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Developing the Collaborative IT System of a Small Size Manufacturing Company

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<p>The needs for better communication and knowledge transfer are increasingly evident in many organizations. Especially the needs for real-time collaboration and communication have become critical. The case company in this study has identified these needs for effective communication and aims at developing an efficient real-time collaborative IT system.</p> <p>The objective of this study is to propose a collaborative system which increases possibilities of communication and knowledge transfer in the case company. The study is based on best practise of knowledge management, project management and building collaborative systems. This study is part of a project to build such a new infrastructure in the case company, but spans the period from the system planning up to the testing procedures and preparations for further improvements.</p> <p>Action research was adopted as a research approach to conduct this study and analyse the data. Data collection included a wide range of sources such as interviews, meetings, discussions, participant observations, questionnaires, and validation session with the experts. During the case company interviews, eight main challenges to be addressed in the new collaborative system were indicated by the interviewees. After that, according to the findings from literature and the current state analysis results, a collaborative system was developed and tested in order for the case company improve the communication and knowledge transfer.</p> <p>The proposed collaborative system suggests how the communication and knowledge management can be streamlined by introducing a collaborative system in the case company. It also proposes an action plan how to further develop the proposed collaborative system based on the results of the testing of the newly built collaborative system.</p>	
Keywords	collaborative system, communication, improvement, knowledge transfer, testing, knowledge management, ITIL

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<p>Kommunikaation tarve yritysmaailmassa on lisääntynyt viimeisen vuosikymmenen aikana. Internetin yleistymisen on lisännyt mahdollisuutta kerätä tietoa ympäri maailmaa ja hyödyntää tietoa kaupankäynnissä. Kerätyn tiedon hyödyntäminen yrityksen sisällä vaatii tietojärjestelmältä parannuksia. Yrityksen sisäisen kommunikoinnin tulee olla yhtenäistä, nopeaa ja luotettavaa. Tämän lopputyön esimerkkiyritys on tunnistanut tehokkaan kommunikoinnin merkityksen ja tähtää tehokkaaseen reaaliaikaisen kommunikoinnin mahdollista-vaan järjestelmään.</p> <p>Tämän lopputyön tarkoituksena on ehdottaa ryhmätyöskentelyyn sopiva tietojärjestelmä, joka lisää mahdollisuuksia kommunikoida ja mahdollistaa tiedon siirtäminen yrityksessä. Lopputyö perustuu tiedonhallinnan parhaisiin käytänteisiin ja ryhmätyöskentelyn mahdollis-tavan järjestelmän rakentamiseen. Tämä lopputyö on osana suurempaa projektia, jossa tarkoituksena on uusia esimerkkiyrityksen atk-laitteisto. Lopputyö päättyy ajanjaksoon, jossa järjestelmän suunnittelu on päässyt rakennetun järjestelmän testausvaiheeseen ja tulevien parannuksien suunnittelu alkaa.</p> <p>Tutkimusmenetelmäksi valittiin toimintatutkimus, joka sopii tähän aihealueeseen ja tiedon analysointiin. Kerätyt tiedot sisältävät tietoa eri lähteistä, kuten esimerkiksi haastatteluista, kokouksista, keskusteluista, työn seurannasta, kysymyksistä ja asiantuntijoiden vahvistuk-sista. Tietojärjestelmän toteutukseen tunnistettiin kahdeksan erilaista haastetta, jotka ke-rättiin lopputyöhön mukaan haastattelujen pohjalta. Tämän jälkeen pohjustettiin tutkimuk-sen teoria osuudella, jolla selvitettiin nykytilan analyysin tulokset. Kommunikaation mahdol-listava tietojärjestelmä kehitettiin ja testattiin, jotta lopputulos vastaisi lopputyössä asetettu-ja vaatimuksia.</p> <p>Esitetty ryhmätyöskentelyä ja kommunikaatiota varten rakennettu tietojärjestelmä keskittyy yhdenmukaiseen ja kommunikaation kehittymiseen tähtäävään toimintaan yrityksen sisäl-lä. Lopputyö esittää lopputyöhön kuuluvaa kehityssuunnitelmaa, joka perustuu uuden ra-kennetun tietojärjestelmän testauksen lopputulokseen.</p>	
Asiasanat	Tietojärjestelmä, kommunikaatio, yhteistyö, tiedon jakami-nen, testaaminen, tiedon jakaminen, ITIL

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Abstract

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1 Introduction

This study focuses on improving the communication in a newly built collaborative system with the aim to share real-time information smoothly in the case company. This section presents the introduction of the study.

1.1 Collaborative System

In this study, *collaborative system* is an IT system or a cluster of different IT systems which enable users to work and interact with each other virtually (Graham and Barter 1999:7). It brings together workers from different locations for sharing knowledge, documents and thoughts in an effort to reach a common work-related goal. Collaboration, in this study, concentrates on getting the needed information fast for decision making and work support. Collaboration can be defined as a process where different teams may have different goals and perspectives for the same problem but they solve it constructively by exploring the root cause and fixing the problem by searching for different solutions. The solutions might be too difficult to solve individually but, with this holistic collaborative view, the solution is achievable (Chrislip and Larson 1994:5). The reason for building a collaborative system is to construct a platform where virtual teams could achieve more together than individually or by using unconnected IT systems. With the improved communication and knowledge transfer, the outcome is expected to facilitate real-time interaction in the company.

The definition of a collaborative system depends also on where it is planned to be used. In this study, a collaborative system means a computer based information system for use in the workplace which will be described from the functional point of view. Smedlund (2012), for example, described the use of collaborative systems for services. These systems typically imply a platform based on which the services are running. Service platform attracts both customers and external companies to invest in business activities (Chesbrough 2011: 105). Usually, collaborative systems are categorized into two types of external and internal processes which they involve. Also typical of such platforms is to bring together these two types of processes, so that the collaborative system provides a flexible front-end for its users. In practice, this means a dynamic, personalized web-site, with a convenient interface. In this study, the customized, interactive web-site is considered as a main tool to improve communication.

In this study, the collaborative system and communication are linked together because they are seen as a key element for improvement of knowledge transfer. In a collaborative system, communication is managed through a computer system and a shared platform. A computer system is a technological platform where the set of components interact using different protocols over network or in a virtual environment (Smedlund 2008: 866-876). A collaborative system means a system which imports information and delivers it to the intended users. Technically speaking, such a system contains a group of similar or different components (sub-systems) which are interacting or working independently as part of the platform. This system has a structure (system architecture) which, ideally, should be easy to maintain. Such system can typically be either open or closed depending on whether a system has connection to the outside physical environment. Finally, such systems can be real-time for responding to every action interactively, as well as be used for data storage. Interactive actions and data storage typically go hand in hand, since organizational communication usually requires transferring data from the storage source to its destination.

A collaborative system is, thus, an IT-based platform which contains a set of tools that facilitate a workflow of data which can occur between the teams and individuals in the company. Such a collaborative system (often also called a *platform*) enables the possibilities to share ideas and interact with colleagues, as well as can be used in organizational changes and different organizational functions support, for Internet-based knowledge sharing and data gathering. A collaborative system typically has a hierarchical structure; the stored data is available and also structured and ease to find, if needed. By now, the latest (standardized) collaborative tools have been developed by such giants as Microsoft (for example, Microsoft SharePoint is widely used), Google (with Wave which is an open-source software), Voice over IP (VoIP)-system, and different other, for example, smaller chatting systems. In the market, there are hundreds of other different solutions with different combinations of features installed.

A collaborative system is also an environment which puts together and enables a wide range of other tools indispensable from modern work life. These tools and systems typically include: workflow systems, project management with own customized sites, knowledge management, prediction market, social media tools, online chat system, instant messaging system, telephony, mobile device communication, video conferencing, web conferencing, application sharing ability, synchronous conferencing, e-mail system, faxing, voicemail, Wikipedia platform, web publishing tools, revision control,

charting and document management. When all these tools and system are brought together, the collaborative system is build and users can communicate with each other and share information.

1.2 Case Company Background

The case company of this Thesis is a medium-sized product and currently service provider in the field of logistics. The customers of the case company are mainly Finnish but lately export business has grown also overseas. The company also provides consultant services and has a little software production unit also in the field of engineering. The company was founded 1975. The number of employees reached 130 in the year 2012.

Figure 1 below describes the organizational structure of the case company.

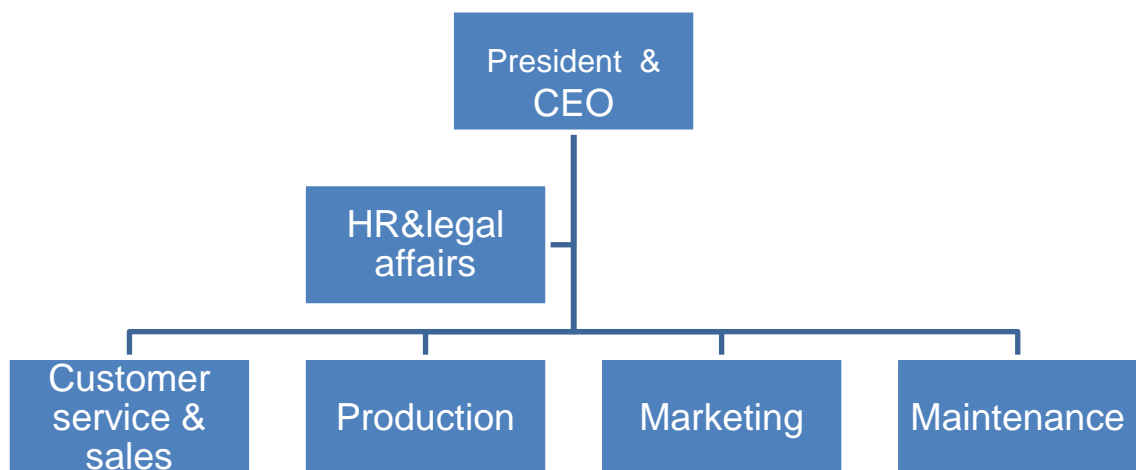


Figure 1. Case company organizational structure.

As seen from Figure 1, there are four main business units in the case company. Marketing and Production are the business enablers of the company. Maintenance unit is responsible for IT-infrastructure. HR & Legal Affairs is a rather small unit for internal customers. Finally, Customer Service & Sales unit is responsible for sales and corporate customer service.

Currently, the case company has growth from 100 persons a couple of years ago to employ approximately 150 persons now. This rapid growth has also affected the services which have now become more versatile to meet customer needs. In 2013, the company has expected to further increase the services in the area of telecommunication according to increased service requests.

Figure 2 describes the products and services which are produced by the commissioning unit of the case company, specializing in import and export business.

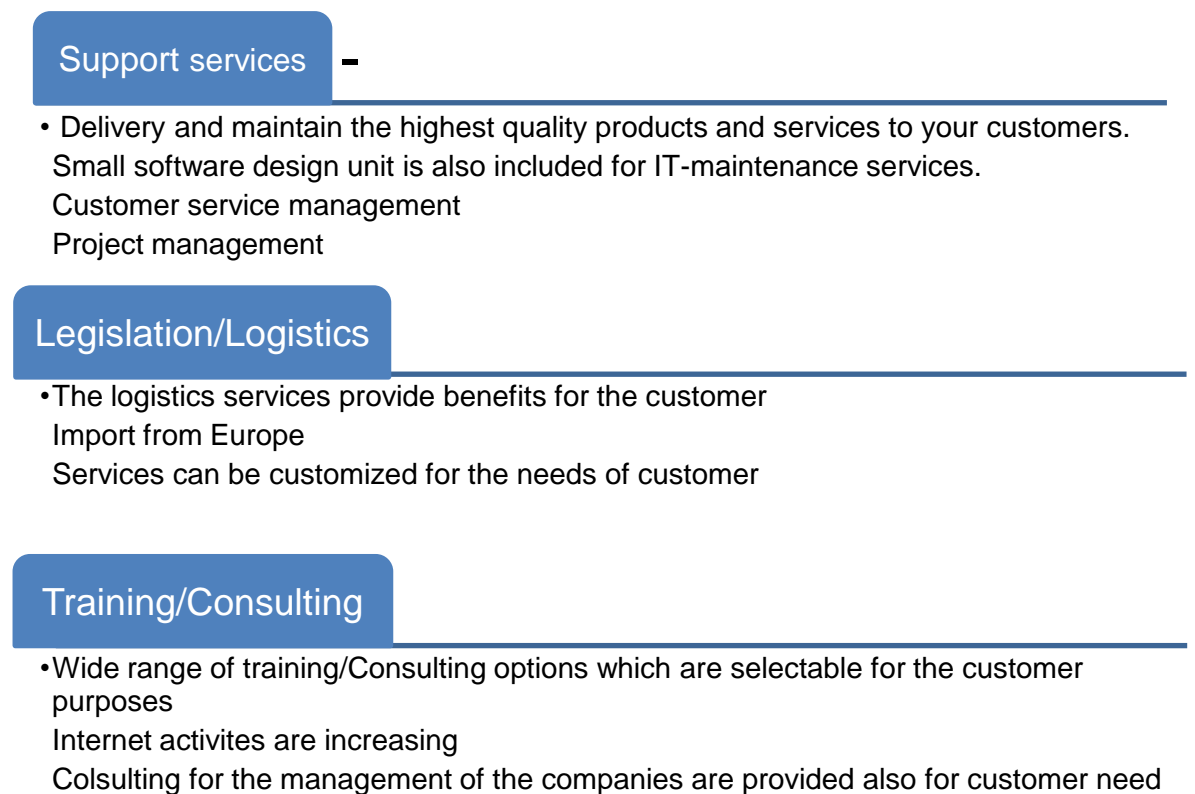


Figure 2. Structure of service provided by the case company.

As shown in Figure 2, the services consist of three types of offers. In the case company, products and services implementation is done through the service catalogue and pricelist, with marketing and sales enabling these procedures. In the new collaborative system, these processes will also become part of the platform.

1.3 Business Problem

In every industry business is growing globally, and meantime it is requiring more and more real-time information for decision making purposes which requires increased amount of communication. (Li et al. 2012: 295-296). Product development and market areas are increased because of Internet usage and world globalization. The growing markets and increasing number of rival companies force the case company to think about new ways to improve its competitiveness in the market.

So far, the case company has adopted only separate elements of the available collaborative tools, and still widely uses telephone connection as its main communication tool. At a moment, employees do not communicate much each other as a result. The current email system has limits on its storage; there is no space for emails, the email software is not supported and system is not compatible with other modern systems. Thus, the case company has identified that their IT systems could be of more value for communications but the current system is outdated.

The case company can improve the communication using different kinds of methods. The modern IT system can provide IP-based phone calls, chat messaging systems for real-time conversations, better e-mail system, virtual team sites, business intelligence features, data storages, HR-functions, integrations for other similar functionalities. The purpose of the new collaborative system is to make employees work easier and automate the workflow for the certain parts of the process. When improved, the case company can save resources and money when knowledge transfer is organized more smoothly through a collaborative system. Customers, employees and production need communication for their daily work, and a collaborative system can make it possible.

In the case company, a new collaborative system could also reduce order handling time, prevent data loss and help business intelligence evaluate sales, order status etc. Orders from start-to-end will become possible to trace down, and improved communication inside the company will reduce the time which is needed to perform different work procedures. The new system will also enable business intelligence for big data to help business decision making. Finally, the data will be easily available for the sales and the management, as well as for risk management.

Therefore, the case company is interested to benefit from developing a collaborative system. As an outcome of the new system and its services, there will be a possibility to raise the communication in the case company to a new level. But before the system is in place, there must be a process specified for the system development, including the testing of its initial version. Before that, the system should also be benchmarked, which is also going to be done in this study. After the testing, the system will still need improvements to make it even better, according to the users' feedback and business needs of the company.

