train employees** was needed as well. The training process required a tool for audio transmission as well as screen sharing for instructional purposes.

Poor task handling: TriVolos needed a **task handling solution** that had to fulfill many preassigned objectives. Since the company had already developed a small tool for tracking work time, they knew exactly what they wanted.

Four technical solutions were requested that would meet all objectives and would solve their issues concerning virtual work. The diagram in figure 13 shows the path from the problem areas to the requested IT solutions in a simple graph. The next step would be to find and analyze solution patterns.

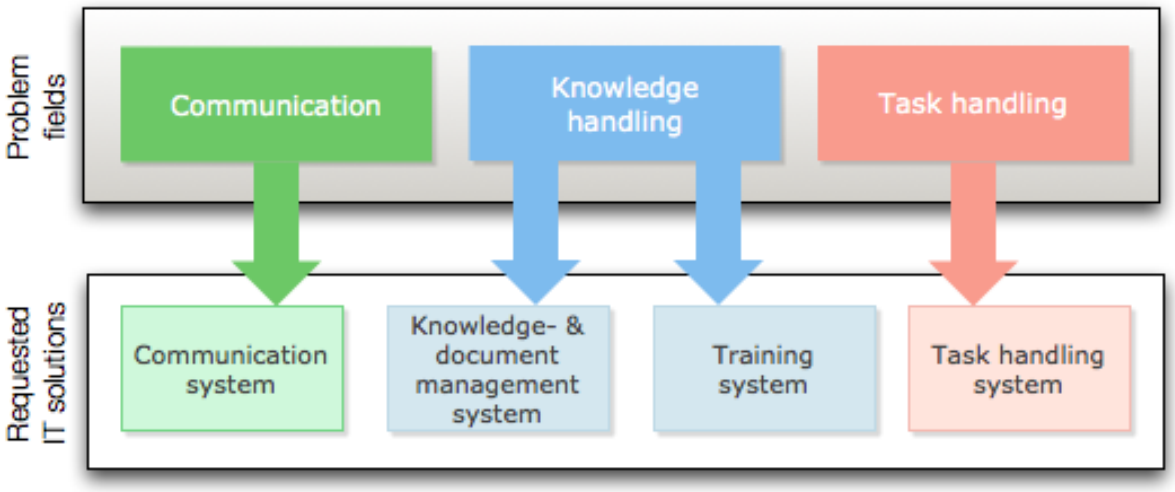

Figure 13: Transformation from problem fields to requested IT solutions.

4 Practical approach on problem solving

The formulation of objectives thanks to the use of the problem solving cycle showed that the three previously defined problem areas lead to four different requested technical solutions. The next step was to find IT systems that would solve their issues and thus optimize their virtual working business.
A general approach on how to find solutions is presented for each of the four IT fields. Afterwards, research for solutions was executed, which was then analyzed to see if it matched the mandatory objectives. The remaining systems where then evaluated and one solution was selected for implementation.

4.1 Information distribution

Information distribution is a general issue for every company. While bigger companies often have defined ways of how information has to be transmitted, and which path it has go to, smaller businesses like TriVolos normally do not have such an infrastructure.

In order to find possible solutions for communication issues, the available technologies had to be compared. The transformation of information is divided into two major categories - synchronous and asynchronous communication. Every form of communication may be categorized into one of these, even if modern internet technologies seem to merge them.

Definitions by Coakes [2006, S.65] :

Synchronous: Simultaneously. Live conversation

Asynchronous: Not synchronous. Conversations with time lags, as in e-mail.

Figure 14 by Woods [2005, S.297] shows what place communication captures in a company's way of working. Communication is one of the two links between management functions and the employees workspace needed here.

He also provides a list of synchronous and asynchronous methods of communication.

Synchronous/real-time communication forms (by Woods [2005, S.299]):

- Instant messaging and chat
- White boarding
- Application and screen sharing
- Video and audio conferencing

Asynchronous forms of communication (by Woods [2005, S.299]):

- E-mail

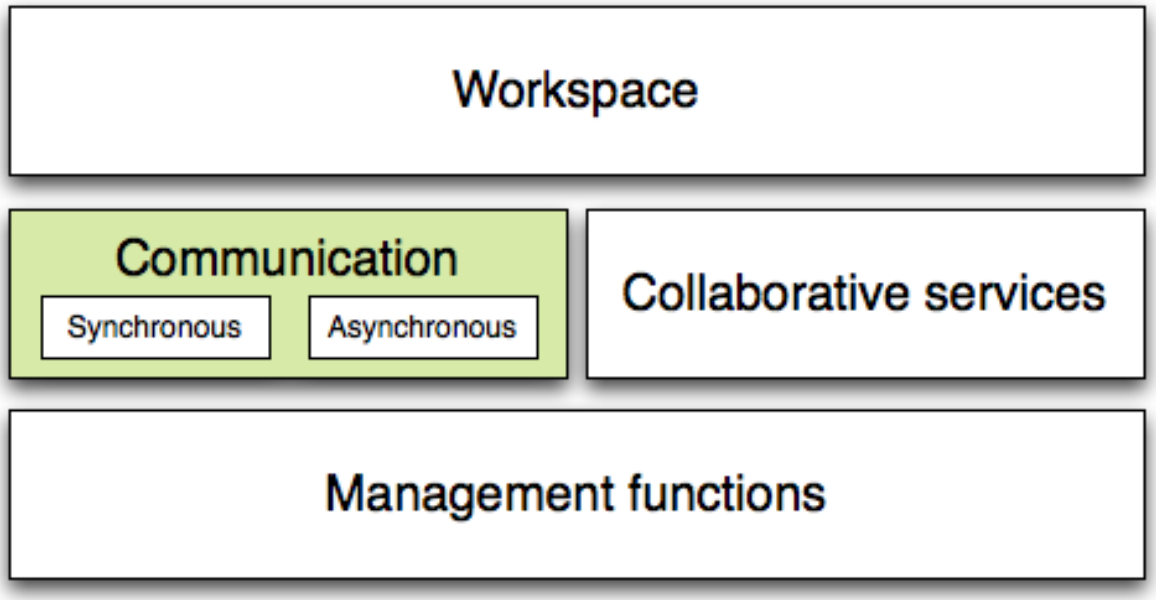

Figure 14: Place of communication in company by Woods [Woods, 2005, S.297]

- Message boards
- Broadcasting
- Subscriptions and alerting
- Discussion threads

Communication methods differ by the amount of people involved. 1:1 communication thereby means that one person is sending information to the exact other one. Therefore 1:F means that there are few receivers, 1:M stands for one to many. On the other side, there is also the option of F:F (few to few) and M:M for many to many. Generally, communication paths that include one sender and multiple receivers could be summarized as one-way communication. 1:1 and all forms including multiple senders refer to two-way communications, so that both parties may interact.

Not every company or situation fits the same attributes, so different situations may require different technical solutions.

IT based solutions categorized by the way of interaction by Lipnack and Stamps [1997, S.90] :

One-way (1:M & 1:F) Online broadcast, internet video, internet radio, online publications, digital packaging, e-mail lists, podcasts, application and screen sharing

Two-way (1:1, F:F & M:M): E-mail, internet phone, chat, online meetings, online conferences, www, file transfers, online documents, forums and message boards

Rao [2005, S.35] analyzed different communication types and compared them by attributes that are important when choosing a specific method. He categorized the methods by their level of interactivity, their bandwidth to operate, their strength of structure and the re-usability.

Table 6: Properties of knowledge activities and assets by Rao [Rao, 2005, S.35]

Communication Type	Interactivity	Bandwidth	Structure	Re-usability
Documents	nil	low	high	high
E-mail	medium	low-medium	high	high
Phone	high	medium	low	low
Meetings	very high	very high	low-medium	low
Presentations	medium	high	high	low-medium
Workshops	very high	very high	medium	low
E-learning	medium	low-medium	high	high
Coaching	very high	very high	low	very low

4.1.1 Solutions

Nowhere has virtual work had such huge impacts for the company the way their paths of communication have. An appropriate solution had to fill the gap that was created because of the colleagues working abroad, and their lower integration into daily communication paths.

General company related information

General information is news that concerns every employee. This kind of information is mostly spread by management and should keep employees "up-to-date" in different ways. Typical content of such news could be information about new employees or about employees leaving the company, information about the office infrastructure or all internal news that keeps the system running and motivates their employees.

Based on the communication methods and ways previously presented, this distribution is sourced by one and is addressed to all employees - so a 1:M (one to many) communication method, without interaction between sender and receiver - one-way communication flow. The differences between their situation before virtual workplaces and afterwards lay in time and place. Only a matched up combination of both led to positive information flow. Before it was executed in a synchronous manner of exchange; whereas, in the virtual world, place and also timezones do not allow this kind of communication.
Their exchange unconsciously changed from synchronous to asynchronous, but they did not shift the way they communicate general news and information.

Out of the existing communication methods, these are asynchronous, one-way, 1:M variants:

E-Mail lists

Online publications (Twitter)

Internet video, radio

Podcasts

Online publications are a very general term. Since the development of internet related technologies happens very rapidly, different systems are now available to publish online. Over the past few years a new service developed under the name "Twitter".
"*That is how millions now interact on the internet. Twitter, a kind of "social net- working" service, allows people to publish their thoughts in the form of brief text snippets or "tweets". A tweet cannot exceed 140 characters. Once tweets are placed online, anyone can see them and respond.*"
Ojeda-Zapata [2008, S.7]

Project related information

Their project and task related communication suffered from the same underlying problem. All their communication was based on the fact that they could talk to each other in office buildings. As already mentioned, project related work was just growing and so they had no long lasting experience in how to communicate efficiently in project teams.