1.4 Research Objective and Research Question

The objective of the study is to improve the communication in the case company by enabling a better communication and a smooth knowledge transfer in the new collaborative system. To be able to provide a solution for the company, the collaborative system will require planning, development, testing and further improvements. This study is part of a bigger project which will continue and end at the end of the year 2013. The project goal is to build a well-functioning collaborative infrastructure.

For this study, the research scope plans to cover the improvement of communication from planning and building of the new collaborative system up to improving it according to the test results. The study is based on a large amount of collected data related to planning (Round 1) and implementation (Round 2) of the system, but the main question to address is this: How the new collaborative system can be improved to provide better communication and smooth knowledge transfer in the case company? Since the case company does not have previous experience in using collaborative platforms, this topic requires special investigation. Some things are especially important to the company, for example, the employees and their experiences about the collaborative system, and communication and usage of business intelligence.

The main research question for this Thesis is, thus, formulated as follows:

How could the collaboration platform be developed for smooth real-time communication and knowledge transfer?

If this research question is resolved, the output would provide resource savings, quality improvement, service development, shortening the delivery time, all because of communication is improved and knowledge is transferred in real-time and smoothly.

1.5 Research Design

The research of this study started when management has agreed to proceed with the collaborative system and the research question was formulated. Secondly, the data was collected. Data collection was done to identify the requirements for improving the collaborative system. Thirdly, the data was analysed then, at the same time, literature review provided knowledge needed to develop an approach for solving the problem. Fourthly, the proposal to solve the problems was constructed by combining theory and data, which would make improved communication possible and increase quality of knowledge transfer.

The research design applied in this study is shown in Figure 3 below.

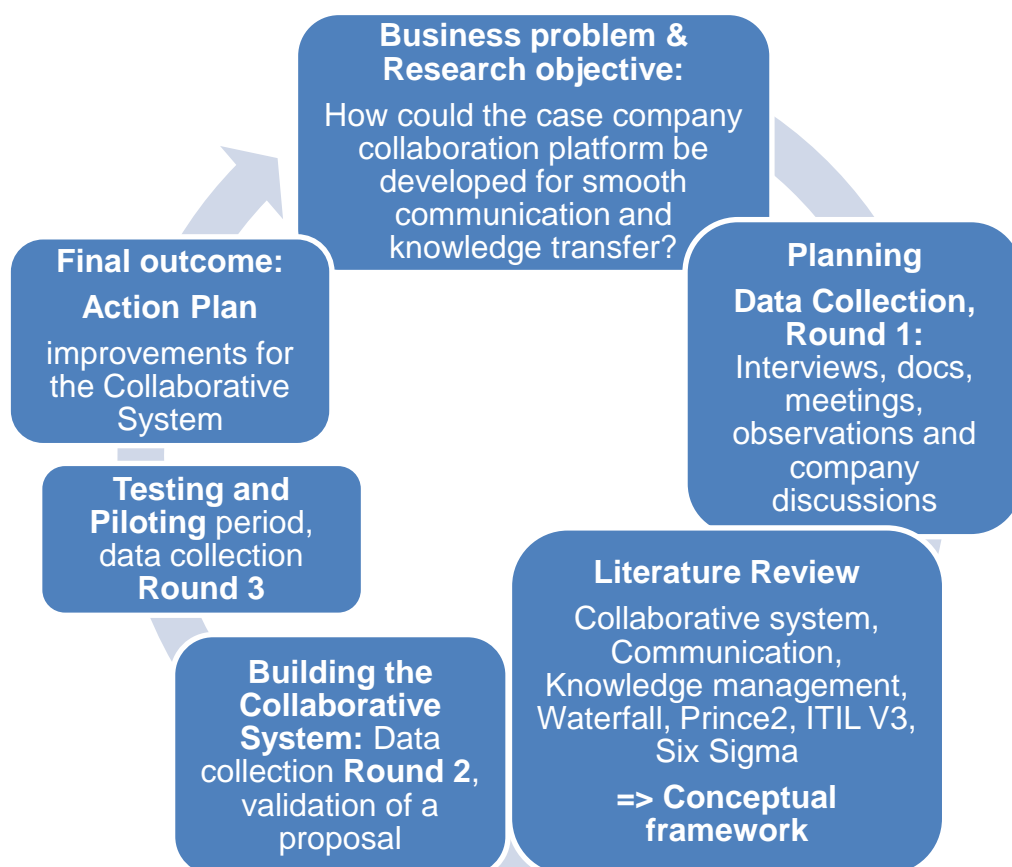


Figure 3. Research design in this study.

The study contains business problem and research objective which triggers the current state analysis (Section 3) and literature review (Section 4). Literature review gives detailed information about the principles of building collaborative systems and methods used to improve them. For the development of the collaborative system (Section 5), data is collected from at least three sources and is interpreted in line with the principles of qualitative research. Data collection draws from interviews, meetings and company discussions and analyses the results from the testing period and validation sessions in the case company. As the outcome, the research proposal for further improvements is presented in Section 7.

2 Method and Material

This section overview the method and material used in this study and explains how the data collection was made and analysed. The study is conducted according to the qualitative research principles, for which action research is chosen as the research approach for this study.

2.1 Research Approach

The study is conducted using the action research approach (AR). According to Blichfeldt's and Andersen (Blichfeldt and Andersen. 2006:4), AR contributes to both practical concerns of people in an immediate problematic situation and to science simultaneously. It requires active communication of the researcher and the environment, and emphasizes the importance of learning as a primary aspect of this research approach.

The selected research method is a practical, cyclical approach to professional inquiry in any problematic situation. Research process begins from analysis, which is followed by a draft version of the proposal. The proposal is then tested and evaluated before a new cycle of plans for a change is developed and implemented. After the taken actions are reflected upon, the process can be started all over again. (Coghlan and Brannick, 2005:25)

Action research methods have become suitable research in companies around the world. From the action research point of view, the best way to examine the study is to think about the way the practice will proceed according to the actions suggested during the study. The focus of action research is, thus, shifted from analysis to identifying elements to implement change.

In this study, action research begins with diagnosing the business problem (illustrated in Figure 3 above). The diagnosis addresses the research questions of how the case company's collaborative platform can be improved for smooth communication and knowledge transfer. Secondly, the data is collected based on the interviews, meetings and company discussions, as well as extended by results of the brainstorming session. Thirdly, grounded in literature review, the planning phase starts. The data collection plays an important role in the planning phase. After the theory and practice are combined, the conceptual framework for developing improvements is suggested. Fourthly,

the proposal for the improvements of the collaborative system is constructed. This proposal is based on Data collection round 2, and this proposal includes documentation for the testing procedures. This proposal for the test phase is then evaluated and validated. The study ends before the fifth phase, the Implementation process, which is the final step in improving the collaborative system. For the implementation of testing, this study prepares the final proposal, ready for operational use. If the data is changed during the process, the cyclical nature of AR allows to do the iterations again, as many times as is needed for achieving the set targets.

2.2 Data Collection and Analysis Methods

In this study, data are collected from a number of different data sources and it was done in two iterations. The study conducted three different data collection rounds to strengthen its validity and reliability. *The first data collection* (Round 1) consists of employee interviews, meetings and company observations and is done for the Current State Analysis (Section 3). *The second data collection* (Round 2) consists of employee interviews, meetings and discussions, observations and a brainstorming session done for the development of the Current State Analysis (Section 6). *The third data collection* (Round 3) collected data from the testing and piloting periods and from the meetings with the employees and management following the testing and piloting stages. This data collection round aimed at further improvements to the system and collected data for the development of action plan for further improvements (Section 4).

Figure 4 below contains the description of the timeline for the study. In the study, interviews, meetings and observations were conducted in two round of data collection (Round 1 and 2). Round 2 also contained the important brainstorming session where all requirements were approved and scoped, and the system design actually developed. In Round 3, testing and piloting were done, for further infrastructure development.

The timeline for the study is shown in Figure 4 below.

THE TIMELINE OF THE STUDY

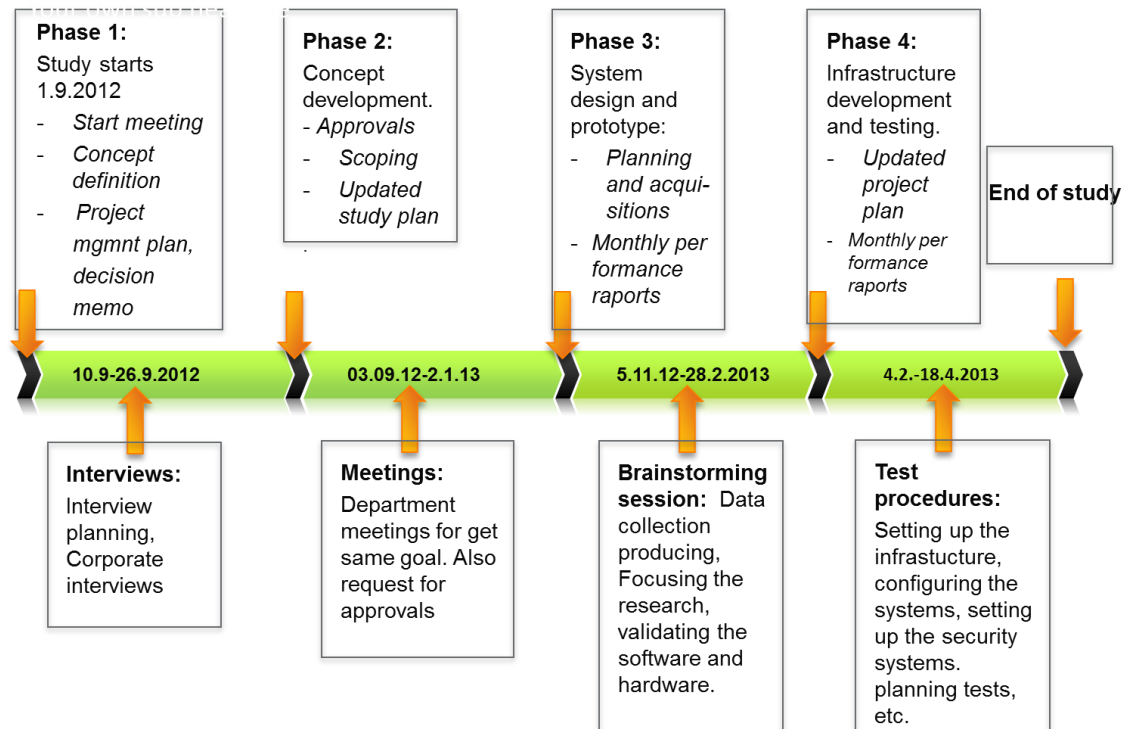


Figure 4. Timeline of this study.

The analysis of the data collections were made in all subsequent rounds, for the planning phase (based on data collection in Round 1) and the implementation phase (based on data collection from Round 2), and finally, testing and piloting (data collection Round 3, aimed at further development). As a result, the data collection and analysis, the validation of the conceptual framework was possible to merge into the proposal for the collaborative system, and the action plan for further improvements.

2.2.1 Interviews

First, the data collection (Round 1) was based on the interviews from the employees of the case company. In the meetings with the management of the company the represented solution and even when the need of collaborative system questioned the benefits of using the collaborative system were based on a long-term based planning. The given information from the meeting was giving a direction for the study. After the meetings and interviews there was managed discussions formed to the two different partner companies where the personnel introduced their communication platforms. The personnel represented the use of their communication tools and how components were

installed to the platform. Companies were interested for future communication platform for integration purposes.

Interviews were organized in Rounds 1 and 2 of data collection. They were conducted for identifying the features of collaborative system and its communication which were in need of improvement. The questions used in the interviews are given in Appendix 2 and 3. The interviews are shown in the timeline of the study below.

THE TIMELINE OF THE STUDY

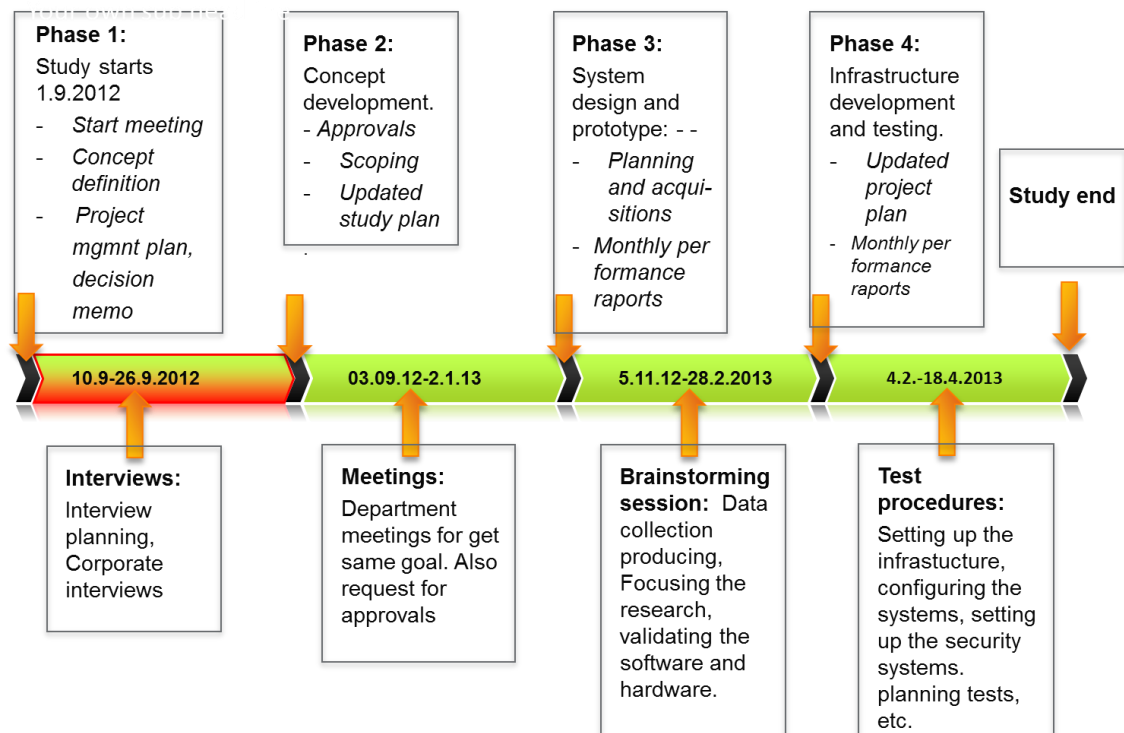


Figure 5. Time of the study: Data collection, interviews.

In Round 1 of data collection, there were five interviews conducted. The interviews were semi-structured interviews and the responses were given by persons representing top management, ICT management, risk management and production. They were chosen because all of them are using the current system and its sub-systems (such as email and file transfer) and had opinions as for its improvements. The participants and departments they represented, as well as some other details of the interviews are shown in Table 1 below.

Table 1. Details of the Interviews conducted in Round 1 of data collection.

no	Interviews	Date	Duration
1	Management	10.9.2012	60 min
2	Customer service & sales	15.9.2012	60 min
3	production unit	20.9.2012	60 min
4.	Marketing	26.9.2012	60 min
5	Top management review	18.12.2012	60 min

As seen from Table 1, data collection contained five interviews which were lasted one hour. The interviews were based on the questions delivered in advance to the employees of the case company. In these questions, there were asked about the problems of communication and how they would like to contact other employees. The interviews gathered requirements from top management, customer service, production, marketing, and finally the review interview with top management for the requirements which were not known before. The first interview asked the management where the most requirements came from. The second interview contained requirements from the customer service and sales. The third interview gathered data from production unit which is responsible for making the product, warehousing and shipment. The fourth interview contained requirements from the marketing side responsible for brand creation and relations with partner companies. The fifth interview collected the top management requirements and advanced requirements related to all other requirements. The interviews gave a wide range of data of what employees really needs on a daily basis.

The questions of the interviews were sent to those departments earlier so every department had the opportunity to inquire about the requirements in their departments and present their collective point of view. The questions targeted the need to improve communication and enable knowledge transfer. In the departments, the interviewees conducted a meeting on their own where they discussed the requirements in their teams.

2.2.2 Meetings

In the data collection Rounds 1 and 2, it was needed to make conclusions for the management approval. The management wanted to participate in the improvement of the new collaborative system in the case company. Therefore, meetings and discussions with the management are shown in Figure 6 below.

THE TIMELINE OF THE STUDY

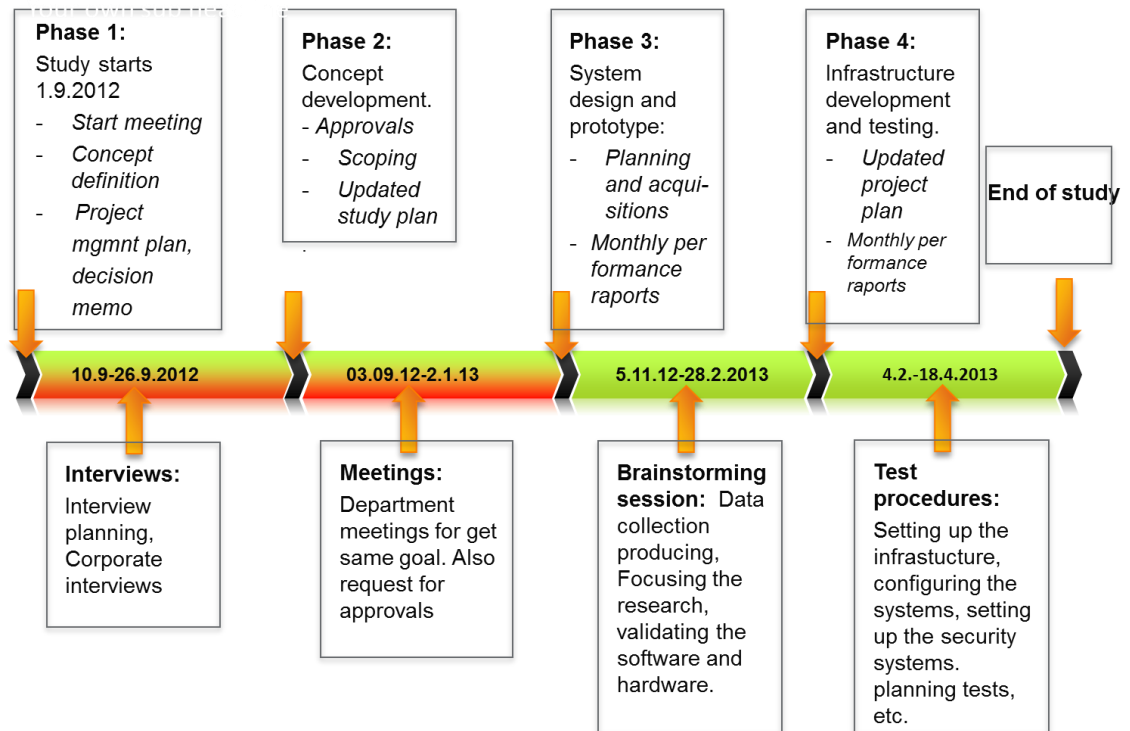


Figure 6. The timeline of the study: meetings.

Figure 6 describes the meeting and discussions with the management which participated in the concept development and approval of the direction the project was developing to meet the criteria set by the case company.

The discussions covered the content of ICT management in the new collaborative system. Also the topic of risk management was discussed with ICT-management. The other topics covered management, production, customer service with sales, maintenance, and also touched upon change management. The details of meetings and discussion with management are shown in Table 2 below.

Table 2. Meetings schedule.

Date / Duration	Action
03.9.2012, 2 hours	Meeting: Management
15.9.2012, 2 hours	Meeting: production
	Meeting: customer service and sales
	Meeting: Marketing
	Meeting: Maintenance
31.12.2012, 1h	Meeting: Management
	2 nd meeting
2.1.2013, 2 hours	Meeting with ICT manager

As seen from Table 2, the meetings were scheduled at the end of 2012 and the beginning of 2013, and were documented by making the memos of the meetings. The marketing section did not organize a meeting because the management approved the initial marketing sections' improvement requests.

The main focus of the meetings was to get approval for the required improvements to move the project forward. The meetings become useful forums for this study to have decisions taken. The timetable was also under discussion because of urgency to get system online and prepare for the influx of the orders that will come before the summer. The milestones of the study were also needed to approve in the steering group meetings.

Additionally, the meetings with Production, Customer services and Sales units, and Maintenance included approval of what the communication tools should be which are required to increase collaboration. One of the meetings also included employees from various sections of the Production department. Production department used this possibility to discuss the requirements, and the meeting room was crowded with the employees of the Production department. As a result, the schedules and suggested requirements were approved.

Finally, in the review meetings with the management of the company, the represented solution and the needs for the collaborative system were questioned against the possible benefits of using the collaborative system, based on a long-term based planning. The decision taken in this meeting gave a direction for this study. After the meetings and discussions, two different partner companies where the personnel introduced their

communication platforms were chosen for interviews to inquire about their experience. Their personnel related about the use of their communication tools and how components were installed to the platform. These companies were interested for further improvements to their communication platforms for more integration purposes.

2.2.3 Observations

In this study, observations were also used as input for the development of the proposal. This means that the researcher, as part of his work, followed the daily work routines of the employees and made observations. These observations were made systematically for groups of:

<ul style="list-style-type: none"> • customer service and sales staff
<ul style="list-style-type: none"> • marketing staff
<ul style="list-style-type: none"> • production personnel
<ul style="list-style-type: none"> • maintenance personnel

The purpose of observations was to determine what users actually do when they arrive at work and what is really necessary to accomplish the work. The observations were made after the interviews and before the meetings over the period of 1.11-15.11.2012, and were aimed to prepare for the testing procedures. The observations were conducted by following the users' daily activities, with the purpose to check daily routines of the employees.

As a result of interviews, meetings and company observations, which formed Round 1 (for the current state analysis); it was also possible to conduct an important brainstorm session (in Round 2).

2.2.4 Brainstorming Session

During the brainstorming sessions, all the requests and innovations from the earlier interviews, meetings and from the other companies' experience were discussed. All these types of input were included into a mind map with which the planning discussion started. In the brainstorming session, several employees participated (IT-manager and one employee, those who planned to participate in the testing process as well). The

brainstorming session was a filtering process where all the ideas were displayed and discussed, and during the session only those requirements which were in scope of the project was taken into the next phase of the study.

In this study, the brainstorming session served as a requirements gathering session where the requirements and innovations were discussed and scoped to implement into the collaborative system of the case company. Since the brainstorming session was kept after the data gathering (Round 1), it made a separate phase of data collection (Round 2). In the brainstorming session, the quality of the data collected before in Round 1 was further increased because better scoping and improvement iteration processes. The brainstorming session is shown in the timeline in Figure 7 below.

THE TIMELINE OF THE STUDY

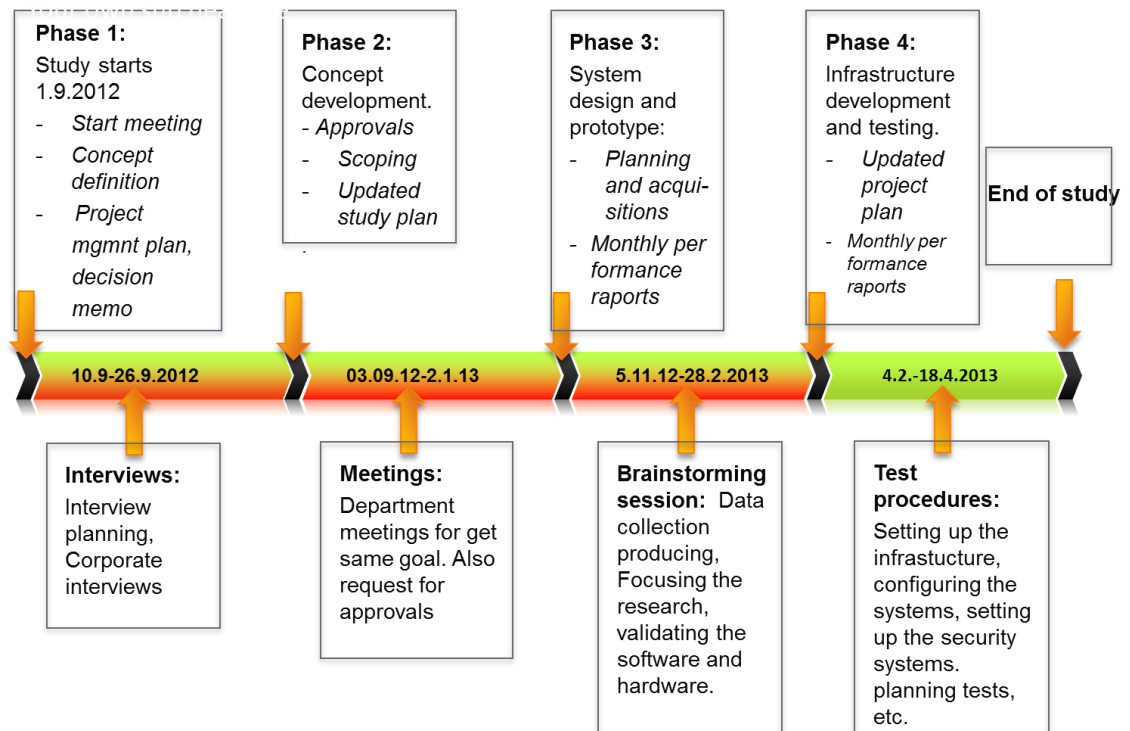


Figure 7. Timeline of the study: brainstorming session.

Figure 7 describes the phase three which led to the system design and prototype development where the direction of the study and steps for improvements were planned. The goal was to plan the infrastructure of the collaborative system in such a way that functionalities will be best chosen and the structure would address the need for decreased maintenance.

Brainstorming session focused directly on the research problem of this study, namely: how to improve communication and knowledge transfer in the case company. During the brainstorming session, there was a discussion about the requirements and the features important to include.

2.2.5 Benchmarks

The Benchmarks for this study are comparisons of the proposed collaborative system to the other collaborative systems, and evaluation of what they can offer for the study. The benchmarks were gathered in two different ways. First, by examining the available platforms from close or similar fields, with the main focus placed on the needs for communication and the tools included in these systems. As the collaborative system manufacturers are quite many and there are Finnish products as well as foreign products available, benchmarking gives also a first look at the available system and the requirements and standards they set.

The second way to examine benchmarks was through visits to partnering companies (suggested by the employees in the interviewing phase as those of interest as for their collaborative systems). These visits to the partner companies also helped to get acquainted and selected the communication tools they were using. All the partner companies were using different communication tools but they were all compatible with each other. The team which visited in the partner companies consisted of Maintenance and Sales. The reason for this was that Maintenance and Sales had expertise in communication which brought extra value to these visits. The company visits consisted of the presentation of the company's intranet and their core functions of it. The backgrounds of the partner companies were different and it was seen in the way how they organize their collaborative systems and present their data.

One of the companies was a successful international company which was presented all of its material in English. The communication tools were designed for this particular company and it contained all possible communication methods. The other company was operating purely in the Finnish market and its materials were in Finnish. As a result of partner company visits, the meetings memos were created to document what things were approved to move on.

2.3 Validity and Reliability

Qualitative researches reliability relies on systematically carried research. The validity refers to truthfulness and accuracy (Denscombe, 2000: 241). This secures the credibility of the researcher and philosophical belief in the value of qualitative enquiry. Qualitative analysis is a process where measurements are required (Patton 1999:1195).

Reliability is defined as increasing trustworthiness and authenticity. Reliability in this study will be secured by using different data sources and collecting data at different points of time as shown in Figure 4 (the timeline for the study).

Validity is defined as the study's ability to measure what it is intended to measure, and evaluate how the topic and content match together. The planned data collection will be done by using many techniques in an effort to reply the research question from several perspectives.

Rigour is also needed to ensure the quality of the study. In this study, it is planned to be tacked by a detailed reporting so that the research process can be replicated by another researcher if necessary (Smallbone and Quinton 2011: 3-11). Rigour also defines that research stays internally logical and consistent. The study's credibility depends on these issues which are especially important to qualitative research.

3 Current State Analysis

This section examines the current state of collaboration and communication tools in the case company. The data used for the current state analysis comes from interviews, meetings and discussions in the case company.

3.1 Current Collaborative Tools: Description

The case company is small-sized company where communication is not at required level. To improve the communication there is a need to obtain more information as a foundation for future collaborative system. Its global communication has increased which requires for a new system handling multiple information sources. Currently, for its daily operations, the case company is using a number of collaborative tools (called “the current “system”) which is running under Windows Server 2000.

The email system is based on Microsoft Exchange 2003 standard environment which contains 19 Gt database for emails. The database is currently full and the server uses its own resources for maintaining the email system. The Server contains storage space for different kind of media files and documents. Microsoft server 2000 has been a good tool for the company but it has been used without updates since 13.7.2010 (according to Microsoft support services which ended the support for this product). In the beginning of the 2000's, this system represented the latest technology but after a decade it needs upgrading. The computers and laptops are using Microsoft Windows XP and Windows 7 at a moment.

Figure 8 below is actual screenshot from the current Server.



Figure 8. Screenshot of Server 2000 from the case company.

In the Server, there is also the employees' *data storage*, mostly of invoicing based on the orders so the speed is important variable in this area of business. All files are stored in folders; and during the years of working there are many sub-directories and data scattered around. The physical location of the system is placed on the case company's facilities. The company neglected to invest IT-infrastructure but the current plan is to change this situation for the better.

Maintenance of the Current IT System

The current service maintenance process is presented in the case company in Figure.9.



Figure 9. Maintenance process in the case company.

As shown in Figure 9, the maintenance processes are simplified the user is giving a notification for the maintenance who will do the corrective actions. Presently, there are no resources for IT-system development or technical project management in the case

company. The actions are usually synchronized by phone because the situation is usually technical which is preventing using email. Issues can be also fixed in the office when maintenance people are visiting the offices, when they fix the issues and document the problem. After that, the user gets notification about the resolved issue. Since technology is not the main criteria for the case company, resources from the maintenance are kept at a minimum. The case company is aware that the increase of the communication is vital and plans to improve this situation.

The current system is about the end of its lifecycle. Certain services, for example, backups and files are stored for a certain period of the time. Business analysts are gathering data manually, from the information stored in the system. The user is currently using emails and file-folders for communication, and the on the other side of the system are maintenance and customer services. The knowledge which will be need for new collaborative system will be developed according to the users' needs. The requirements of the study are gathered below in Section 3.4 as the requirements for the collaborative system.

Plans or to develop a new collaborative system started when these needs were recognized. The new features will be implemented in the Building phase, after which the new collaborative platform design will be put to test (for testing and piloting) after the hardware installation and software installation are done. When the technical planning is implemented and technical design is ready, there are various technical and operational documents still need to be created. Basically, the goal is to make these documents easy to maintain but all core elements need to be included and described.

The needs for the new system were collected in the data collection (Round 1, the current state analysis) and further refined in Round 2. In both rounds, it was done through interviews, company meetings and discussions and observations at the work place.

3.2 Data Collection Round 1: Interviews

The interviews collected suggestions how to improve the communication that will best suit the employees. They are focusing on the communication from the perspective of users and further developed based on certain types of observations.