1:1 or F:F are common used communication channels for project related information distribution. Where 1:1 communication was already practiced by using internet phone systems, the F:F part was suffering since teams were distributed around the globe. Again, the differences started with collocating people. Since the only problem here was the non-attendance of other team members, a synchronized time of information exchange would be helpful.

No further technologies or systems could to fill the gap here - fixed scheduled meetings on a regular periodical basis would keep everyone informed and motivated.

4.1.2 Analyzing and evaluating solutions

Not all of the technical solutions found would match the company's needs. Information exchange using multi media technologies requires a lot of effort to produce and distribute them. That would lead to less information exchange because the expenses would rise and then the opposite would happen: less information exchange because of too much effort.

Simplicity and speed are the most important points, because those were the main reasons the problems occurred in the first place. Therefore, the solution had to be as simple as possible, and should avoid that employees do not use the system, because they do not understand it.
Twitter and email-lists seemed to be simple and easy to use. Whereas email was known by every employee in the company, twitter was something completely new.

Twitter is a system to broadcast short messages (maximum 140 characters) around the globe. There are no restrictions concerning the possible target group for the information. The advantages to normal emails could be extensive though. Advantages of twitter:

Short messages: everyone reads the message

Less effort: effort is even much lower than creating an email.

Less administration: email-lists have do be administrated

The conclusion of all these advantages would lead to a system that would be used more often by management as well as the employees. The only disadvantage would be the missing boundary between an internal (employees) and an external (world) communication.

By solving the boundary issue a twitter-like solution would close the information gap perfectly.

The problem of missing project information did not need a real technical change or implementation. Online phone conferences, which they already practiced, only had to be coordinated to avoid missing updates on news which led to less motivation.

4.2 Knowledge processing

Knowledge and its management was one of the two problem areas concerning the handling and distribution of knowledge since they began working from different locations. It was obvious that the current situation could not last any longer with their technical systems and a new one had to be implemented.
Technical related employees, e.g. designers and software developers, had already been using a kind of application to store information in a database. This was a first step for the company, but they could not use this system for all domains. The reason was the complexity of the solution, and the immense costs of training all employees on the system. The trial for this system had already shown that the company recognized its problem and had tried to find a solution on their own. Their major issues concerning available solutions were costs. Implementation costs, maintenance and training expenses were too high to introduce a convenient solution.

Types of data to process

Through their experience, TriVolos found out what data they would like to store and manage. Basically, any information that was consulted and had to be managed, belonged to one of these three categories:

Reference on work & "How Tos": Especially in the technical areas of work, knowledge was often gained through research. Also shorter references about how something has to be done or how something is handled within the company and its infrastructure were requested. They had already had a web-based system to store information here.

Instructions: Whenever a new person was hired or an existing employee took over new tasks, there were instructions about how to handle these tasks. This could be compared to reading manuals - about their IT systems, or how e.g. order handling had to be processed.

Documents: The company produced lots of documents (word processing, presentations, spreadsheets) which were stored locally in the office. A digitized "library" would make these documents available to external employees as well, and would make them much easier to handle (backup, security, searchability).

As shown here, their usage of knowledge management would be rudimentary. Whereas, the first two types require some type of text storing and processing, documents have a more complex structure than simple text. Nevertheless, the requested solution had to handle both types as seamlessly as possible.

4.2.1 Solutions

Drawing a strict line between communication and collaboration systems gets harder through continuous development in content management applications. Tools of both domains could be grouped under the term groupware or collaboration tools. Virtual working companies make use of both systems combined and in a comprehensive way. Groupware represents software that is used to help groups of colleagues organize their activities. This includes many different aspects, which make them a general solution for enabling virtual work. Groupware is also used as a general term for virtual supporting systems. [Kimiz, 2005, S.225ff]

The company's demand could be defined as a system for enabling collaborative creation, editing and processing content - in textual form as well as document based form. Collaborative writing tools are often used in virtual workplaces to support coworkers in different areas.

Collaborative writing systems integrate some basic requirements: [Youngblood and West, 2008, S.531]

- compatibility with software
- easy to use (similar in use to standard software)
- no manager function needed
- reliable and secure storage of content

In addition, functionality should imply: [Youngblood and West, 2008, S.531]

- simultaneous editing
- comparison between different versions
- recovery of a previous version
- insertion of comments

These attributes very accurately match the objectives previously defined for a solution. The requested features could be summarized as asynchronous collaborative text editors that include intelligent document management.

Over the past few years, a new way of consuming content related technologies emerged: SaaS (software-as-a-service). SaaS is used as a synonym for software that does not require installation on the company's IT infrastructure. The software can be applied as a service without any thoughts about the infrastructure it is based in or running on. By 2012 about 50% of all software will be applied this way. There are clear advantages when using SaaS software. No hardware or infrastructure costs for the software, initial costs are lower and no software maintenance are good reasons for smaller companies to choose this type of a solution. Additionally, they normally require less employee-training and are often offered with a free trial period. [Coleman and Levine, 2008, S.239]
These points made SaaS an interesting technology for TriVolos' needs.

Portal systems

Gordon and Tarafdar [2007, S.450] write: "*Creating an intranet portal is an effective strategy for improving an organization's innovation competence by improving its competences in knowledge management, communication, and collaboration*".
They describe the "knowledge portal" as a special version of portal software that is used to store, reuse and exchange knowledge in an intranet. [S.450f] [Gordon and Tarafdar, 2007]

An exact definition of a portal system is difficult because the term is used in variable contexts. Portal systems describe human generated and edited content aggregations with the idea of organizing and personalizing its content. Typical portal capabilities are automated searches or web services like common rooms and collaboration facilities. It functions like a gateway to company internal services and intranets. Access could be given for email-systems, forums, search engines and so on. Portal systems are often offered as SaaS services. [Gordon and Tarafdar, 2007, S.1194f]

Portal systems are very common in literature but are not often considered an exactly defined IT software to just purchase - they are more like a concept of how an intranet infrastructure could be managed, and insist on other technologies in the background, which get combined by one infrastructure system.
Capterra.com (http://www.capterra.com/portal-software) offers a free comparison between different portal providers. Required integrated services and other needs can be selected and the website shows matching systems.

Forums

Discussion forums or message boards are well established frameworks in the internet world. Forums can be restricted to internal usage only, so that topics could be discussed privately. Discussions are started by posts and then are organized in a very open manner. The basic idea of discussion forums is the process of communication and collaborating between its members.

Forums were one of the first techniques to spread information and give the readers the possibility to participate on information exchange related to a topic. Countless providers are available starting from free services to professional solutions with integrated additional features.

Forummatrix.org (http://www.forummatrix.org) is a comparison service provider for forum solutions. Again, required attributes can be selected and a "choice wizard" tries to find an appropriate system.

Wikis

Wiki systems has become very popular over the last couple of years. Wikis are web-based tools to enable very simple collaboration. The word wiki itself comes from Hawaiian and means "fast" in their language. Wiki systems provided easy functionality to write and publish information in

HTML format, which is the basic internet language for website creation. People therefore “create” web pages like normal documents and automatically publish them within the wiki infrastructure. One of the basic features of wiki systems is the integrated version control. Every content page is related to exactly one keyword. Every page created this way can be recovered to an older version and every saved step between the actual version of a content element and the initial one is logged. [Raman and Narayanan, 2009, S.1551ff]

Hybrid forms

In addition to the stricter definitions above, some systems cannot be categorized into one of those solutions. Systems specifically built to fulfill a special need are made in hybrid forms. They are created for knowledge sharing purposes or to automatize document management issues. Often, these systems work very well for a special application area, but are harder to implement for companies that have to achieve multiple objectives. Such solutions are provided by companies as ready to go applications - which binds the customer to the company. This would mean that the customer depends on the interfaces, features and future features provided.

Separate solutions

Another option to solve the company’s challenge would be to implement different solutions for different needs. This could led to more than one piece of software to maintain, and also user training would be more complex. Nevertheless, this would be an option if no single solution is available. As this would mean a lot of effort and expenses for this way of solving the problem area should be avoided.

4.2.2 Analyzing solutions

The solution variants presented had to fulfill the mandatory objectives in order to even evaluate them. The software found was sometimes difficult to categorize into one of the above given schemes, but every system (except the hybrid solution) had their basic idea in one of the areas.

Portal systems could be found for a wide range of domains. The idea of such systems is to fulfill all business related tasks in just one IT solution. Generally, this means less maintenance costs and less training effort for the employees. Unfortunately, this was also a disadvantage for TriVolos, because based on the idea of just fulfilling the company’s needs, these systems included a lot of additional functionality that was not requested. These extra features needlessly increased the application effort. In addition, features usually have their price, which would mean that the company would pay more for features they do not need.
By using the above mentioned portal comparison website Capterra.com, systems fulfilling the mandatory objectives could be filtered out. With regard to the database research of portal business applications, four solutions - shown in figure 15 - would match TriVolos’ needs.

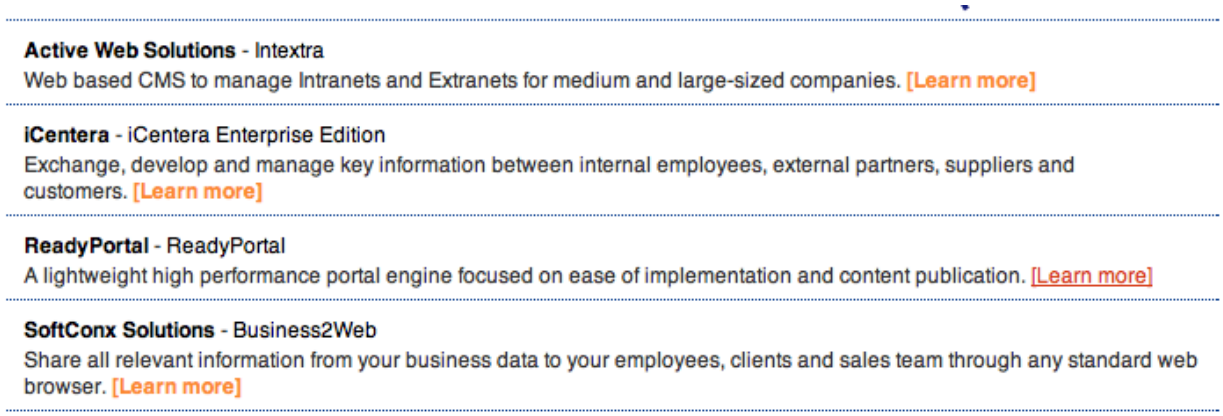

Figure 15: Result of portal comparison based on capterra.com research.

In contrast to the portal systems, wiki offers a strictly defined idea of how content should be stored. A comparison to wiki systems showed that all systems stored their content in a very similar way. Also the search functionality was a major feature although the preparation of search results was partly different. Wiki systems generally have very narrow software structures and their main focus is on handling text content. Most systems offer access-controlled editing and reading. The handling of file formats other than images (which could be easily integrated into a wiki page) is often not well implemented for greater use like in document management systems.

Forum software is even more specific than wiki's. They are made more for discussions than for real collaboration. Since their main objective is to keep people corresponding, their implementation did not match TriVolos's needs for knowledge management function. The idea of forums is not to edit or handle textual content, but to add additional information from other participants. Also mandatory objectives e.g. document management functionalities are not required in forum software and version control is (if integrated) very rudimentary.
A second system would be needed to handle documents, which would require the implementation of two separate solutions. Although this would be a possibility, one of the mandatory goals was to find a system that integrates textual content as well as documents.
Forum systems and therefore also separate solutions did not match the company's mandatory objectives.

Google (http://www.google.com/a) offers another way of collaboration. They previously developed various smaller solutions that fulfilled different needs. By introducing GoogleApps, they merged those systems into one solution for small and mid-sized companies. GoogleApps could therefore be seen as a kind of hybrid form - they offered small solutions for specific problems that could be easily integrated.
Amongst others GoogleApps includes following systems:

Google Sites: System to share textual content web-based. Similar to wiki technology.

Google Docs: Document management system for many different document types. Existing documents can be important into the system and later edited. In addition, the creation of new documents and simultaneous editing of files is possible. Different opportunities for sharing documents with colleagues or with the public are feasible.

Google Groups: Collaboration support service to allow teams to virtually collaborate within such a group. Combines other Google applications into one system for easier access and sharing control within a team.

Google Calendar: Calendar system with integrated access and sharing mechanism. In addition to personal calendars, company-wide calendars can also be created and then shared by employees.

Google Mail: Google's mail system.

Each Google product could be used individually or as one whole system in GoogleApps. The main difference between individual use and the combined product is the shared access control for users. This allows companies to install every employee just once in the system, giving them different rights for all the applications.

Some of the solutions were offered as systems that had to be installed (and also maintained as such) on TriVolos' own IT infrastructure - others were offered as SaaS services that did not need any further technical implementations. There are even solutions available that allowed a choice between these two possibilities. Since one of the main objectives was reduction of maintenance and infrastructure costs, full services in the form of SaaS were preferred when both were offered. The greatest drawback that had to be questioned was the fact that the data would be stored externally - a general security issue of SaaS applications. The company had to decide if this drawback was too critical or if they trusted the supplier's infrastructure and their policy concerning the handling of data and information.

4.2.3 Evaluating solutions

Three types of systems remained: portal systems, wiki's and the mixed system of GoogleApps. In order to distinguish these systems, a value-benefit analysis was used. Portal systems differ in their implementation and so the average values for the four previously selected systems were determined. Wiki systems on the one hand are very similar in their design and do not differ that much. Only two major GoogleApps applications were rated. Google Sites for textual content management and Google Docs for all document related requirements needed to be evaluated.

Three different main criteria were chosen. The general objectives were previously defined as general goals every solution needed to fulfill. These very general criteria were important for the company management because of their experience with newer web technologies. Whereas, most of these criteria could be crucial for a lot of virtual working companies, TriVolos was focused on

			Variants					
			Portal		**Wiki**		**GoogleApps**	
		weight	*score*	*total*	*score*	*total*	*score*	*total*
General objectives	**40%**							
Universal worldwide usage		12	4	48	5	60	4	48
Easyness of handling		10	2	20	4	40	4	40
Easyness of administration		8	3	24	4	32	5	40
Security mechanism		6	5	30	3	18	4	24
Future-orientated		4	3	12	3	12	5	20
				134		**162**		**172**
Explicit objectives	**40%**							
Version control		6	4	24	5	30	5	30
Easy textual content handling		10	3	30	5	50	4	40
Document management integration		8	5	40	2	16	4	32
Search in textual content and documents		8	4	32	2	16	3	24
Access control (levels)		4	5	20	2	8	4	16
Linking mechanism within the system		4	5	20	4	16	4	16
				166		**136**		**158**
Costs	**20%**							
Implementation costs		8	2	16	4	32	5	40
Maintenance costs		6	3	18	5	30	5	30
Training costs		6	3	18	5	30	4	24
				52		**92**		**94**
TOTAL SCORE				***352***		***390***		***424***

Figure 16: Value-benefit analysis to evaluate knowledge management system.

future-related solutions. Additionally, simplicity was rated highly and was the focus here. Portal systems are normally simple to use or handle, but as TriVolos works with a lot of employees for short time periods, so they were interested in a solution that was almost self-explanatory for users. GoogleApps received very high ratings in this section, because of its general approach to their offer. Every system (in this case Google Site and Google Docs) is a system in its own and therefore, very simple to use. Especially, Google Docs, it was designed after the common standards of office programs. Future-orientation was also a big plus for Google, because the system is very open to other systems, and they also announced further developments for their applications in the future. Employees need to be trained for the usage of portal systems and also the effort for administration is higher because of the strict distinction between administration and usage.

The next class was the explicitly defined criteria for knowledge management systems. Here, the portal systems benefited from being designed for specific needs. The deeper integration of different types of media displayed advantages in the combination of textual managed knowledge and documents. Wiki systems could not fulfill TriVolos' requirements for document integration and handling.

Finally, costs were very important to TriVolos. Since portal systems were developed solutions to achieve some special overall goal, they were more costly than wiki's or GoogleApps. The latter ones were sometimes available as free versions as well. GoogleApps allowed full use of its "Standard Version" without any costs. This version integrated more features than most of the costly

portal systems. A professional version could be used if more storage is required for documents and content or a professional guaranteed service level agreement is required.

GoogleApps would be the best available solution based on this value-benefit analysis. Easy handling for all users and the integrated general collaboration functionality were huge assets. Adding to the fact that the solution is free of charge, the decision to implement GoogleApps would become even more consequential.

4.3 Training

The second problem area concerning the handling of knowledge, besides the knowledge system itself, was in what manner it would be distribute and broadcast. The training and education process had to be improved by implementing appropriate technical solutions. A training system was required to help new employees get used to the internal systems. Not only was training requested, but an opportunity was needed where people could meet virtually and gain knowledge together as well. This was usually done by working together on one computer and showing someone how to do something. Especially when working with a huge amount of numbers, e.g. in controlling or marketing, mutual workplaces were used. Sharing one computer, or more important the computer screen, is an easy and effective way to train and coach someone.

There are different approaches for long-distance training. The company required a 1:1 communication path here, but solutions that could also handle 1:F would be preferred for future developments. Since the training effort had high impact on interaction between the participants, only two-way synchronized systems could be used. The two-way communication flow was also important, because the trainer required instant feedback in order to know if the trainee understood what was being explained.

Web based training (WBT) is a common term when talking about training in virtual environments. WBT is an approach to deliver instructional programs through multi media technologies to remote audiences. The internet and web based tools are used to create learning environments. These environments are the key factor for WBT, because they enable the possibilities of the training process. [Khan, 2001, S.5]

TriVolos did not require much infrastructure to build this type of learning environment. The training process was more like a chat between trainer and trainee. The trainings were only held when someone joined the company or started to work in a new domain. Even then, virtual training was only required when one of the two parties was located externally.
Long lasting implementation of a training system was not the objective - an easy way to bridge the gap of locational difference was required. This matched the general objective of not implementing the best available solution pattern, but a solution that should lead to high satisfaction with low expense as previously presented in figure 8.

4.3.1 Solutions

Many different IT solutions could be used for online training. Some applications are not even created for training purposes, but could accomplish the task quite well.

The solution needed to integrate two major features:

Table 7: Virtual teaching methods compared by Whalen and Wright [1998, S.97]

	Interactive text and graphics	Audio conferencing	Video conferencing	Desktop sharing
Mode	asynchronous, synchronous in combination with text-chats	synchronous	synchronous	synchronous
Method of communication	chat	real-time audio	real-time video	real-time video
Bandwidth requirements	very low	low	medium	high
Level of interaction	medium	high	high	high
Easiness to use	high	high	high	medium
Effectiveness of presentation	low	medium	medium	high
Communication costs	low	medium	high	high

Audio The audio component was crucial, because it was needed for every training purpose. Some trainings did not even require or allow other techniques (e.g because of limited bandwidth).

Desktop sharing This feature should work as a simulation of sharing a computer desktop in the office. Whenever working on the same computer was required, desktop sharing should be the appropriate solution for trainings.

Both components were required to do trainings as if in the office. If possible, one system should implement both parts in one.

Three different types of software may integrate both components:

Online learning and training portals These systems offer a wide range of functionality related to learning and training purposes. They integrate both parts - audio and desktop sharing - into one solution, which makes them very comfortable to use. Recordings of trainings and multiple user trainings are often possible. These systems are normally web-based and do not need any additional installation on one of the participating computer systems.