The interviewees pointed to the *challenges in current communication*, and stressed the need for *better communication* in the case company. Business hours are busy time for

the company which means that they would need focus on a one thing at a time. The information which is available may not help the employees if it is not accessible. Also issues with shipments and products can be decreased when appropriate instructions and communication tools for emergency would be exists. The “movement” inside the company is also stressful for the employees which should need to focus on the core business. Suitable notifications, instructions and invitations directly would decrease the need of use archives if need for the history is relevant. The possibility that two persons are doing independently the same work and in urgent matters is frustrating, and there is a need to get contacting the expert are variables on the limits but those are possible also avoid in the communication enabled company.

The interviews from the management side showed that the concern about *the financial status* of the company, and the need to increase efficiency in doing business were the main issues. *The information flow* which managers expect could increase efficiency could make it possible with the new collaborative system. Business intelligence, if used correctly, could also help as a system where resources can be directed well and by use of communication tools for communicating with revenue, stock, component prices etc.

The results of the interviews also brought up *the recommendations* for communication tools such as chat, and discussion forums. Low starting threshold for using these communication tools is a special requirement according to the interviews. Recommendation for knowledge transfer was to use sufficient disc space and request for workshops and training. Communication also calls for daily use of virtual teams and meetings, and scheduled tasks which can be synchronized through the new collaborative system.

During the interviews, there were questions raised about the communication needs for the case company. The answer was that mobile phone is limiting the communication because if there are no alternative choices for communication. If the user is not reachable by phone, the information does not reach through. Therefore, the needs for proper communications tools (e.g., email system and chat system and discussion forums) are obvious and vital.

Overall, all of the interviewed persons were familiar with communication needs and tools they would like to use. For example, Sales wanted to improve communication to the in contact with the Production department, so that order processing would start as

soon as possible and they would be involved from the beginning. The Sales department was the only place where the requests for communication improvement were ready as a list of requirements. The Production department announced they need improvement in the knowledge transfer to save time between order making and product delivery. They also expressed their wished for some particular features of communication that should be includes in the new collaborative system. The full account of interview results can be found from Appendix 3.

3.3 Data Collection Round 1: Observations

Observations were used to collect information about the current state of the IT system and the needs of the employees, as input for the development of the new collaborative system. This means that the researcher, as part of his work, followed the daily work routines of the employees and made observations. These observations were made systematically for groups of:

<ul style="list-style-type: none"> • customer service and Sales staff
<ul style="list-style-type: none"> • marketing staff
<ul style="list-style-type: none"> • production personnel
<ul style="list-style-type: none"> • maintenance personnel

These observations were conducted over the period of 1.11-15.11.2012 by following the users' daily activities, with the purpose to check daily routines of the employees as for the need potentially addressed by the collaborative system.

Customer service and Sales: A daily routines starts when employee is coming to work. The first activity is to start computer and unpack the bag. When computer and email is started, it is time for a first business call. Usually, at this time a colleague comes to visit and asks some questions. After the business calls, the employee sends emails and before sending the email, its content is verified by colleague. When one hour is done and phone calls are received and made, it is time for a coffee break. During the break the colleagues can discuss the monthly management meeting or the last month proceedings. The decisions are put in the bulletin board but also sent as an email to everyone. If not everybody is notified, a printed version of the management meeting can be distributed. After the coffee break, the day continued with a business trip to a nearby company to make a new order or a product presentation. During the business trip, the

mobile phone is used for contacting employees. When business trip is over, the employee calls business calls and write emails which is sent during the business trip. Reporting is done by email messages. The orders to the production and reports for the marketing are made for the papers which are sent by an email.

Marketing: A day starts when employee is coming to the work and opens the computer. First, he is doing the preparation for the meeting and revising the latest reports and analysts. During the email checking and calendar updating, several phone calls came from elsewhere and after preparations are made then is time for the meeting. After the meeting is over the meeting memo is delivered to the email box. The decisions and action points are put into the use and phone calls are called. After the implementing these actions, the meeting is starting. He needs information and visits the sales section to update the current situation of products which are sold in that particular business. The sales analyses and management reports are made on paper and delivered by email.

Production: The day of the Production team starts with preparations for the new coming day. The orders are checked from email and regular mails. If there is not enough information in orders then production staff is phone calling to fulfill missing information. During the daily work there might have phone calls about the orders or orders where is need to change some criteria's. Shipments are stored in data storage where the products are sent to the customer and where the acquisitions are coming. During the day employees of the Production make phone calls to and from different logistics companies, sales and vendors.

Maintenance: Maintenance is responsible for the maintenance of an IT-infrastructure, mobile phones, faxes and fixed phone lines that is providing the Internet-connection. A regular day starts with reading the emails and regular maintenance actions. If employee of the case company does not have access to the email, the maintenance will receive the phone call from the user. Maintenance uses email and phone calls to its work.

As a result of these observations, it seems that in the case company is mostly using phone calls, emails and personal contacts for the communication. When people are calling to each other, it may reserve the phone lines preventing urgent calls from outside of the company. When the phone call or colleague visits, then the working stops.

Employees also used email which is time consuming because the email storage space is not large and emails which are older may have been accidentally deleted. When colleagues come to visit or it is needed to make a visit to colleagues with an issue, this issue is often an older case which may require data retrieval which is again very time consuming do the outdated data storage.

3.4 Challenges of the Current IT System: Summary

Summing up, the case company's current system needs improvement. Its challenges can be described in Table 3 below. It can also be measured by comparing the current and the planned new system. In Table 3 below, two systems are compared, the current and the new values of the systems. Table focus only on the main features which are most important to the company and relate to the research question. Table 3 contains email database size, amount of servers, data storage limitations, workflows, possibility for integrations, availability for business intelligence and is intranet and extranet in use.

Table 3 below contains a list of system features compared to the old ones.

Table 3. Requirements for the new Collaborative System compared to the old system.

System feature	Old system	New collaborative system (to be developed)
Email	19 gt (divided by users)	no limitations
File storage	~140gt	4 tb (no limitations)
Servers	one	multiple
chat	no	yes
workflows	no	yes
integrations	no	HR systems and ERP
Business intelligence	manual	semi-automatic
Intra/extranet	no	yes
Wireless connection	no	yes

As shown above, the new collaborative system features will be significantly improved. Mostly the data storage will change because of cloud services bring a lot of storage

space and servers hard discs can store more data than earlier. Additionally, the case company's documentation for the current system is from the year 2000 when the current system was implemented (if there are any updates made after year 2000 then it is not documented). The new system will improve this issue also.

In addition, the case company does not currently have a special change management procedure and it does not involve project management or team to continuously improve the system. This would provide continual improvement and an opportunity make requested changes to the system whenever it is necessary. As the change management is implementing requests from the business side, it also could implement users' innovations as well. At a moment, the current system can deliver only e-mails. Files and folders can storage a limited amount of information. In the future, the system can deliver messages and real time data, and there is a possibility that changes may have to be done according the ITIL change management process in the future. These measurements are challenging but possible to implement. It is also possible to measure e-mails and the current data storage and compare it to the new one. The Maintenance team could be responsible for change management in the future.

3.5 Requirements for the New Collaborative System

The current state analysis collected the results on what is needed from the new collaborative system and what features the users need. The data was collected from the interviews and observations described in Sections 3.3 and 3.4, and further enriched and approved in the brainstorming session (data collection, Round 2) by the case company management.

Summing up, the current system has used all of its resources and it cannot be updated because the age has expired for the used software. The current system has provided few features which are needed for improved communication. For example, email-system is needed for the new system, so the new platform has to contain it, provided there is possibility to gain more storage space and the latest communication software.

Table 4 below shows the requirements and purposes of the technical acquisitions.

Table 4. Requirements for the new collaborative infrastructure.

Requirements	Purpose
Network: Fiber connection on Local Area Network	Fiber connection provides fast response time. When WAN-connections are also Fiber, the connection does not slow the speed.
Active network devices	Firewalls, Routers and switches provide new fiber technology Network fast experience.
Servers	Server components change such as instant component switching technology enables fast issue handling.
Cloud	Access for relevant data is needed immediately. Cloud service provides accessibility
Other needed devices	There is also need for UPS-devices in the case of electrical outages. Air cooler system for servers are needed for maximize lifecycle of the devices. .

The requirements from Table 4 indicate the results of the investigation to the server room and revealed that some of the active network components are in need of updates. The new system will also take advantage of the increased the speed and response time of the local area network. Data availability will also increase by using the cloud opportunities for data storage (e.g., as a backup for their data which is usable around the world). The business critical data is stored into the case company where data analyses are made. Deviations are included in the risk analyses where has made possibilities of having the electric shortage or power failure in the case company. The preparations for the deviations need to have functional UPS-device which storage electric for certain amount of time. The purpose of UPS-device is to save stored data properly without any data losses and safely shut down the equipment if electric shortage is long enough. UPS-device can also stabilize voltage peaks which are meant to save active equipment from sudden damages by voltage peaks.

It needs to be reminded that the study is focusing more on the improvements to communication and knowledge transfer. The case company uses communication for exchanging information in different purposes. In the field of business, there are situations which might be crucial if there is not suitable communication available. The main tool for communication is currently focused on the email system where messages can be sent and received. Communication methods can also be extended to include a chat

system where real-time conversation can be made. Discussion forums and news sites are also capable to give information which is relevant for a long time. Wikipedia can be seen as a corporate dictionary for provide information and facts which are relevant in the case company. The intranet sites have been noticed to be helping to be a learning center. The availability of relevant data by other employees can give a holistic and deep view of the core processes. Intranet sites will also get updates frequently and user itself can update the changed data.

In any arrangement, the chosen components must bring a long lifecycle for the use of software, so that the maintenance team would have no worries about the code. The planning phase (Section 6) will make sure that every component is suitable for the company.

A special requirement is also that a user should access every feature from the intra pages. Layout, buttons and forms must be categorize so that operations can be executed in a simplified manner. The user interface should thus provide a dynamic environment which is needed for the case company.

Collaborative system measurements

The effectiveness of the new collaborative system can be identified by measurements done by users themselves. Data collection (Round 1) identified the variables which need to be fulfilled. Overall, from the answers of the questions and observations, the most valuable aspects to measure in the new collaboration system should be: a) collaborative system reaction time, b) document download time, and c) the current news interval time.

First, the *Collaborative system reaction time* means that when communication tool should be fast in sending messages, for example. Secondly, the knowledge which is put into form of documentation should be quickly available for users and contains the latest information. If the speed of local area network is suitable for a large amount of data, then also *the network speed* is a variable where the amount of data and response time can be calculated.

All these measures relates to the needs which were identified from data collection (Round 1). Improved usability will place more focus on delivering information and customer experience with the user interface.

In summary, the improvement of the communication requires the improvement of the overall infrastructure which should include a fast, reliable network which is fully functional locally, even during the electrical shortage. Real-time operations can be gained by using fibre cables where the speed is increased when compared to the older copper cables. Availability of the data is needed when the employee is doing their work and when data is needed multiple times a day.

Presently, in the case company, the communication is based on emailing, phone calls, meeting, and occasionally blog writing. Communication is based on situations where different contacting methods are needed. There are possibilities to extend these channels in the future to communicate also with chat system, chat-channels, VoIP-phone system, and forum-based discussions. New features are also virtual environments which can be created if needed. The information is distributed via company's pages for all whoever needs the information. When this infrastructure is built, it will enable a full use of the benefits of the collaborative system.

4 Best Practice for a Collaborative System

This section examines the fundamentals of service development viewed from different perspective. Additionally, a conceptual framework based on the best practices is constructed at the end.

4.1 Knowledge Management

Knowledge management is making of the organization's data and information available to the company through portals and with the use of content management systems. Knowledge management can be described as organizing company's activities and increasing quality of founded data. Knowledge management needs fully understanding of (Jashapara 2004:5) Knowledge management defines several levels of knowledge which are in the first level data service. Data service level gives correct data for right place, right form and right time. At this level the functions are obtaining the information externally, data collections and buying the data. Information and data has to be mined so they actually meet the set criteria. Mining the data includes organizing the data, data classification, and thing lyrics. Storing the data and reuse of data from databases and data archives are also necessary.

Value of data can be measured if it is distributed correctly. Different data products, tailoring the data needed form are relevant things for data distribution. The second level of knowledge management is developed as a self-service where users can search most data and information. ICT-specialists will be doing necessary works for maintenance and development instead of librarians. Second level supports management and specialists. The main functions of self-service are management of data, training, guiding and advising. Third level requirements are management as a part of everyone's work and every process. Main functions as part of strategic projects are implemented from knowledge management.

Knowledge generation contains five phases which are helpful when data in transformed knowledge. This is illustrated in Jashapara's cycle (2002) below.

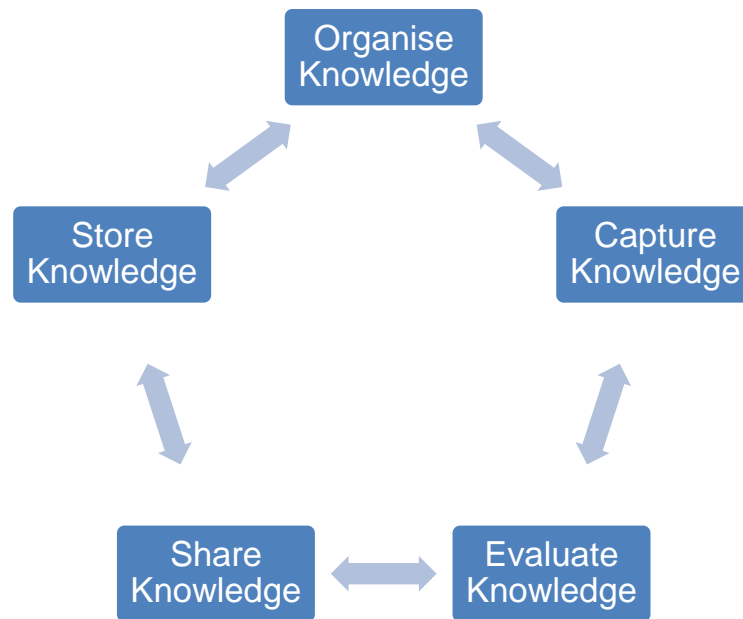


Figure 10. Knowledge management cycle (Jashapara 2004:5).

Figure 10 describes how Jashapara sees the cycle of knowledge management. When new knowledge is found it must be first captured. When the knowledge is found it can be investigated. The knowledge will be evaluated. With iterative data mining procedures the value of knowledge is maximized. After evaluation the third phase of the cycle is sharing the knowledge. The value of the knowledge is depending how, when and who it is distributed. After the knowledge usage the fourth action is store the knowledge. Knowledge can be useful later when business intelligence tools are trying to analyse business environment. When data is stored then it can be put in the last phase of the cycle. Organising knowledge as a structured content it is possible to find later. Because acquiring new knowledge is iterative process and knowledge may be updated once and a while this cycle can be do again.

Knowledge management is also linked to *a learning organization* and *team learning* for evolving with constantly changing business environment, which has been enabler for company growth.

Organizational learning

Organizational learning is growing in the case company, and the company is learning from other companies and business environment. The company learning is based on knowledge acquisition, Information distribution, information interpretation and organiza-

tional memory. The knowledge acquisition is based on congenital learning, Experiential learning, Vicarious learning, grafting and searching and noticing (Jashapara 2004: 69). There are three possible searching methods available which are scanning, focused search and performance monitoring. First the scanning is organizations behavior monitoring where target is to obtain non-routine but relevant information. Secondly, focused search is meaning for searching a particular organizational problem. Thirdly performance monitoring is a method of internal objects and measures which is focused to satisfying the external stakeholders.

Team learning

A team can learn more and achieve more than same amount of individual people. Teams are gathered as team members who have certain abilities and fulfill the team knowledge (Jashapara 2004: 62). Knowledge transfer is easier to manage inside of the team. Team learning abilities can be supported through group trainings where employees are separated for random team and then there is given group works which are needed to think together.

Improving quality and creating useful information and data is easier achieved through team work. For improved knowledge transfer it is important to know who is leading in data production, data storage and how data is structured (Jashapara 2004: 73). Structured data can be including a lot of memorizing information which has been only in the minds of employees. Organizational memory can be added in the company's databases which removes the value of silenced information. Process oriented stable environment where is no updates needs this is a benefit.

In this framework, communications is of special importance for the organization. Figure 11 below shows the description of how communication is integrated into knowledge.

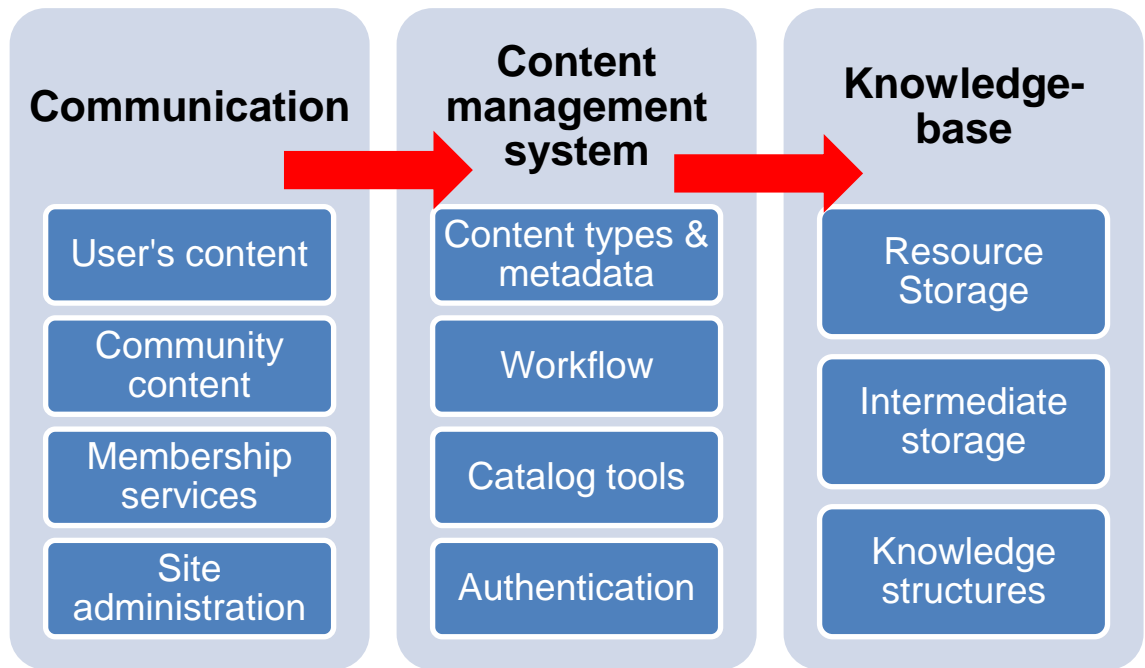


Figure 11. Description of how communication is integrated into knowledge. (Jashapara, 2004: 131)

As Figure 11 describes, communication is integrated into learning through three steps. First, there is a communication layer. In the case of a collaborative system, the user can normally use communication by writing the user's content, participating in community's discussion forums or chat groups, using membership services which are related to the work or by administrating the web-site where the communication is done. The second layer is a content management system where content types and metadata are usually handled, as well as workflow, authentication and catalogue tools are used. In the third layer, there are such knowledge structures which include intermediate storage for information and resource storage. These three layers altogether - communication, content management system and knowledge - point to the need to support the communication enablers and technology.

4.2 Communication

Communication is needed for creating work culture to employees of the case company. Value which is coming from Partner Company by their products and knowledge is need from a case company communication model and knowledge transfer possibilities. Employees are the members of the organization which is evolving with the business. When the employees are hired globally and business is international the case company

will need functional communication. The people from different cultures and with different backgrounds make the organizational culture. (Nurlita, 2012:260). Employees needs also support from other employees which is important to achieve same goal. The organizational communication means for employees formally or informally to discuss different kind of matters, exchange innovations, update existing or create new documentation, report making possibility for management or ask guidance. (Nurlita, 2012: 259-260) According a survey the most used way to communicate from management to employee was using messages. According to survey over a half would send message which contains new information. Some of the new information would be sent only in an electronic form. (Sproull and Kiesler, 1986:1506-1508).

Internal communication is formal or informal discussion among inside the company which consist of three forms. One form is communication from management to employee. Second is communication from employee to the management. Third is a parallel communication with colleagues. (Nurlita, 2012:260). According Nurlita's research there is six found variables which affect organizational communication. The variables are trust, shared decision making, honesty, openness in downward communication, listening in upward communication, attention in high performance goals.

The communication on the organizational level is can be put in to internal, external, informal and formal communication (Huhta 2007). Communication's benefits are visible when communication is done at the right place at a right time. For example, business opportunities must be use whenever it came across. Effective communication brings also positive behaviour in organizational culture as people of the case company will use communication as a work tool.

4.3 ITIL- Framework

Information Technology Infrastructure Library (ITIL) contains a library full of best practises for IT management. The originally the framework is developed in 1980's by Great Britain's Cabinet Office and ITIL contains description of a procedures, processes, checklists and even tasks which need to be done. It is meant to generate corporate base level for IT management. The framework aims for improve performance and perform only necessary actions. Also quality is one of the core processes which are aiming for continual service improvement. Its service design is used as a reference framework in this study. With a structured service development process an organization can

achieve multiple benefits. Continual service improvement (CSI) deliver value for business and IT by monitoring the service level and by feedback loop when service move through the service lifecycle (Taylor et al. 2007: 68), and this action increase the value and saves resources when it is used together with quality framework. An additional benefit for this requirement would be that the platform is operating system independent. There is also a need to use security frameworks because of the data protection for risk reasons. (Taylor et al. 2007: 17-18)

Figure 12 below describes how the services of the collaborative system can be built.

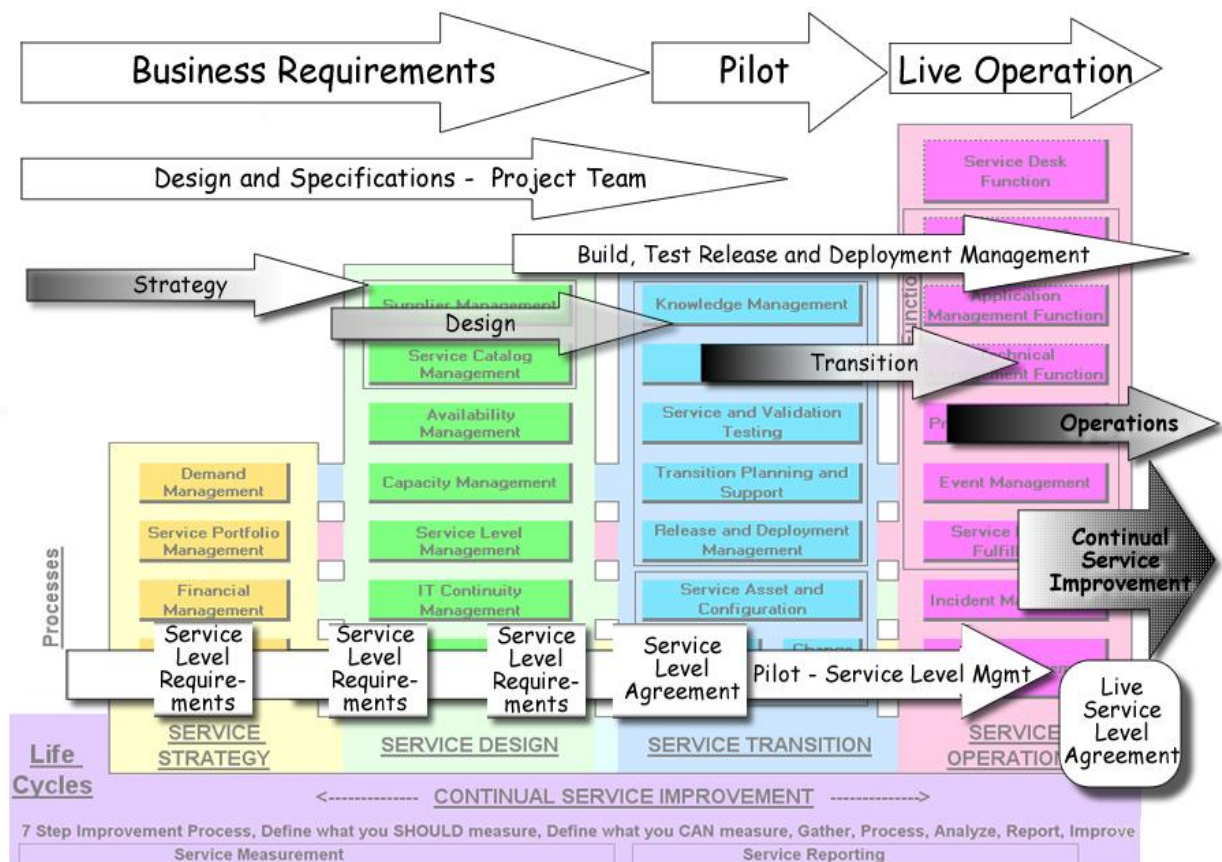


Figure 12. ITIL-based process based development. (Adapted from: OASYS 2013).

Figure 12 describes how the business problem is aiming for towards the implementation. It describes what data is needed to be gathered when researching a new system and is giving guidance from best practises. As Figure 12 describes, the foundation for the platform is continual service improvement, which exists from strategy level to the service operations level. For the foundation ITIL based functions are separated by four categories which are Service strategy, Service design, Service transition and Service operations.

The scope of Service strategy is to find suitable strategic approach to service management and set up standards and policies that will lead to IT service design. Service improvement may influence also by external factors which are information security or local regulations. The service strategy includes also strategy generation and RACI-list (Responsibility, Accountable, Consulted and Informed). RACI list contains need of actions, where is agreed what are done, who is done and when it is deadline. If the list is large then it is necessary to put tasks in the same list. Here is study's RACI list below. The alphabets describe the role of the person in that particular task. (I = informative, A = Action, R = Responsible). Service portfolio contains description of collaborative system services. Service pipeline defines services in the future basis, Service catalogue is presenting actual services in use at a moment and retired services contain services which are end of their lifecycle.

Service design contains availability, capacity and supplier management which defines that system contains suitable resources for every user. It same time gives assurance that every component, feature and service has agreed person who is responsible for the action. Availability management's purpose is to ensure that the services are running on agreed levels which are requirement set by business. The availability management aims for providing centralized collection of availability issues all over the collaborative system. Availability management is responsible monitoring the service availability is on agreed levels all system functionalities. Capacity management is using calculations to ensure that all users has similar resources use in the collaborative system and it contain active role in the service lifecycle and continuity management when also future demands are used as measurements to gain full benefits of the system resources. Supplier management contains control methods of the services which are provided by the suppliers. Since supplier management is giving knowledge about the suppliers and external services, co-operation or integration with capacity management is important for lifecycle management.

Importantly, for any service design the responsibilities have to be defined. The ITIL framework recommends that RACI-list is suitable for definition of services. RACI-list is illustrated in Table 5 below as projected to the situation of the collaborative system maintenance.

Table 5. Responsibilities matrix in ITIL (RACI-list) for a collaborative system (developed based on: ITIL 2007).

Task	Type	Test specialist	Project Sponsor
Collaborative system introduction	Action, Responsible	Informative	Informative
Acquisitions	Action, Responsible		Informative
Collaborative system build	Action, Responsible		Informative
Collaborative system settings adding and hardening	Action, Responsible		Informative
Collaborative system test planning	Action, Responsible	Informative	Informative
Collaborative system platform testing	Action, Responsible		Informative
Collaborative system user acceptance testing	Responsible		Action

Service design and service transition are part of service portfolio, which is included in IT-infrastructure. Service Portfolio is illustrated in Figure 13 below.

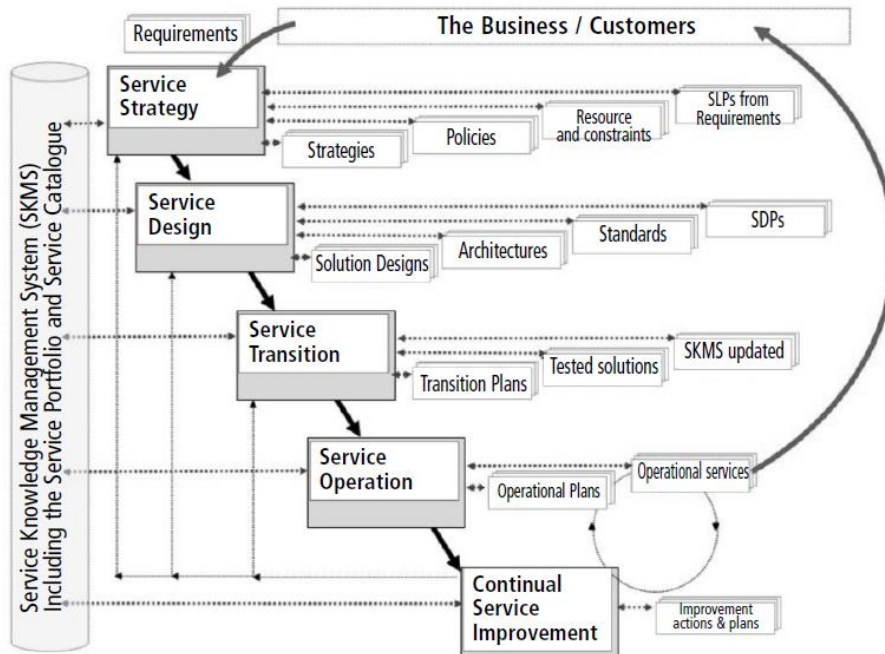


Figure 13. Service portfolio overview (Taylor et al. 2007: 42).

As Figure 13 describes, the ITIL service portfolio for the collaborative system contains five stages where the foundation is the bottom of Figure 13 and is called continual service improvement. When the future strategy and plans are defined, it is time to move to Stage 2 where service operation's operational plans are made. With these two stages are defined plans which are part of the business action and visible for customers.

Stage 3 is service design where the study's collaborative system services are planned. Each software and entire environment with used standards is described in this stage. Service design in the service portfolio plays an important role as an architecture, standards and solution designs. Service portfolio controls service designs transition plans and tested solutions. Service operations control the actual production. The final stage is the highest level and is containing strategy, policies and requirements.

ITIL also contains service management which defines a set of customized features which increase value for the users. Production of services is usually difficult to measure and control (Fanning and Taylor 2007: 25). Services are meant to increase value of the employee's work or occupy fewer resources. Main purpose of the Service design is to develop new or change existing services during the collaborative system lifecycle (Fanning and Taylor 2007:30). When the new service is developed, feature cost, functionality, and quality must be known, as well as when the service is going to be in use. ITIL has set requirements for testing through the user acceptance tests which is part of Service Acceptance Criteria (SAC) (Fanning and Taylor 2007: 54-56). SAC for the new collaborative system for the case organization will be discussed in more details below. To briefly introduce them, SACs were discussed at the brainstorming session and workshops and later used as input for the system model, its requirements and overall direction.

Service transition contains configuration management system which takes care of establishing and maintaining consistency of a product performance. Service transition model is illustrated in Figure 14.

Service Transition V-Model

For any business requirement there must be equivalent validation and testing.