Remote desktop systems Remote systems were usually used to administrate computers remotely. Some of these systems extended their functionality so they could be used for training purposes as well. Software may have to be installed on one of the participating computers and they offer less collaboration utilities for learning issues. Remote desktop systems do not necessarily integrate an audio channel.

Simple screen sharing tools Screen sharing tools do not offer most of the functionality of other systems. Screen sharing is often just an additional integrated part of common software when one of the participating user desktops should be visually shared.

4.3.2 Analyzing and evaluating solutions

Online training systems strongly differ from provider to provider. Therefore, an evaluation by comparison and benchmarking different attributes was not possible. Two of the mandatory objectives could be solved by any of the three different system categories mentioned above: independent of the computers' operating systems and desktop sharing. The third mandatory objective was much harder to evaluate - the required bandwidth for sharing desktops. This was a very important objective for TriVolos, because some of the employees did not have fast internet connections and therefore, had problems with multi media content.
The speed of the desktop transmission became the most important attribute of evaluation. Unfortunately, these criterion needed to be tested for every application, because there were not any exact specifications about bandwidth requirements available on the providers' websites.

Similar to every other requested solution, the training system should be as simple as possible

as well. Unnecessary features would lead to unnecessary effort in employee training and additional costs would arise.

The approach here was to begin with the system type that required the least effort for personnel and implementation training costs, and then proceed to more complex solutions until one solution matched the last open mandatory objective: the required bandwidth.

“Skype” was used to try a simple screen sharing tool, because it was already applied by all employees for audio conferencing. The effort to use it would be very low, but unfortunately the speed and features did not match the requested needs. The desktop sharing mechanism was one of the newest features on the popular communication tool. It worked well for instantly sharing someones desktop without any installations or other arrangements. The test team was not satisfied with the speed of the transmitted desktop video, so it could not be used for training sessions that required a longer duration.

Next, remote desktop systems were tested. Many different providers offer their applications - sometimes almost free to use or some expensive systems with additional administrative features. Systems were tested starting from almost zero costs to monthly fees - always considering the speed of the solution.
A system named “Teamviewer” offered the first affordable and successful training session. Even with small bandwidth internet connections the system worked fine and also fulfilled almost all of the objectives listed. The only drawback was that a separate audio channel (for example via using Skype) is required.

4.4 Task handling

Task handling is one of the major parts of collaboration as figure 17 by Woods [2005, S.298] shows. Virtual working companies have an extra need for managing all activities that have to be processed. Workflow management systems not only handle the management of tasks, but also integrate many other functionalities which were not requested by TriVolos. The company had a very exact idea about how the solution should look and what functionality it should achieve. An exact list of objectives (categorized by priorities) was defined to start a research of the market.

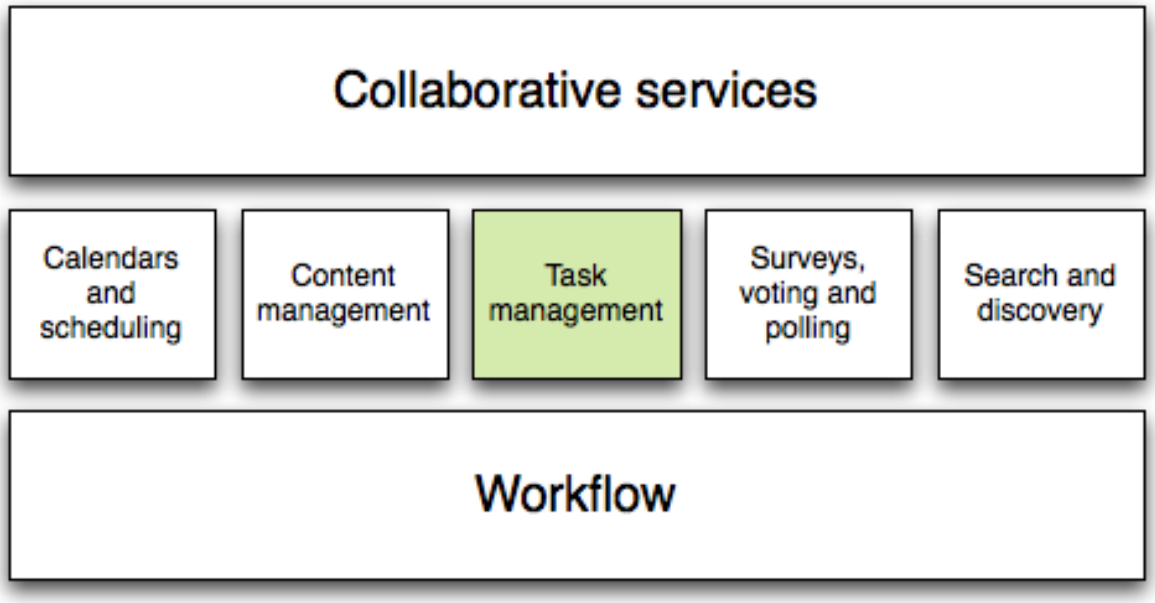

Figure 17: Task handling as a collaborative service.[Woods, 2005, S.298]

4.4.1 Research on task handling solutions

Initial research on smaller task handling solutions showed that systems could be divided between systems to install on every computer an employee is working on, and web-based solutions that required a web browser. There were many more systems to install on, but they were mostly developed for one operating system only.
Since TriVolos worked with colleagues from abroad as well, they did not know which computer and operating systems a colleague was using nor could they demand that a specific one be used. Another drawback would be the fact that installing software on a personal computer is often associated with security risks.

Only web-based solutions would fulfill TriVolos' requirements and thus, research was concentrated on this. Although some providers had task handling products, they did not meet the mandatory

defined objectives. Obviously, TriVolos had very high requirements for this type of tool.

Summary of missing features of mandatory objectives:

Usable for routine & project related tasks. Every system found should be used for both types of tasks. Nevertheless, most applications were designed as small tools to track employee work time - like clock in and out systems. Relations between task and projects could not be built without a hierarchical structure.
Others were more focused on project management with an additional utility for tracking times of project tasks. They required that common tasks are represented in projects and would thus lead to administration overhead.

Although the latter ones would fulfill the structuring requirements, they were not made for non-project related operation.

Access control & manipulation detection. TriVolos had already worked with some external employees they had no visual contact with. If virtual collaboration tools would make it possible, they even thought about expending virtual employment. The solutions found did not provide appropriate techniques for avoiding or detecting system misuse. First of all, almost all systems allowed entering worked hours without tracking them whilst working. This means that (like in a spreadsheet document) every employee enters the worked times whenever they want - control of this would not be possible. Thus, employee could estimate the hours and enter whatever they would like to.
Furthermore, everyone could enter time marks for every time period. If someone changed times of day in the past, no one could prove the change and if it was acceptable. No changing or adding of time marks should be allowed without manager authorization.
Another issue was access control. Hardly any system separated between manager and user accounts. Many systems allowed for the calculation of costs, but this should not be accessible to every coworker.

These control and manipulation issues were big drawbacks and TriVolos knew exactly what they wanted. Without answering them they would have no idea whether the collected data was correct or not. This would lead to mistrust in the company. Since trust is said to be the most important intent in virtual work, none of the solutions found were appropriate.

Table 8: Decision making table for task handling problem

	Purchase	Upgrade	New development
Easy handling	+	+	+ +
Anti-manipulation functionalities	- -	+	+ +
Detailed statistics	-	+	+ +
Customizable	- -	+	+ +
One-time expenses	+ +	-	- -
Ongoing expenses	-	+	+
Time till use	+ +	-	- -

Marginal extra effort. Lack of live tracking of activities would lead to another problem: more effort would be needed for allocating worked times to processed tasks as well as controlling the times. Whenever someone changes the activity a note would have to be made.
While there were some systems found with live task tracking abilities, they had problems with the user interface. When switching the project or task, the employee had to search for the activity in the time tracking software. This would take some time and disrupt the workflow, which would lead to the situation that people would possibly stop using the tool.

Easy and fast switching of processing activities should be one of the primary functions of such a tool. Only those systems without any project capabilities worked as expected.

There were three possible ways to solve the task handling issue.
First, an adjustment to the defined mandatory objectives would have to be possible. That would have meant that one of those three missing features had to be ignored and a new comparison would have had to be done.
The second option would have been to upgrade and optimize their self-developed tool they were using at that time. The system would have to be upgraded and partially rebuilt to match all of the mandatory objectives.
Finally, a completely new development was an option. A redevelopment takes the longest time, but they could integrate all features from scratch.

The management had to decide which of these three options would be the best for the company. Thus, an evaluation was made.

Table 8 shows the benefits of both own developed solutions. They outrange a purchased version in every area because the company on its own could develop a perfect fitting solution with all its required features. An upgrade of the already used version would not lead to a satisfying solution because the application could not be changed easily to fulfill all functionalities perfectly.

The effort of rewriting some software code would have been to high.

The big drawback on both self developed versions were the immediate occurring expenses. The upgrade of the already used version was estimated with about 500 man hours which are huge costs in comparison to a purchased version. A prototype of a new developed system was even estimated as a multiple of the effort the upgrade would take. A smaller benefit were the savings when the software would be in place. No monthly fees would have to be payed except some additional administration like backup and other maintenance costs.

The second drawback was the time factor. As mentioned before, it takes some time to develop or upgrade an application and even then it may not be immediately used. Depending on how many developers work on the project, it would take at least a few months to establish a system that runs without any major problems.

4.4.2 Decision

A compromise concerning the task handling issue was made. The company wanted to benefit from both variants by combining both solution concepts.

A company providing a simple solution was selected for installation. TriVolos was able to start tracking times immediately. The solution was very easy to use, so longer employee training was not required anymore. Project could not be represented in the application, just tasks - which was acceptable for most of the work. Projects were represented as simple tasks; whereas, the names of such tasks referred to the project. The greatest benefit was that every employee from then on was integrated into the software, which included employees abroad as well. The employees got used to tracking their time in a live system and the management and development team gained experience about how an appropriate solution should look.

Parallel to using the providers service, specifications for a self-developed application were written. All of the objectives previously described had to be included and prioritized. In addition, the knowledge about usage of the other system should be integrated into the specifications. When development was completed, they would switch the application and start a trial period with their internal employees. After passing all tests with the internal employees, the remaining employees could start using the application.

4.4.3 Specifications for the new development

Before developing a new application, its specifications have to be defined. This was relatively simple, because the objectives were already defined and there was a general understanding in the company about what was required. The developers were already using their own software at that time, so the specifications did not have to be that detailed. This old tool provided very beneficial - it worked like a prototype for them. It is much easier to specify features when a prototype is

already available. Figure 18 shows the general structure of how the users interact with each other by connecting to a central server.

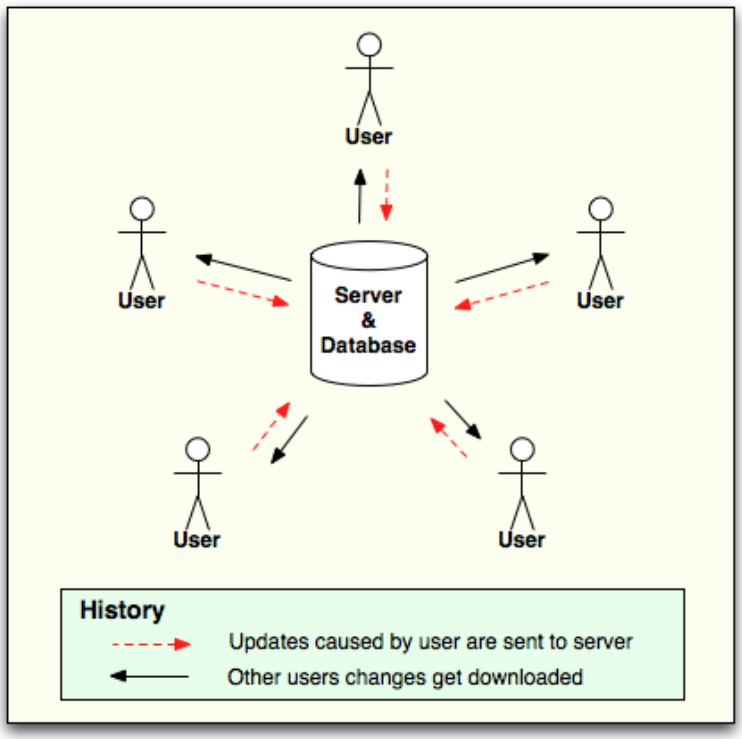

Figure 18: Connection between users and their information flow.

After defining specifications, a software developer could start constructing the application's technical structure. The technical requirements for the application were already provided, because even if the software were developed from scratch, the infrastructure it would be based on should be the same.

Specifications had to be defined for different areas. First, how the program would work and how it should be used by the employees had to be described. Second, the major functions had to be structured. Here the requested behavior of the important functions needed to be defined. The last specifications to write were related to the program's user interface. Since it is the only contact to the employee, the design had to be easy and functional at the same time.

Product specifications

Product specifications describe what the program is intended for in specific situations. This is important for software developers, because they need this informations in order to ensure that the

development meets the users requirements.

Access via login
To allow usage of the program and also distinguish between different access levels, the user has to login first. Access should be granted through a combination of a self-defined user name and password. Deleted or disabled user accounts are not authorized to login and an error message should be returned. No "password forgotten" functionality has to be implemented, because the users are administrated by the managers. Users should be kept logged in until they explicitly log out or close the program.

Usable with all major web browsers
The application should work without the need for installing any software programs on the computer. This means, the system runs within a web browser and only needs such a browser and an active internet connection. In addition, software updates are not required because the user loads the actual version automatically by calling the given service internet address.
The application has to work with every major modern web browser. This is important, because TriVolos would not be able to dictate which browser their employees would have to use.

Synchronized updates between users
The application will be installed on one of the company's web servers. Every user loads the actual software whenever the application is started. Many users will use the application at the same time. They will all update data - even if they just by starting activities, they will be updating the system. The application has to ensure that these updates are transmitted to all other users as well, so they are able to see those changes. When a user requests data, it has to be guaranteed that this data is up to date. An example for how a typical sequence of synchronization will look like is shown in figure 19.

Approve of data changes
At least two access levels are required - users and administrators. When a user changes data related to work time, an administrator has to approve the change. Only when the change has been accepted, will modifications take effect. Since work time data is collected "live", generally no changes should be required by selecting a task the user is working on. If an error occurs or someone tracked time on the wrong activity, modification should be possible. All those changes need to be approved.

One running activity only
Whilst most services from other providers allowed multiple running activities at the same time, this will not be possible with this application. It would not make sense to track

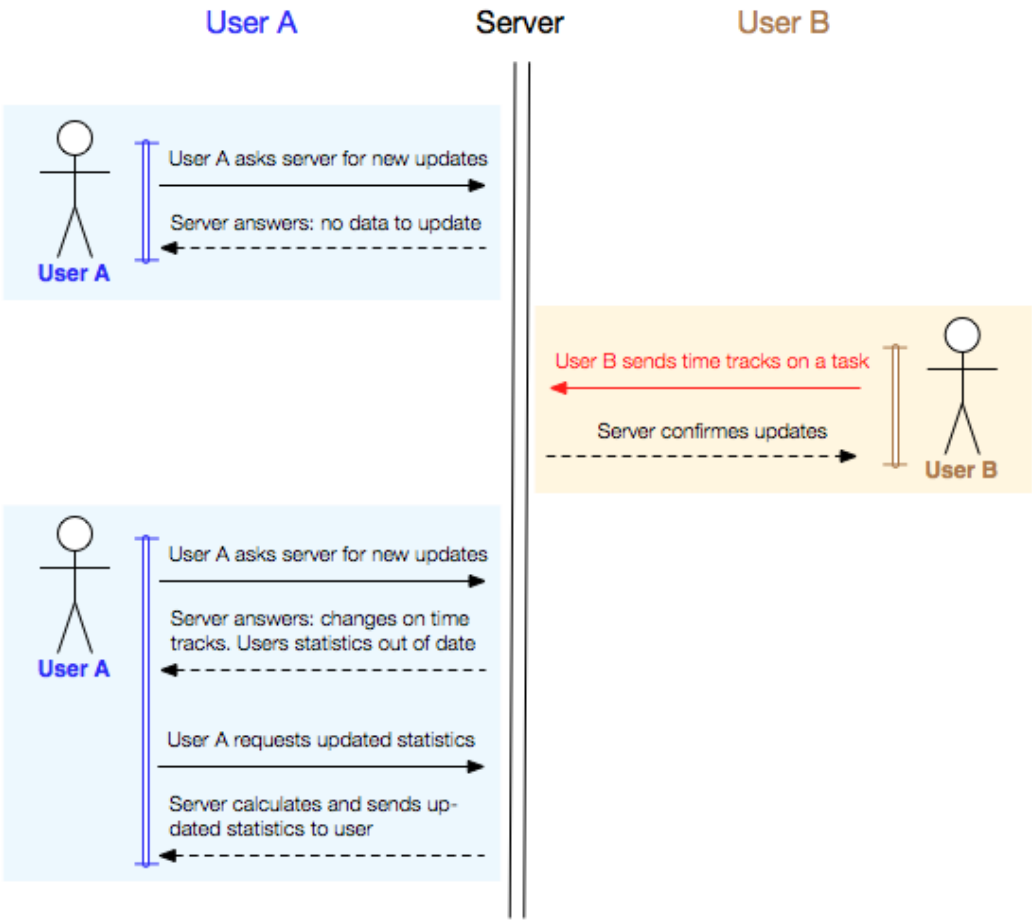

Figure 19: Sequence diagram of data synchronization between users.

time on two different activities simultaneously. Statistics would be wrong - the same goes for costs. Whenever one activity is started the previously running one should be stopped. This would guarantee that only one is running at a time.

Fast switching between tasks

Using the application should not lead to additional expenses. Therefore, the software has to ensure that actions required on a daily basis should be performed quickly. Especially, constant switching between activities has to be optimized. Every additional click is extra effort, which causes additional costs. Furthermore, speed is crucial; otherwise, people would possibly stop using it.

Functional specifications

The major functionalities and their behavior for implementation are described in the functional specifications.

User management
Administrators need extra functionality to manage user accounts. Only they should be authorized to 1) create new user accounts 2) delete accounts and 3) change permissions on them. Other changes than permissions should be possible by administrators and the users themselves.

Task and Project management
Only tasks can track times, projects are used to organize activities in a hierarchical order. Projects could consist of tasks or other sub-projects. In order to manage the order of tasks and projects, an organizational view is required that represents a visual project structure. Also all other activities related to manipulating task or project attributes could be organized within this optical layer.

Views on tasks
Since all the software is about projects, tasks and tracking time on them, the views on these elements are very important. Tasks will require some extra views in order to ensure fast activity tracking. Different views would be useful, so users could filter various tasks by categories. For example, a list of tasks sorted by priorities would be helpful. Additionally, users should be allowed to save tasks in a kind of favorite list. This is useful when employees often need to track time on the same tasks.

Alert view
In order to avoid any manipulation of time tracking, a control mechanism has to be integrated. Manipulation could have intended as well as unintended. In any case, it has to be detected. Therefore, some visual alerts are required. Detections should include: 1) edited or added tracking times 2) unnaturally long duration of work 3) different internet addresses when switching tasks. It is important that when fraud or error was detected by the system, a message is displayed to the administrators.