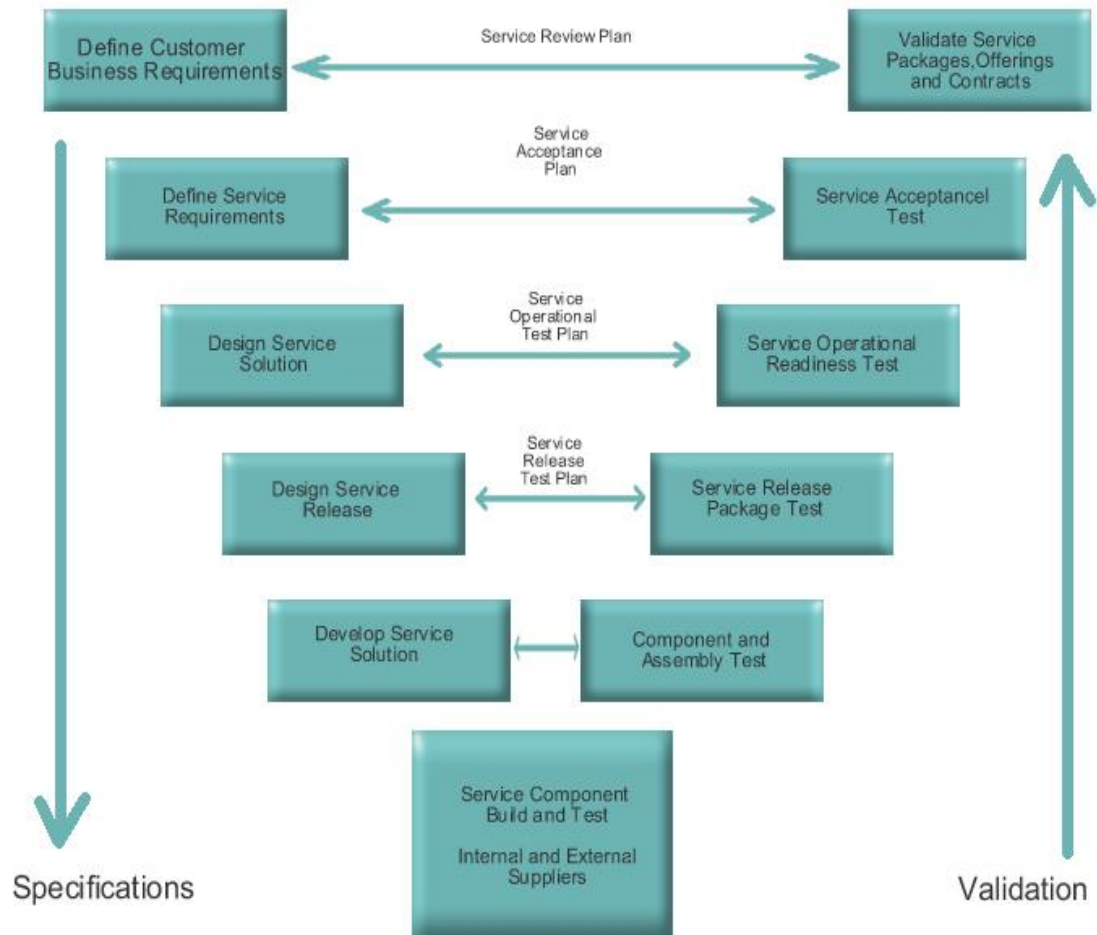


Figure 14. The service transition V-model. (Adapted from Oasys 2011)

As Figure 14 describes, the time after service strategy and service design. Designed services which are defined by customer requirements are validated by a customer packages which is made by planning. After the customer requirements are identified and validated, then the requirements for the services are identified. A service acceptance test validates the services according to a service acceptance plan. Design of service solutions and service operations require a readiness test and further planning for the service. The final phase the service components is a build and test phase before the launch into production.

ITIL can also be used as a business requirement validation. The process starts from the top of Figure 14 where first is need to define business requirement. With service review plan the service or collaborative system is validated and offerings are analysed. The second row defines requirements which service or collaborative system needs to be functional. In the context of the collaborative system development, with service acceptance plan, the collaborative system can go through service acceptance test or in the study customer acceptance testing. Service design would contain a service operational test plan a system with the needed features. This testing would then make the final approach before the collaborative system is launched.

ITIL also helps to conduct measurements. ITIL contains seven step measurement check list where can check what is reasonable to measure. The first two steps are iterative processes. The steps are: First step is Define what you can measure. The information can be found when interviewing business or employees of the company. Second step is defined what you can measure. Companies may have limitations which can be found on processes, procedures or work instructions. Step three is gathering the data which is need for quality purposes. Data collection can be done interviews, components or configuration items etc. Step four is processing the data. The data must have in right form to be useful Step five is analysing the data. Data analysis transforms the information to the knowledge and is giving more value for the study. Step six is presenting and using the information. This step is about to use the knowledge and present it. By presenting the knowledge it turns out to wisdom. Step seven is implementing the corrective action. This step is using all other steps to maximize the benefits the actions to improve and correct services or system. (Taylor et al. 2007: 67-88)

4.4 Prince2 Project Framework

Prince has been published in 1989 for United Kingdom's government agency Office of Government Commerce. It has been used for IT-project management. The updated version of Prince2 was published in 2009. PRINCE2 is a project methodology which is flexible for any type of project, but typically applied to bigger ones. PRINCE2 divides the project work level and management level. The benefit of the two levels is that management can be used for different projects at the same time (Turley 2010:3). PRINCE2 values contain justifications which are Support of the management, Learn from experience, Defined roles and responsibilities, Manage by phases and exception, Product focus, Customized project environment. On the risk management side, the key factors

are business case, organization, quality, plans, risk and change and progress. The agile processes in PRINCE2 are intended to increase the quality. (Turley 2010:3-4)

Project management frameworks aim at producing best practise which generate models and drafts to reduce the amount of work and improve quality. Project is a work which has its beginning and it has an end. A project team is usually assigned to conduct the project which may also be gathered from specialists from different teams for a certain period of a time. The project typically has a steering group which is monitoring a performance of the project, and the project manager is reporting on a regular basis to the steering group about the situation of the project. The purpose of the project is to improve the competitiveness of the company and use the existing experience during the project. If put briefly, project management contains a set of processes for the use of technology, techniques, specialists and best practise for achieve an organizational goal and implementing the products or services. (Mathur et al. 2013: 114-115).

The project manager is responsible for risks which may appear during the project. The project manager proposes the costs of the project to the steering group who approves the acquisitions, approves the milestones which project has reached on limits of the timescales. Project manager is responsible for resourcing and communication for the project's steering group.

Figure 15 below describes the project manager responsibilities in PRINCE2 model.

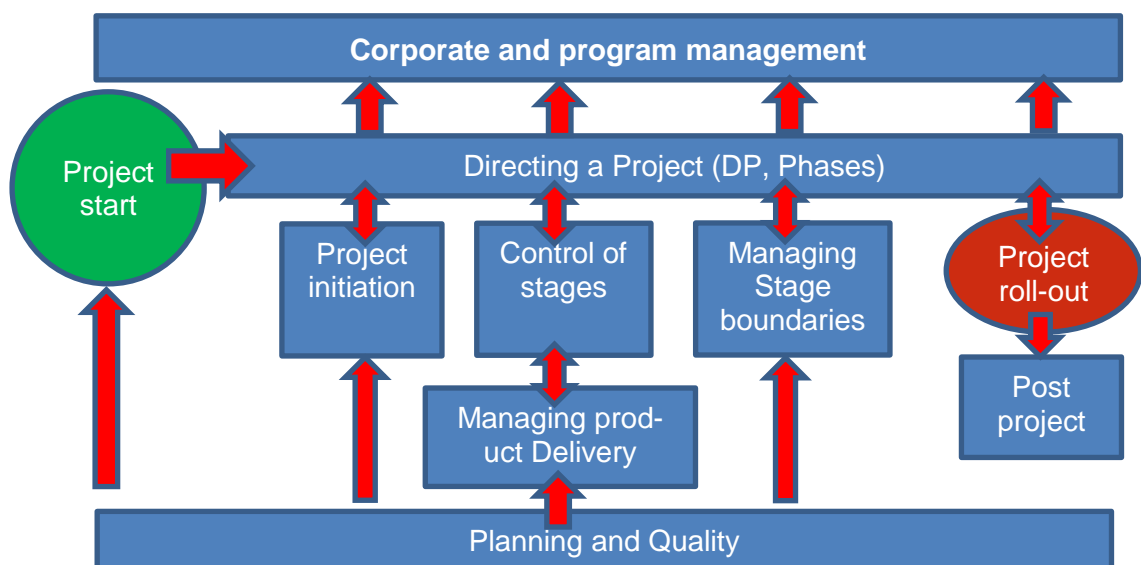


Figure 15. Process overview of PRINCE2 (Turley 2010: 97).

Figure 15 gives the overview of the PRINCE2 project method used in the study. It includes all previous models generalized to a higher level. Project management starts from planning where the literature, interviews is and study's research design is revealed. Project starts and study has necessary data for project direction. Project initiation, managing product delivery and control of stages are all coming from planning and every phase is informed to the steering group. At times there are performed sprints which aim for keeping up in the schedule. Managing stage boundaries is concentrating on the scope of the project. When project and study are finished, the project's outcome is implemented for production and post-project phase starts where the support of the collaborative system begins.

Since this study is part of a bigger project framework, it makes possible to implement also the features from the waterfall method, which is a consecutive design process. The process is designed to flow downwards where the name has come from. The processes include the phases of Conception, Initiation, Analysis, Design, Construction, Testing, implementation and maintenance. (Baars 2006: 5-1). In contrast, the Waterfall approach contains standard procedures of IT-development.

4.5 Waterfall Testing Method

IT systems can be tested with different methods. This study develops a new system which has a little code of its own. Thus, a simple testing method can be selected, such as a waterfall model which is a sequential design process. According to this method, the test procedures are divided into two groups: *dynamic* and *static* testing methods. Static testing contains documentation, reviews, walkthroughs and inspections. Dynamic testing can be used when system is not complete. Testing can be done by checking partial sections code and these are applied to discrete functions or modules. (Anderson 2009: 21)

The waterfall model is based on a sequential testing process which is steadily going on. The Waterfall model phases are requirements specification, design, implementation, integration, testing and debugging, installation and maintenance. Agile testing methods can also be incorporated which are product backlog, sprints and user stories. (Anderson 2009:21)

Theoretical and practical parts of the testing, according to the waterfall methodology, are required for this study to ensure that communication and knowledge sharing features meets the set criteria. Testing procedures are created using the “black-box” testing method. The black-box testing method is used whenever the source code and functionalities of the system is not known when the testing is started. Source code of the system may be known during the testing and specification-based testing can be done. Consultants are invited to the testing period which makes ensuring that when the consultants arrive the source code will be turning known.

Test sequences can be based on the pre-made test cases which are provided by the test manager. A test result gives either the expected value or an unexpected value for what application is supposed to do. These tests can be functional or non-functional. An advantage of the black-box testing is that requires no programming skills. The testing personnel may also use a visual testing method when the issue is found. In visual testing, test cases are recorded as a video which gives clear picture of an error or failures. Visual testing mostly includes the customer acceptance and usability testing.

Since for the building of the collaborative system there is also a need for the quality insurance and monitoring, Six Sigma will be overview below. It is an approach which was developed for long term quality measurements based on time estimations and quality of the work. The next section briefly describes the Six Sigma approach.

4.6 Six Sigma

Improving quality is critically important for business continuity. ITIL has set standards for these issues already, and it established a lifecycle continuity process. But Six Sigma has the ability to monitor the quality and made calculations which are not familiar in the ITIL framework.

Six Sigma was originally developed by Bill Smith who was a quality manager at Motorola (Montgomery and Woodall 2008: 329-331). Six Sigma is an approach for measurements that indicate how a process is performing. Six Sigma contains as a set of tools includes qualitative and quantitative techniques for process improvement. Six Sigma's purpose is to find improvements for the quality of processes and identify and remove the root causes of the raised issues. Six Sigma also decreases the variation of

the quality by monitoring the process. The results are stable and can successfully predict the overall process results. The term Six Sigma is linked to process manufacturing, and the decision making is based on data and statistics. Six Sigma uses the Define-Measure-Analyse-Improve-Control (DMAIC-cycle) or Define-Measure-Analyse-Design-Verify (DMADV-cycle) method for creating new collaborative system and making verifications. (Montgomery and Woodall 2008: 333-342)

In the context of this study, Six Sigma can be used when the new collaborative system acquisitions are installed. By development of the Six Sigma principle, strategy and procedure for quantitative metrics can be based on the Six Sigma method, if the guideline is provided to apply the Six Sigma principle for performance improvement (Han et al. 2008: 21-22). To improve the customer experience, Six Sigma uses statistics for issues helping in solving issues and minimizing defects, as well as making maintenance response time faster. The term *root cause* is familiar from quality processes which define the issues as an original cause. Six Sigma measures and continuous improvement of quality is targeting for improve performance through the needed actions. It usually combines two frameworks, Lean and Six Sigma, with Lean focusing on identifying unnecessary work especially suitable for larger projects. (Montgomery and Woodall 2008: 343)

For this study, the Six Sigma processes can be used for streamlining the timing and scheduling. Timing is part of the measurement which indicates efficiency and approximately end of the project. When issues are found, the root cause finding is necessary along with the statistical monitoring. Thus, Six Sigma gives a valuable direction how such project can be conducted how long a time they will take.

4.7 Conceptual Framework for This Study

For the study, the theory part has been summarized into a conceptual framework which guides different phases of the collaborative system development. For example, ITIL best practises are controlling the IT processes of the collaborative system, so that efficient IT service provision would be possible. Quality framework is represented by the principles described in Six Sigma methodology for monitoring the project progress. Communication as a model is part of the research question and aims for applying rele-

vant communication methods. Knowledge management is also part of the research question and together with communication can resolve the business problem.

Table 6 below describes which best practices are used for applying for the collaborative system development in this study, their reference, main elements and grounding.

Table 6. Description of best practice utilized in this study.

Best practice	Reference	Main elements included in the proposal	Grounding
Knowledge management	Jashapara	<ul style="list-style-type: none"> - Sharing knowledge - Capturing knowledge - Organize knowledge - evaluate knowledge - share knowledge 	Proposal gives solution for the knowledge management
ITIL Framework	Fanning and Taylor	<ul style="list-style-type: none"> - Service design - Processes for acquisitions, service creation and infrastructure building 	Proposal opens the doors of infrastructure library of best practices and focus on creating services and processes.
Six Sigma: quality management guidelines	Montgomery and Woodall	<ul style="list-style-type: none"> - Quality measuring - Process indicators - phase estimated duration 	Proposal describes measurable quality control.
Communication guidelines		<ul style="list-style-type: none"> - Communication methods - Survey results 	Proposal describes suitable communication methods which resolves business problem
Prince 2: Project methodology	Turley	<ul style="list-style-type: none"> - Steering group control - Defined roles - phases - resourcing 	Proposal gives controlled project and phases with scheduled study
Waterfall: Testing methodology	Anderson	<ul style="list-style-type: none"> - Testing processes - Performance improvement - documentation 	Proposal identifies weaknesses of proposal by test where weaknesses can be found and fix.

Table 6 demonstrates that the study employs methodologies from the different IT and project management frameworks. The main model is PRINCE2 methodology, which is supported by waterfall and agile methodologies. The PRINCE2 methodology is going from bottom to up and is open for other supportive methodologies which can be used, for example, for agile project management. The project is then seen as a series of relatively small tasks executed as the situation demands. Scrum is also useful for projects which are complex and there is no possibility to predict every issue. Scrum work is done in sprints each sprint is iteration of selected days to accomplish selected product backlog features and is started with sprint planning meeting. (Schwaber 2004: 4-8) Finally, communication and knowledge management are used in the study based on the human interaction to view a process of human collaboration.

5 Benchmarks of Existing Collaborative Systems

In order to see how other organizations have solved their challenges of building collaborative systems, this study has selected three collaborative systems established by companies which produce information and IT-knowledge. Benchmarking follows Jashapara's five needs which are capture knowledge, organise knowledge, evaluate knowledge, share knowledge and store knowledge (as shown earlier in Figure 10).