Notification system
In addition to routine tasks, TriVolos also handles projects. For their projects, the project managers need a system to keep track of the actual status of their projects. A notification system is required to show when a deadline has been reached or a part of the project has been completed. Such a system could also be used to send other notifications between users. For example, task allocations between users would be possible, so the user that was allocated an activity would receive notification concerning the new task.

Detailed statistics
One of the most important parts of task handling systems are detailed views of statistics. Different usages of the program require different statistics. When working with projects,

every detail about the processed tasks and the time used is fundamental. On the other hand, employees need statistics about their weekly work time. What they require is an overview of their actual hours worked, so they are able to plan their next working days. The managers use statistics from the past to plan future investments and resources. They all need different views of the collected data.

Design specifications

Design specifications give information about the requirements of the product's design. This information will be used by the product designer as well as the software developer to create user interfaces. The specifications do not necessarily need to be very detailed. They should help getting an idea about the major user interactions required, so that designer and programmer find a common understanding.

General standards

The application has to meet some general design requirements. Since it will be used by different users and operating systems, the size of the application within the web browser needs to be adjustable. All major display resolutions have to be considered, so no part of the application will be faded out.
Nevertheless, all functional elements of the software need to be well arranged and placed where users would look for them. By following this rule, the software automatically seems to be logically structured and users will find their way through the application.
Finally, the optical aspect should be kept in mind. The user interface should be designed in a modern way with appropriate colors and elements.

Main screen

The main screen is not only the first impression of the application, but also a design structure that has to be kept. All features will be designed into the main design, which is the main reference for the designer. Interfaces for all other features have to be considered prior to building the main screen structures and element dimensions.
A small information panel that includes the actual running task and other data should be implemented at the top. A navigation panel is required on the left side so all functions could be started from one central menu. The main panel holds the real information right next to the navigation panel. Switching a function in the menu panel will cause the main panel to change its content depending on what the function is made for.
The start screen that shows up when the application is launched should include some kind of dashboard in order to display different information simultaneously. Dashboard elements could be statistics on projects or actual notifications.

Project and task administration with time tracking

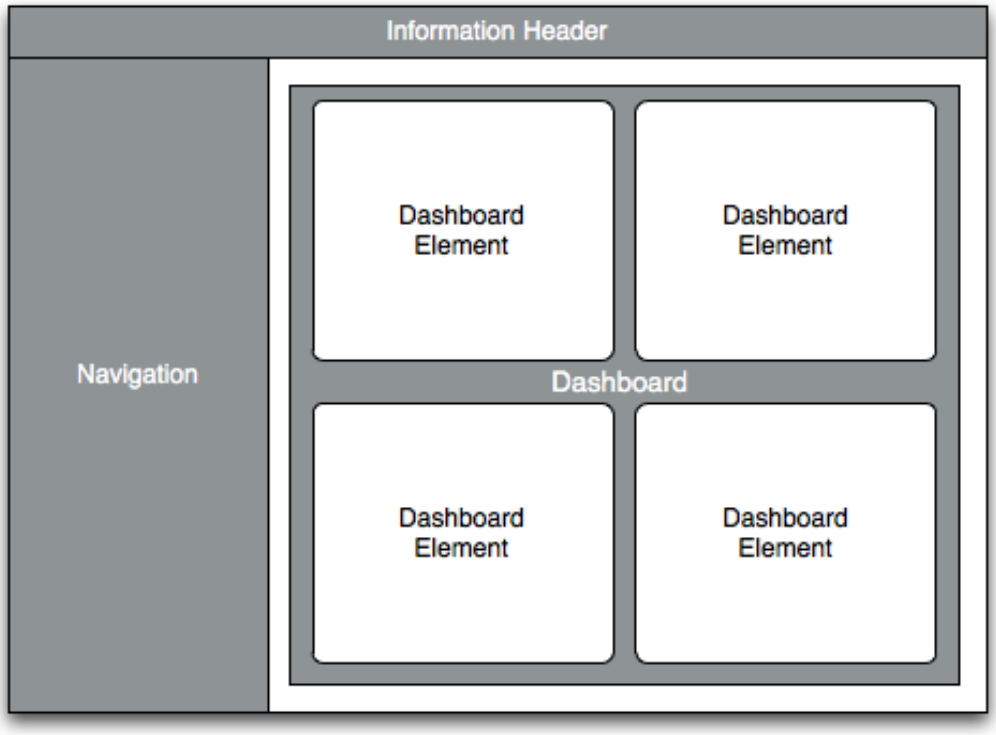

Figure 20: Design concept of a start screen with its panels and a dashboard.

The main features of the application are the administration of its tasks and projects, as well as the tracking of time on tasks. Therefore, most of the functionalities to be implemented will take place in this part. In order to structure the company's activities, a representative view of them is required. Figure 21 shows how projects with their tasks could be structured by using some kind of tree view.

Besides tasks, a button to start or stop time tracking is also included. The running activity could switch the buttons color, so it would be easy to see which task is actually being tracked. Fast switching of task tracking is a mandatory feature.

Meaningful statistics

After times were tracked, statistics are required to output and process the information gained. Since spreadsheet applications are generally used to process greater amounts of data, people are normally more used to their behavior. Therefore, the statistics module should also look similar to a spreadsheet program, including grid functionalities. In addition to this tabular style of view, graphical elements are also common methods to give a quick overview of information.

Furthermore, export functionality should be integrated here that allows all output data to be saved in the same format and style as in the application.

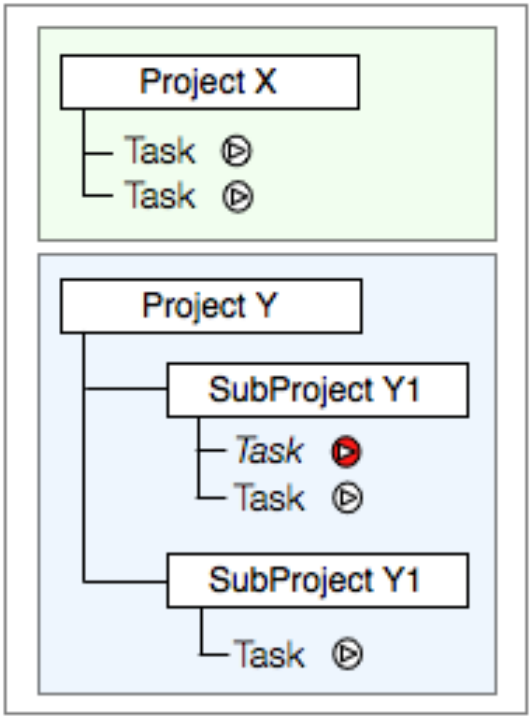

Figure 21: Concept of how projects and tasks could be structured.

5 Conclusion of implementations and their effects

In the last chapter of this thesis, a summary should be given about which implementations were finally executed and what impact they had on TriVolos. Three problem fields were defined that could be typical for virtual working companies. The problem fields were then separated into four domains of requested IT solutions. An evaluation was done for each domain and possible solutions were evaluated in order to find an appropriate one.

After the selection process, TriVolos implemented the suggested solutions in different ways. Some were adopted as recommended, others needed some modifications later on.

5.1 Information distribution

The problem of missing company related communications should be solved by using a short message system like Twitter. As mentioned after the evaluation process, Twitter is public to everyone on the internet and therefore, could not be used for internal messages.

Additional information about projects was requested, but did not require any technical implementations. An idea was proposed in short about how to handle meetings more efficiently.

Accomplished implementations

Whilst public short messages services like Twitter were not suitable, newer services for internal usage became available. These applications were reviewed later, but they also could not be adapted. Most of them were made for larger companies with a lot of functionality that TriVolos did not require. In addition, the costs were too high in relation to the company's requirements.

Figure 12 in chapter 3 showed the communication boundaries within TriVolos. Internal communication and task handling referred to the exact same group of people. Therefore, the task handling application and the short messaging tool would be used by the same group of coworkers. The (later described) development of their own new task management application made it possible to include their own small messaging system. They developed a dashboard element where messages could be written and submitted. These messages are displayed to every user who starts the task handling system. When every integrated employee gets access to the task handling application, they automatically join the communication network.

While the process of accepting proceeded flawlessly, drawbacks did come up after a while. Not every employee seemed to feel comfortable writing a message into a kind of public system. The more experience employees already had with modern internet systems, the faster they were willing to actively use the tool. This became a drawback until management made it mandatory that every employee had to write a message once - no matter what about. This actually helped, but some employees were still more communicative than others.

Effects on the company

Positive effects on increased communication were hard to prove. What every coworker agreed to was that they felt more included into internal company actions, since they had access to a central place to get up to date on news. Furthermore, important information about employee work schedules are now shared. This simplifies the management of collaboration between coworkers because days off and sick days are always immediately communicated.

The only negative effect of using a tool here is when it is not used properly. Employees rely on the messaging system information, so if important news is not communicated through the tool it becomes useless.

Project related information is still transmitted by existing tools. Synchronous communication is executed via internet telephony systems; whereas, asynchronous communication is often done via email. In addition, tools from the knowledge management solution use email for communication purposes. Every project received its own project knowledge center, this is where permanent information that is required is stored.
The only drawback of synchronous communication is the time factor. An on line calendar system is used to optimize the process of consolidating an appointment for a phone conference. The person abroad enters date/time suggestions and the respondent agrees to one of the suggested dates/times.

5.2 Knowledge management

TriVolos' issues concerning knowledge were twofold. They requested one central system where knowledge could be kept, so all employees would have access to it regardless of time or location. Additionally, they needed a plan for training staff from abroad. Two different, but combinable solutions were required. So,different technical solutions were found for each domain. After evaluation, two systems were suggested for implementation.

Accomplished implementations

GoogleApps were implemented as proposed after evaluation. Google sites are used for capturing and developing knowledge related to projects or specified operational sequences. About ten different sites were created and implemented. Google Docs is used to handle all document related work. Spreadsheets or presentations for corporate work were created, but also all written documentation was digitalized for uploading and sharing. Where they used to send documents via email they now upload or create documents in the system and then share the link to the document.

Employees had no problems with the utilization of Google applications. The structure and handling of the applications are similar and self-explanatory. An additional important feature for the users is the single login process to get access to all Google systems. Once logged in, they get

access to the knowledge system, to documents, email and calendar functions. Nevertheless, every Google application and even every single document or knowledge site has its own rights system.

Depending on the requirement and topic, training is either executed by using Skype only or in combination with the TeamViewer remote desktop application. Before they purchased a license for TeamViewer, they tested it and surveyed employees who were involved in the training sessions.

Effects on the company

The positive effects of the introduction of both solutions were multiple. GoogleApps strongly changed TriVolos' way of collaborating. The ability to work on the same content or document simultaneously led to new opportunities. The system is often used to store important documents that otherwise had to be sent vie email. The advantage of using Google Docs is that the time needed searching for attachments within emails no longer necessary. They also use the document system to store job applications. Often times, the decision maker is not available in the office, so after all applications have been submitted, the manager can have a look at all of the applications on line.
Recently, the Google Docs system has been used to keep protocol about what was discussed during virtual team meetings. Google Sites is also used when important news about projects should be communicated.
Two very significant features for TriVolos now are the version control and backup mechanism. Every document or text based content gets versioned and thus, can be easily restored to a previous version. Automatic backup of all types of content is an enhancement for the technical department as well.

Virtual trainings are now realized by using different tools. Skype is used for direct communication, TeamViewer for actual trainings for applications and processes. Additionally, they use Google Sites after a training session to record the training content in written form. This is done by the trainee and subsequently checked by the trainer. So mistakes could be reduced. Now, when a new employee is to be trained in the same topic, they begin by reading these written instructions first. This saves a lot of time - especially for the trainer - and puts the knowledge of all employees on one level. Quality increased because every trainee corrects and upgrades the training materials.

There were not any real negative aspects found about the solutions suggested. One drawback could be that the spreadsheet functionality of Google Docs can not be compared with traditional spreadsheet applications. Google Docs does not offer the same amount of features and it has some general drawbacks for browser integrated software as well. Sometimes it is easier to produce a spreadsheet off line using traditional software and upload the file afterwards.

Thanks to the utilization of these virtual suitable solutions, employees at headquarters also benefit from using the same systems. The training process was optimized and instruction does not take

place without the additional usage of the knowledge management system.

5.3 Task handling

Task and project handling changed enormously. After evaluation, the most appropriate solution for them seemed to be that they develop their own application. This is the only way they would be able to reach all of their mandatory objectives. TriVolos even went a step further - they developed their own business model for task handling and time tracking.

Accomplished implementations

The only convenient way to get all of the features requested was to develop a new system. The idea came up that TriVolos could not be the only company having issues in task and work time handling. Therefore, they started a market study to survey how other small businesses handle time tracking for employees. The results were then analyzed and evaluated. The conclusion showed that almost every company surveyed used simple paper notes where every employee writes down their hours worked. Once in a while, the papers would then be digitalized by transferring the information into a spreadsheet application. The spreadsheet files were then used to summarize the hours and finally the time sheet could be created.

They saw a business idea here and from this idea, they were able to create a detailed business plan. Their software developers began to implement a prototype, which was only used internally for a couple of weeks - meaning without employees abroad to be able to access it. After some modifications and enhancements, the first version was presented and released for all employees to utilize.

They integrated additional features, which were requested by the target group in the market study. Features specifically related to import and export functionalities were recognized as critical and important for other businesses. Calendar functionality was integrated as well and a well-structured access control system.
The short message system previously described in the communication solution was implemented as a dashboard element.

Effects on the company

The new system used to manage their activities has a huge impact on the company. The costs to implement the system were enormous for the company. New employees were hired to successfully execute projects and so, the decision also had a financial impact.

Introduction of the software occurred without any major problems. The employees did not have any negative comments about using the software, which could have happened because they gave detailed insight into their work. In fact, it seemed to be an advantage, because instead of asking their employees for certain information, management now uses the system to get an overview of

the company. The employees also confirmed that the monthly activity information of their hours worked made it much easier. They can now check how many hours they have worked in a day or week at any time.

Management felt the strongest impact. They are now able to handle project teams from abroad without an internal contact who manages and controls work progress. They also commented on the fact that they even feel more productive when they work ex office because they do not get interrupted as often. When a manager needs to be able to concentrate, they can now work from home and not have to deal with any of the drawbacks of not knowing what is going on in the company.
Additionally, it is much easier to handle more employees and interns by having a detailed plan of tasks to be processed.

Apart from the financial investments that had to be made, a positive effect occurred. They now have a very detailed summary about all activities. Every activity can now be allocated to the task's required competences. They performed an analysis of the abilities they required in total and recognized that task/employee allocation was not always perfect. They benefited greatly by reassigning some tasks to other or even new employees. This led to greater employee satisfaction and less fluctuation. The reassignments also had financial advantages. This enabled higher paid employees to be utilized in a more efficient manner, because they were no longer assigned tasks for which they were over qualified.

Before and after comparisons

To show the most important impacts of the implementation, a before and after comparison was created - shown in table 9. The last column shows how strong the impact has been felt by the employees (+/++/+++).

The application as a service

When management decided to implement their own system and later to distribute it as a service, a new company was founded for this project. All implementations were made within this new company and a merchandising infrastructure was created.

A lot of effort was required to produce a product that would be distribution ready. Apart from the product itself, a homepage and shop to sell the software was created as well. Manuals were written and a blog was installed. The application should become an important service for the company. In spring 2010, the company welcomed their first customers.

The following pictures show how the software looked at the time of writing this. Many of the elaborated features were adopted into the application and can be seen in the screen shots.

Table 9: Before and after comparison of task management.

Domain	Before	After	Impact
Management control	Strong differences for management between working in the office and outside of the office. At least one manager had to be in the office.	No connection between management and place of work. More detailed control about what happens than when working from same location without a tool.	+++
Task allocation	Employees often needed to process tasks they were not suitable to. Fluctuation was the result.	Detailed view of tasks and their required qualifications. More satisfied employees.	++
Monthly billing	Inexact paperwork with monthly transfer to spreadsheet application. Easy calculation for employees not possible.	Fully automated working hour protocoling. Permanent access to statistics and summaries.	++
Cost reduction	Higher costs because of bad task allocation. No control over work times for employees abroad.	Financial savings because of correct task allocation. Exact protocol of worked hours for every employee.	++
Routine task handling	No knowledge about how many hours per week were used for routine tasks.	Easy planing and handling of routine tasks.	+
Project handling	No project management without common presence.	Control of project progress from any location. Handling of deadlines and costs thanks to utilization of the tool.	++
Cost awareness	No knowledge about hours processed and project costs. Cost factors were practically never measured.	Costs are one of most important decision criteria now. Detailed knowledge about costs and benefits.	+++
Future planning	Future planning was done without the usage of historical data. This often would have been useful but there was not any data available.	Easier and more detailed planning of new projects. Exact knowledge of projects previously processed and their outcomes.	+++

The main screen

After login, this is the welcome page for the user. As described in the design specifications, it is divided into three parts. A status panel is shown at the top with information about current tracking activity or connection status. The navigation panel is located on the left and the dashboard was integrated on the right. Different dashboard elements can be shown - one of them is the short message system in the upper left corner.

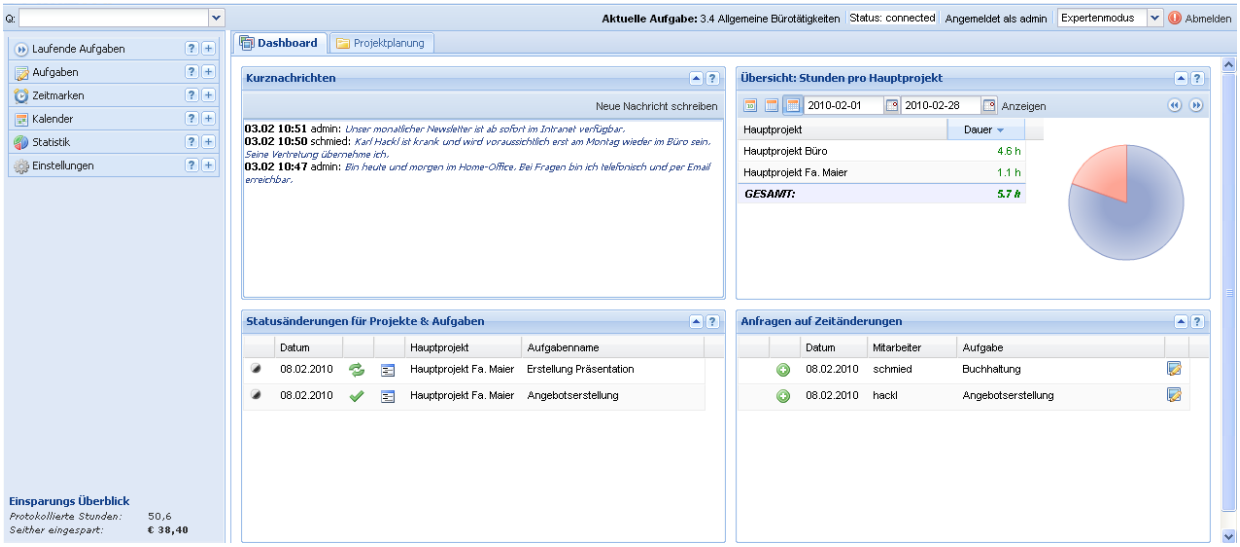

Figure 22: Application screenshot: The main screen.