The companies selected as benchmarks are Metropolia University of Applied Sciences, Fujitsu Oy, and Sanoma Oyj. Their sites are evaluated by features which are visible in their web-platforms. These features are listed and compared to the features proposed for collaborative system in the case company. As the result, Table 12 at the end of this section summarizes 18 features most used in these platforms.

5.1 Case Metropolia University of Applied Sciences

Helsinki Metropolia University of Applied Sciences uses SharePoint 2010 platform for its collaborative system (Tuubi2). The platform is customized for the purposes of the school. Platform has integrated Winhawille, which is a grading system for students and teachers, as well as wiki services and discussion forums where students and teachers can participate in discussions. The SharePoint platform has also integrates Moodle which is another learning platform which incorporates learning materials and has various other possibilities, for example, makes virtual workrooms for teaching and learning purposes.

The language in SharePoint is using is selectable. The languages which are used in Tuubi2 are Finnish and English. There is also possibility to increase font size on the page. The SharePoint pages increase possibilities to communicate with a discussion forum, and ability to give feedback. Email messaging system has integrated also as a part of the SharePoint. The integration enables possibility to send emails through SharePoint.

Metropolia collaborative system also integrates a wide range of other system and software. For example, it incorporates a library system and allows various for library services including search-services for academic publications all over the world.

SharePoint pages are categorized by their content. SharePoint uses SharePoint search or Microsoft Search server application for searching purposes on the SharePoint sites, and this opportunity is fully utilized in Metropolia. However, there are certain other functions available which are not used in Metropolia collaborative system. For example, SharePoint allows for Microsoft Enterprise search and Fast search which are not in use in Tuubi2. Also version history of documentation is not in use. The SharePoint pages are dynamic so content will change and RSS-feed can be subscribed to, which is also not utilized.

Figure 16 demonstrates the user interface of Metropolia collaborative system.

The screenshot shows the Metropolia TUUBI2 web application interface. At the top, there is a navigation bar with the user's name 'Toni Huhtakangas' and several utility links: Outlook, Workspaces, Tools, My Links, and Sign Out. Below this, there are tabs for 'Suomeksi', 'Feedback', 'Help', 'Sitemap', 'My settings', and a search bar. The main navigation bar includes 'FRONT PAGE', 'FOR STUDENT', 'FOR STAFF', 'CONTACT INFORMATION', and 'FORUM'. The content area is organized into three columns: 'Current' with links to Announcements, News, Vacancies, Events, etc.; 'Latest Announcements' with several news items; and 'Events' with a list of upcoming events. A central banner for 'MOB' (mobile) is displayed, featuring a QR code and the URL 'mob.metropolia.fi'. Below the banner is a 'News' section with three articles, each accompanied by an icon: a musical note for a jazz article, a lightbulb for an article on automation, and a seal robot for an article on robot effectiveness.

Figure 16. SharePoint based web application on Metropolia University of Applied Sciences, internal view (Adapted from Metropolia 2013).

As Figure 16 shows, the site is interactive and different kind of communication methods are in use. For example, the collaborative system integrates email system, discussion forum and data storages.

As a result, Metropolia collaborative system creates a lot of value for the organization. Metropolia SharePoint sites target a large audience; its traffic balancer works invisible and actions are fast. SharePoint security options are selected that documents can be opened from the user's computer. Overall, Metropolia collaborative system seems to be quite complete and covers almost every service which a student or a teacher may need to complete the studies. The researcher analyzed the system from the point of view of an internal user, having full access to the system as a student.

5.2 Case Fujitsu

Fujitsu collaborative system is a good example of a platform with a considerable part open for external use. Fujitsu releases a lot of news and information for customers and potential partners on a regular basis. Their pages contain a large amount of information about the company and detailed instructions of how to get in contact with them. As an example for this study, the external view provides a high degree of simplicity which is a key to demonstrate the case company's structure. The pages of Fujitsu cover over 60 different countries which a selection of languages for every corresponding country.

An excellent idea of the company was that all drivers for the products are found on the web-pages, which definitely improves the customer experience. For example, a search for the products can be done using a serial number of the product. Also all user manuals for the products are found at the same pages that could make printed manuals unnecessary.

From the communication point of view, Fujitsu web-pages contain the data which is usable for the customers and also for the personnel of Fujitsu. For example, maintenance can use the same database for uploading the drivers. All relevant information is found and there is no extra visual effects in user interface which can distract the user.

Illustration of Fujitsu web-pages (external view) is shown in Figure 17 below.

The screenshot shows the Fujitsu website for Finland. At the top, there is a header with the Fujitsu logo on the left, the text 'Finland | Valhokki' in the middle, and a search bar on the right containing the text 'Hae'. Below the header is a navigation menu with links for 'Helsinki', 'Tuoteet', 'Hakosuorat', 'Tuki ja huolto', 'Yritysbalo', and 'In English'. The main content area is titled 'Fujitsu in Finland' and features a large image of a Fujitsu building with the slogan 'Think global, act local'. Below the image is a text block that reads: 'Fujitsu is the leading Japanese information and communication technology (ICT) company offering a full range of technology products, ICT solutions and services. Over 110,000 Fujitsu people support customers in more than 100 countries. Together with our customers, we make the most of our experience and the power of ICT to shape the future of society. Fujitsu Limited reported consolidated revenues of 41 billion euros for the fiscal year that ended March 31, 2012.' To the right of the main content area, there are two sidebars. The first sidebar is titled 'Contact us' and contains a 'Contact information' link. The second sidebar is titled 'Net magazine' and contains several links: 'Lean - the umbrella of our business culture', 'IT collaboration across municipal boundaries in Tampere', 'Church centralises financial management', 'Bank of Finland has on-line access to IT expertise', 'CIO Smitta Merikula: Drug safety comes first for Orion', and 'Paper SAP goes Russia'. At the bottom of the page, there is a social media bar with links for 'Jaa sivu' and icons for Twitter, LinkedIn, Facebook, and YouTube.

Figure 17. Web-pages of Fujitsu, external view (Fujitsu 2013).

As Figure 17 demonstrates, Fujitsu pages show the interface which is pretty simple and incorporating a range of communication methods, including the news and information and sending feedback back to the company. If the company has an open event, it is announced in the pages of the company clearly. Clear and simplified which provide the latest updates on the company information increase the value that the company suggests to its customers and simultaneously prove the reliability of the company. Overall, Fujitsu collaborative system is a good example of a company which provides a simplified information flow with high quality.

5.3 Case Sanoma Oyj

Sanoma is a technology oriented media company. The company is large and has used the latest technology in their Internet sites. The company provides a lot of information for the customers and partners. The possibility for web seminars is also made available

for users of their web-pages. Their Internet site suggests a selection of languages (English and Finnish).

Figure 18 shows the external view of the web-site of Sanoma Oyj.

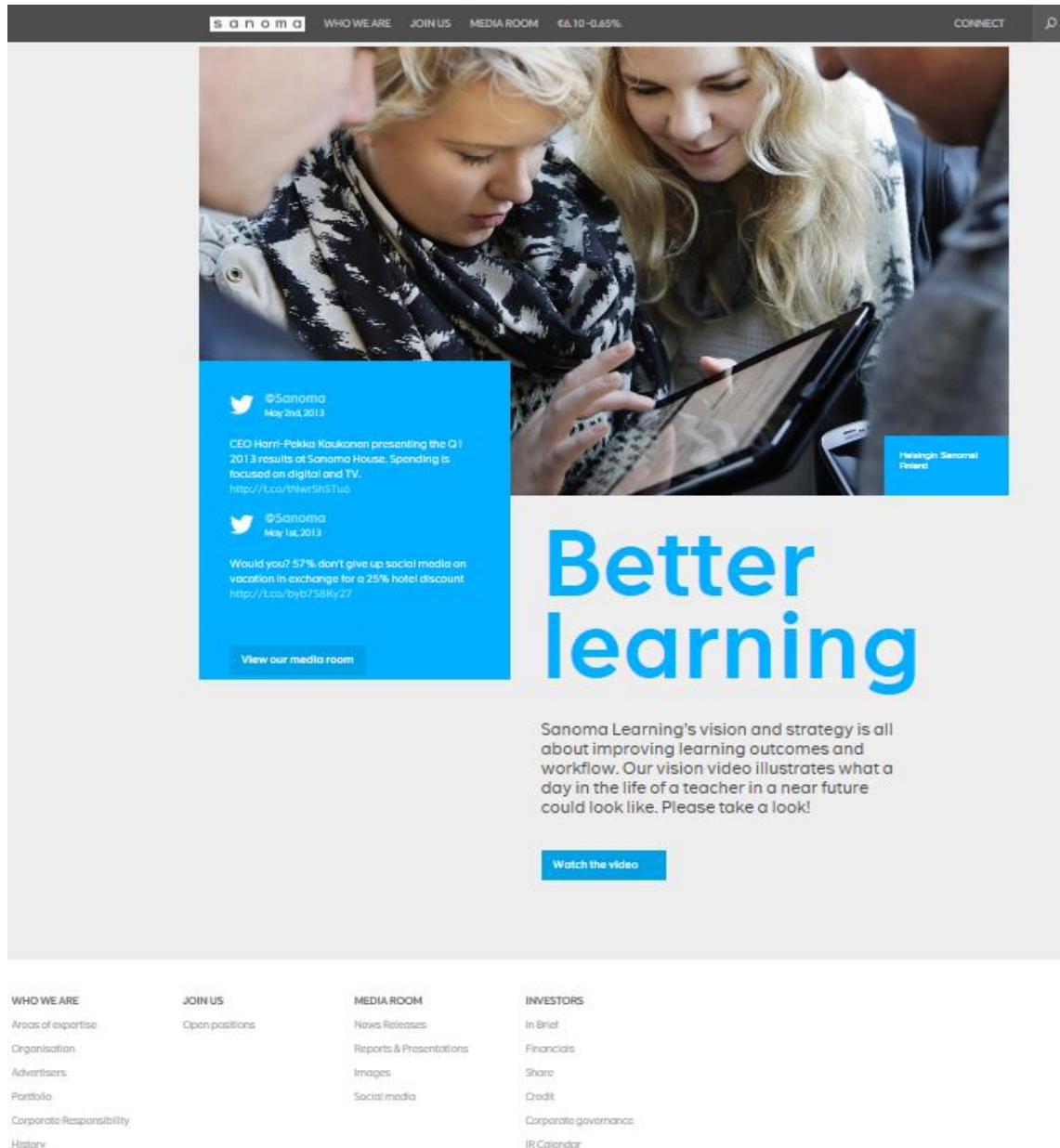


Figure 18. Web-site of Sanoma Oyj, external view (Sanoma 2013).

As Figure 18 shows, the company utilizes the latest visual technology to communicate with customer not only by information but also with high quality pictures. The site contains also videos which are encoded to play smoothly in the Internet browser.

Communication between the company and a visitor of the page is visual but it also provides focused information. The pages distribute information which is categorized in the site. Sanoma also has a roll-out Interactive e-book player and Sanoma Pro has launched Professional books via online connection service. The pages are linked with social media as a Twitter and a Facebook.

5.4 Benchmarks from Two Partner Company Visits

The second way to examine benchmarks was through visits to partnering companies (suggested by the employees in the interviewing phase as those of interest as for their collaborative systems). These visits to the partner companies also helped to get acquainted and selected the communication tools they were using. All the partner companies were using different communication tools but they were all compatible with each other. The team which visited in the partner companies consisted of Maintenance and Sales. The reason for this was that Maintenance and Sales had expertise in communication which brought extra value to these visits. The company visits consisted of the presentation of the company's intranet and their core functions of it. The backgrounds of the partner companies were different and it was seen in the way how they organize their collaborative systems and present their data.

One of the companies was a successful international company which was presented all of its material in English. The communication tools were designed for this particular company and it contained all possible communication methods. The other company was operating purely in the Finnish market and its materials were in Finnish. This company used only the most commonly popular communication tools. Knowledge transfer was reached in terms of the documents, trainings and instructions organized for the users. In both companies, Intranet provided all the relevant data which the employee could use at work. The news of the industries were readable and clearly presented. As a result of partner company visits, the meetings memos were created to document what things were approved to move on.

As a result, the communication tools for the two partner companies represented a normal level of communication which included: the chat-system, discussion forum and virtual group meeting ability. The further possible benchmarks what the case company is going to need for the study is the benchmark on customer experience (measuring

how the users are feeling about these communication tools). Another part of the customer experience is a response time. All communications are needed to use during the working day. It is required that simplicity and comparison is made between requirements and system.

These company visits also inspected some particular components of the visited companies' system as the limits of the boundaries of those visits allowed. The user interfaces of the visited companies were also checked, and mostly it was discussed how the employees of the visited companies are using the communication tools and how often. Overall, the interfaces of the visited companies were different since they use different technologies. The international company's intranet was full of information in different languages and the web-site content was large. The second, Finnish company outsourced the maintenance of its intranet but the content of the intranet was very simplified, but there were many documents inside which made the system quite heavy to use. After visiting the partner companies, the Maintenance team member and the Sales member had more ideas about the user interface what their teams would need to improve communication.

5.5 Summary

The selection of benchmarks of three collaborative systems compared the web-pages using the same platform, although the user interfaces of the selected companies are different for the users. Similarities of the components are observed, identified and put into Table 7.

Table 7. Comparison of features of the benchmarked collaborative systems.

Features	Metropolia University	Fujitsu Oy	Sanoma Oyj	Case company
login features (restrictions)	x	n/a	n/a	x
Languages selection	x	x	x	-
Discussion forum	x	-	-	x
Mobile phone support	-	n/a	n/a	x
Chat	-	n/a	n/a	x
Document storage	x	x	n/a	x

Wikipedia	x	n/a	n/a	x
Moodle	x	n/a	n/a	-
News	x	x	x	x
Workspaces	x	n/a	n/a	x
Intra/Extranet	x	n/a	n/a	x
E-mail / notifications	x	n/a	n/a	x
Feedback (closed section)	x	n/a	n/a	-
Search – engine	x	x	x	x
Workflows	x	n/a	n/a	x
Possibility to integrate 3 rd party systems	x	n/a	n/a	x
Support for different programming languages	x	n/a	x	x
Video conferencing possibility	-	n/a	n/a	x

Table 7 shows the results of comparison of the web-sites of the companies focusing on various areas of knowledge and technology. In this selection, Metropolia University of Applied Sciences represents the part of the “Creating the knowledge of technology”, Fujitsu Oy represents “Creating the professionals of the Technology”, and Sanoma Oyj representing “Publishing the new technology” sectors. These companies make good example of communication and availability of knowledge.

Table 7 compares a range of selected variables between the three benchmarks which were partly different and partly similar. The comparison is made by using the visible and accessible site tools for web-site visitors. In addition, Metropolia University of Applied Sciences provided access for the intranet, so that certain intranet features were also used for comparison.

As a result of comparisons from the two benchmarking visits of the partnering companies, a list of measurements important to measure the collaborative system was created. These measurements are summarized in Table 8 below.

Table 8. Benchmarks obtained from the partner company visits.

Measurements	Explanation
Start time (collaborative features)	The time when User interface is ready after the computer is started.
Communication tools in use	Measurement contains communication services comparison relating for email service.
User experience	How the user feels that system is suitable for case company use? Are users comfortable for use communication tools?
System Components (Technical)	What is the maintainability of the components. Does the response time of collaborative features meet the criteria
Business intelligence	Analyst's communication tool for management. What and where? What is needed for monthly figures.
How the collaborative system will reach people?	The given output, news and sites which are in use how well those suit in the case company?
Comparison	Does the requirements and visited company system provide any similarities?

As a result of all benchmark comparisons, the communication needs for the case company could also be defined more clearly. Some of the required features are possible to use in the case company's collaborative system as well. Based on the data collection and observations made in benchmarks, the needed features for the case company were formulated as a preparation for conducting further data collection (Round 2). The new round of data collection and the development of the collaborative system for the case company are discussed in the next section.