Project and tasks view

This is the main page for starting and organizing all activities that are processed in the company. An in depth, infinite structure enables the organization of all kinds of projects. The “play” button activates an activity to be tracked while, the red button means that this activity is actually running. Information about actual tracked hours or deadlines are summarized here.

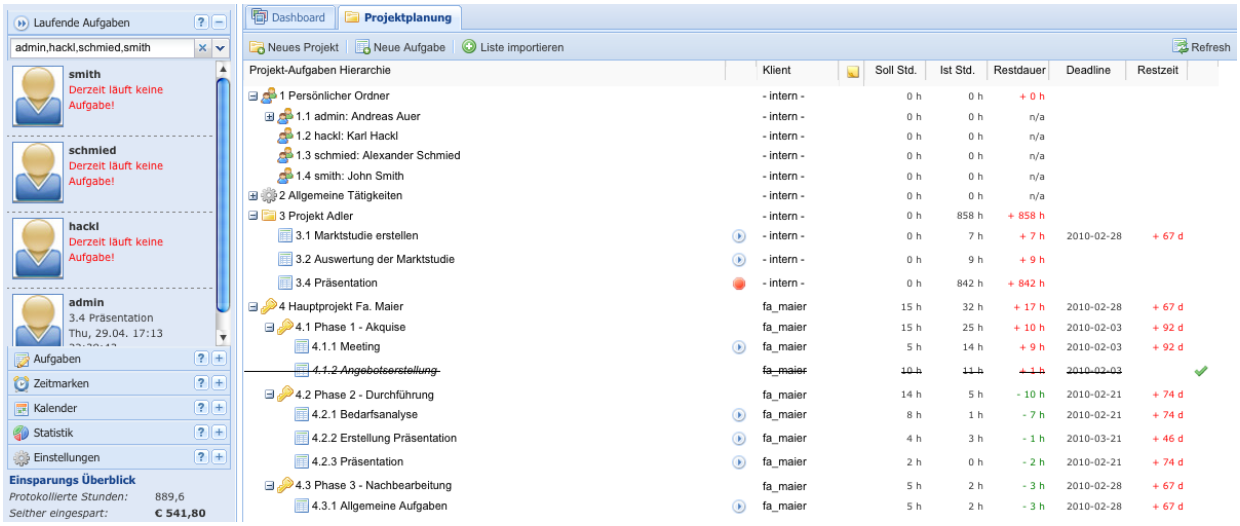

Figure 23: Application screen shot: Project and tasks view.

Overview of actual activities

This panel appears within the menu panel is used to monitor who is actually working on what activity and for how long. This tool is especially important for managers working abroad to be able to monitor what their team members are working on.

Figure 24: Application screenshot: Overview of actual activities.

Calendar view of elapsed period

The calendar is a tool where all protocoled data gets visually summarized. Again, a productive tool for managers abroad to be able to see what was going on.

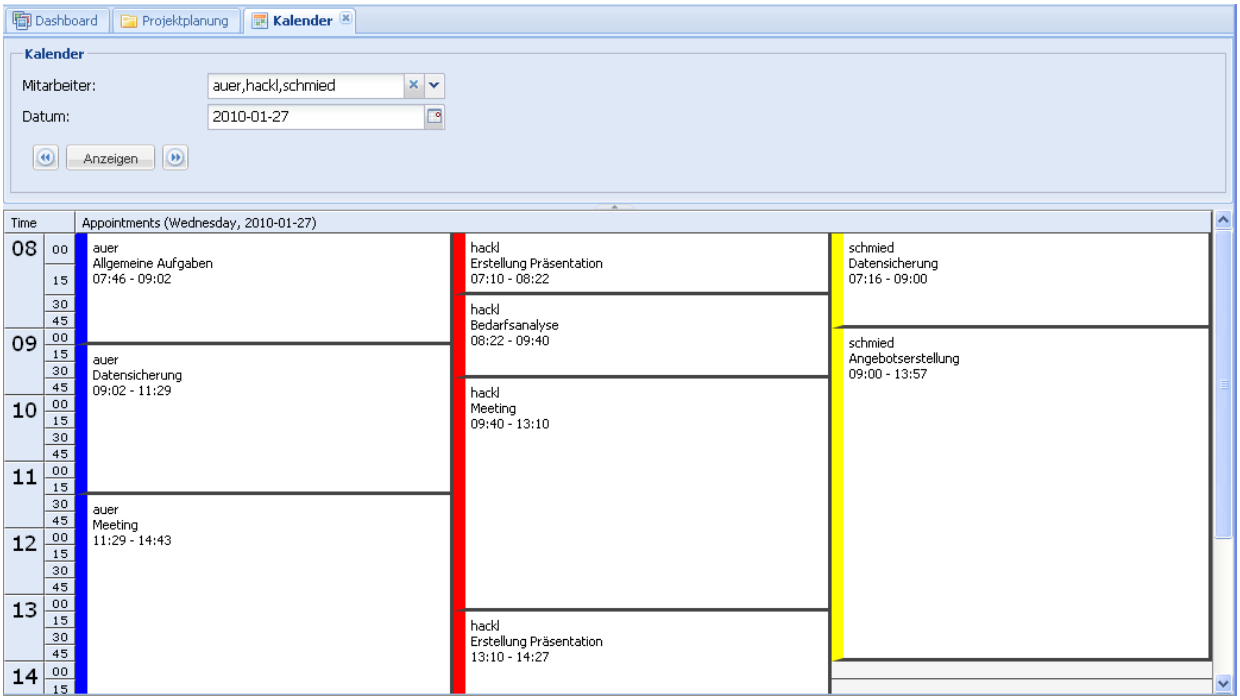

Figure 25: Application screen shot: Calendar view of elapsed period.

Processed activities in detail

The heart of the application is the tracked activity times. They are called “time marks”. Whenever a user changes their activity, a new mark is created - so this is the real collected data. All information and statistics are based on time marks. An intelligent access control system was integrated for later manipulation of this data.

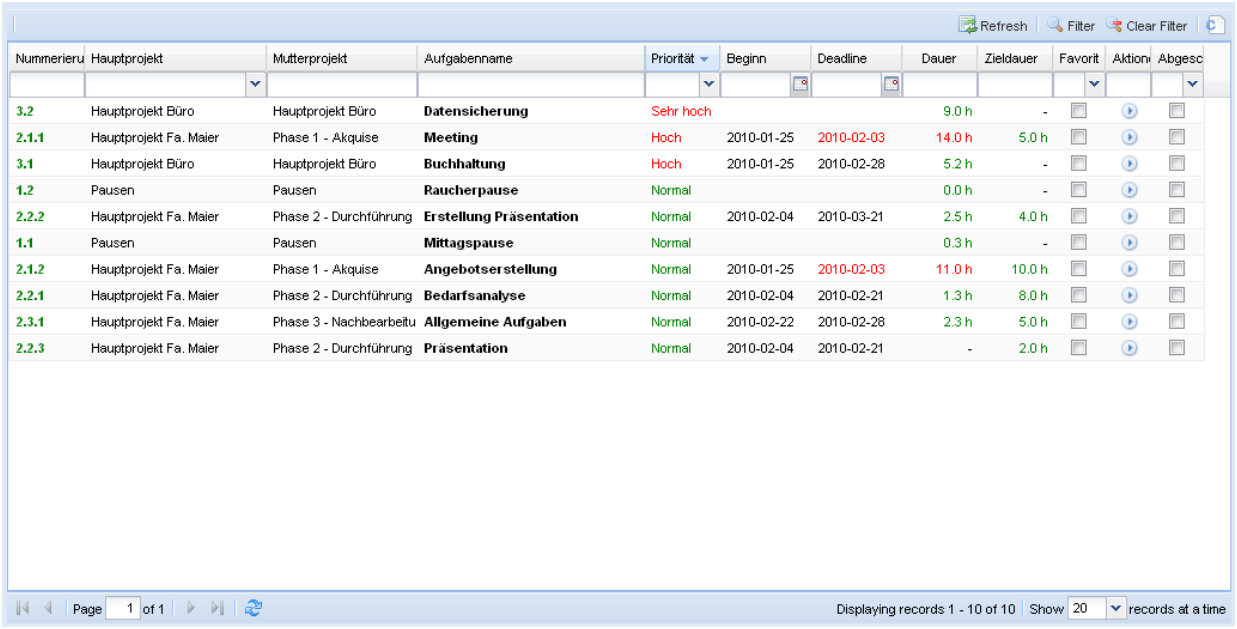

Figure 26: Application screenshot: Processed activities in detail.

5.4 Overall conclusion

The general objective to improve TriVolos' situation without need of major financial investments was successfully accomplished. This was confirmed not only by management, but by employees as well who now use the suggested applications in their daily work life. Expenses were handled especially well, so just one solution had to be purchased. Of course the implementation of their own task handling system made a huge financial impact, but decision to implement this solution was also driven by the idea of offering the application as a service.

Interesting was, that by introducing these new applications, not only was the virtual working part of the company greatly impacted, but some other general issues like backup strategies or document management improved as well. Another impact occurred with the employees as well. The efficiency and effectiveness of activities increased, too. Collaboration within the company and also within smaller teams changed. Team members now work on the same documents or share tasks in a more productive way, and the commitment to their work is much stronger.

The most immense impact seemed to be on the managers. Previously, the company could not be managed without at least one manager being located at headquarters, not the situation is different. Management can work from abroad without losing touch with the team. This dramatically increases the quality of working from abroad (externally). They even plan more trips now, because they are able work from anywhere they like.

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