6 Development of the Proposal

This section describes the development of the collaborative system, following the results of the current state analysis (Round 1 of data collection, described in Section 3) which investigated the users' needs and the management requirements for the new collaborative system on a general level. This initial stage resulted in the description of the current state of the case company and the collaboration tools used before the collaborative system was launched.

This section overviews further data collection and development of the collaborative system. It presents *the Planning* stage and the results of Round 2 of data collection, which subsequently led to *the Building of Collaborative System*. It also reports on the results of *The Testing and Piloting* phase, and discusses their results (which makes Round 3 of data collection) implemented after the launch of the new collaborative system. Eventually, Round 3 of data collection led to the development of the action plan to improve the collaborative system further on (presented in Section 7).

6.1 Planning the Collaborative System

The early planning process started in the beginning of the study, before and along with the interviews to gather data in Round 1 of data collection (for the current state analysis). The results included relevant but general information about the collaboration needs, the company existing collaboration tools and their value for the users. After that, the collaborative system design was further specified in Round 2 of data collection, which is presented in the sub-sections below. Round 2 of data collection resulted in a well-defined list of requirements for the new collaborative system, as described below. The data collection for Round 2 started with observations in the case company.

6.1.1 Data Collection Round 2: Observations

Observations were used to collect information for Round 2 of data collection about the needs of the employees to help formulate the requirements for the development of the new collaborative system. In this round, the researcher focused specially on the communication and collaboration needs of the employees. The researcher, as part of his work, followed the daily communication and collaboration routines of the employees and made his observations. These observations were made by following the users'

daily activities, with the purpose to check daily routines of the employees as for the need potentially addressed by the collaborative system. When the researcher observed different groups of personnel some observations were made, the observations were based on the behaviour of the users. Based on this behaviours and data collection one there is made list of important features. To summarize the observations, the respondents further specified their needs and desires from the new collaborative system (which were later approved in the brainstorming session).

Table 9 below summarizes the communication channels presently used in the case company, and those that correspond to these current channels, but as desired in the new collaborative system.

Table 9. Communication analysis results from the observations (Appendix 3).

Communication need	Current communication channel or method	Required action (in the new collaborative system)
Set a meeting	Phone, Email	Calendar reservation
Comments	face-to-face, Email	Message, informative
Discussions	Face-to-face, meeting, phone	Conversation
Business proposal	face-to-face, phone, email	Meetings & conferencing
The receipt of orders	phone, email	workflow tool, chat, email
Send / receive tasks	(Email)tasks	Work assignments
Company news / business news	newspaper, email, face-to-face	Market signalling
Monthly reports / business reviews	email, meetings	Planning and resourcing
Warehouse, shipment details	documentation, email	Ordering
Communication among the colleagues	Phone, email, face-to-face	informative, social
Documentation	paper, email	knowledge sharing

As summarized in Table 9, the collaborative system for the case company and its features should possess a certain set of features, which were translated into the system's features by the researcher.

For example, the recognition of *email system's* importance is acknowledged and therefore email system is placed on the requirement list. The new email system would improve the message delivery and also would enable workflows in feature specific tasks. *Data storage* was identified for the enabler of the knowledge transfer. During the observation the users seemed to prefer the older but familiar systems over the new technology systems. Thus, suitable interfaces used for the new system were Wikipedia sites or folder-type storage. During the analysis of data collection, the brainstorming session finally refined the list of these needs and their translations into the features of the new collaborative system. This made the results of the observations when following colleagues in Round 2 of data collection.

6.1.2 Data Collection Round 2: Interviews

The results of interviews revealed that open discussions is needed in case company to discuss organisational culture. It was seen that company has got sales from foreign countries that a change is needed for opener atmosphere in the case company. The main issue was, however, that Marketing and Sales need a real-time communication.

The interviews of the personnel of Marketing gave an answer to the question: "What are the communication needs for the case company?" If summarized, the answer was: "This need for communication was not thought of earlier, but now when the knowledge is needed for business purposes, the need for communication improvement is obvious almost everywhere. The problem is acknowledged and result may be seen in a couple of years. The basic need is to get in contact in real-time. We are informed that IT-infrastructure might have suitable solution to fill this communication hole."

From the customer service side, the situation is even more complex. "Because we now have customers, services and products in foreign countries, the service level must be higher, and when customer calls and information is missing, there must be an alternative real-time conversation tool in use for the case company which must not be a telephone."

During the interviews, the collaborative system was open to discussion as for how it can benefit the employees. It also gives benefits for management who get more results, satisfied customers and more data from markets and rival companies. Customer service is using communication not only for the customers but also other use in the case company. Production is needed information about orders and shipments.

6.1.3 Data Collection Round 2: Meetings and Discussions

The meetings were necessary for get formal approval from the case company management and employees. Meetings were also a place for giving opinions and hearing about the plans for the collaborative system. The meetings were also a suitable place for making decisions that were needed to approve of the software and server platform in use. Overall, for Round 2 the atmosphere from getting opinions on the new collaborative system changed to more positive when these meetings were conducted.

Most usable meeting was with the IT-manager who has willing to take maintenance of the future platform under the maintenance team. The meetings were also useful to see what kind of organizational culture the company has. The meetings were conducted as part of the project-like activities along with the project milestone presentations and approvals.

6.1.4 Data Collection Round 2: Brainstorming session

The data mining and discussion were the actual points of the brainstorming session. The brainstorming session produced a picture which content was needed in the new collaborative system to be includes. At the brainstorming session, the e-mail system was prioritized as number one, when the document exchange was put in the second place. As the result, the features which were identified in the brainstorming sessions were selected for the actual system building efforts.

The brainstorming session put all the collected ideas on the map, discussed the suggested variables, and put them into different categories shown in Figure 19 below. There were identified nine different categories. The communication categories were gathered as four categories which are needed to work with. The idea is presented in the mind map in Figure 19 below.



Figure 19. Categories of needs for the new collaborative system (based on the results of the brainstorming session).

The mindmap in Figure 19 summarizes the needs that respondents indicated in the new collaborative system. They were categorized in the following groups. Firstly, the system needs a good *email system*, with the individual and team calendars. Typically, the software which contains an e-mail messaging system for sending and receiving emails also has functions such as *calendar*, *tasks* and *workflows* included in addition to the email sending/receiving features. Since these needs were also indicated by the participants, they were categorized together, as provided by the same software set.

Secondly, *document storage* was stressed as one of the most needed features. This need also integrates the capability to share these documents in the case company. Thirdly, the collaborative system should incorporate access to all the *office programs* used in the case company, as well as some *tailored software*, which will also take into account the access rights to get access to it. Fourthly, as for the communication tools specifically, the participants stressed the importance of *virtual workspaces*. For such virtual workplaces, more virtual communication tools would be needed such as *chats*, *open and closed chat rooms*. Fifthly, *discussion forums* could extend the range of the suggested communication tools. Sixthly, Wikipedia was mentioned many times and an important source of references, so *Wikipedia* and *Wiki tools* could also be included in the system. As for other functionalities, seventhly, *backup and recovery* function was emphasized as critical to the collaborative system. Eighthly, *business intelligence* search was pointed to as necessary. Finally, security control rounded up the list of categories needed in the new collaborative system. There were also some other requests which were very reasonable but not related to this study. These categories which were not included in the study were given to the ICT-management who takes care of the actions of technical problems.

This structure of knowledge support, sharing, transfer and data storage correspond to Jashapara's five needs of knowledge management illustrated earlier in Figure 10. It includes how knowledge is captured, evaluated, shared, stored and organized. Incorporating all these features, a suitable user interface was the next step to be developed for the new system, as soon as the list of requirements was finalized and approved in the brainstorming session. Among the suitable user interfaces those like, for example, Wikipedia, SharePoint sites, Server folders were chosen and evaluated for the needs of the case company. Another group of available software contains alternative contacting methods such as contains conference systems, chat system and virtual meeting rooms. These alternative contacting methods were also included in the list of the needed features since they support smooth real-time communication but additionally also allow for using telephones at the same time.

If further generalized, these nine categories could be further groups into three main clusters. Group 1 contains *the e-mail messaging system* with the related functionalities such as calendar, tasks and workflows. Group 2 incorporates the functionalities supporting business such as *data storage, software, backup and recovery, business intelligence, and security*. This group corresponds to the knowledge management by

Jashapara (2005) and aims to capture, evaluate, share, store and organize knowledge of the organization. Finally, Group 3 contains alternative contacting methods such as chats, discussion forums, conference systems, wiki tools, and virtual meeting rooms. These alternative contacting methods support communication needs for smooth real-time communication. These three groups summarize the functionalities recommended by the case company to build the new collaborative system.

6.2 Building the Collaborative System

This section describes the process and results of building the new collaborative system for the case organization.

6.2.1 Steps in Building the New Collaborative System

As shown in Sections 6.1-6.5, the study identified several groups of functionalities to create a model for the new collaborative system, taking into account the opinions of the management, production and employees who are using the system. In addition to this development, the new service design also needed suitable resources for launching and testing the new platform and its systems to handle its IT infrastructure. Before implementing the design, there were three major variables identified vital for successful implementation. First, IT-system must meet the criteria from the internal customers' perspective. Secondly, the system must pass the testing in both piloting and real production mode. Thirdly, every process must be clearly defined for all services which the new collaborative IT system would provide. These criteria were supposed to ensure that the new collaborative system would help the company by making the employees' work more simplified and by providing tools and innovations to improve daily work.

The planning, gathering data collection and execution the actions for the installation focused on the business problem (building the system and improving communication and knowledge management). After the defining the scope the study, management needed to incorporate PRNCE2 – the project management framework which is suitable for collaborative system building. The ITIL-framework with best practises covered the need of streamlining the IT infrastructure. During the installations, the timing schedule raised issues, as well as the quality measurements, because the management wanted to know the exact schedules, processes and issue statistics. When the installation was

completed, the tests were to start. Standard waterfall test methodology was used to meet the criteria for quality test procedures.

As a result, the proposed collaborative system was built on Microsoft SharePoint Enterprise Server, with all of the indicated communication features enabled. It also incorporated other servers such as Microsoft Search Server & FAST Search to fulfil the need for information search inside the case company as well as to secure modern data storage functionalities with Internet sites and intranet features including Wikipedia, document storage, three different search engines, 21 different templates for creating the team site and dynamic layout, and the content change possibility. After that, the system was also enabled to be contacted from everywhere, on condition of authentication. The layout also enabled publications, Wikipedia, discussion forums, personal sites with personal dashboard, the chat tools, video conferencing, open and closed discussion forums, and other requested communication tools as earlier requested by the users (in Figure 19).

Thus, based on the data collection (Round 2) the first version of the collaborative system was developed. The next section gives a more detailed description of the newly built collaborative system.

6.2.2 Description of the Newly Built Collaborative System

The new collaborative system proposed to handle multiple actions to enable communication and improve knowledge transfer for the users in the case company. It can be described, first, by overviewing its technology architecture, and second, by describing its user interface.

Technology Architecture of the New Collaborative System

Figure 20 below summarizes the features of technology architecture of the newly built platform.

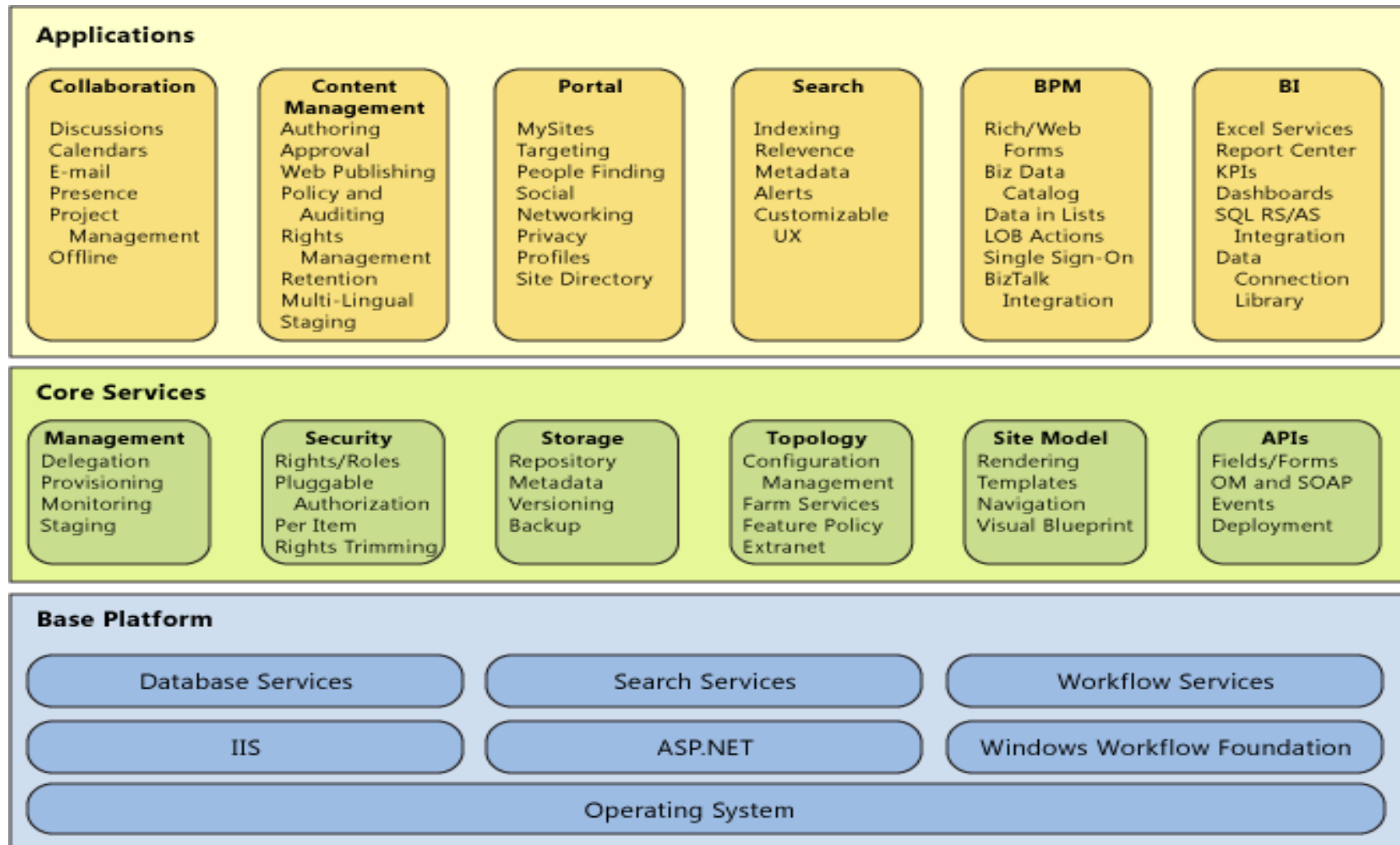


Figure 20. The description of the content of the new collaborative system.

Figure 20 shows the technology architecture of the newly built collaborative system. This architecture consists of three main layers. The system, first of all, contains *core services* (marked green) which are need for running it; management, security, storage, topology, site mode and AP-services. The core services support *the application layer* (marked yellow) where the collaborative tools, content management, portal administration, search and business process management (BPM) for document management and business intelligence components are running. Finally, *the platform base* makes the third, most basic technological layer (marked blue). This layer demonstrates that the new collaborative system is built on SharePoint platform which gives a possibility to use different components and get regular updates from Microsoft. This layer consists of components such as SharePoint Search services, Microsoft SharePoint enterprise platform, database services, and workflow services. One of the advanced features of the collaborative system is the ability use a server farm which means that when server storage is full the platform can increase dynamically another server for use, and all these services are online. Finally, this technological architecture also includes ability to use external connections, if necessary, and these connectors for databases are included in the platform.

The collaborative system parts which are used to build platform are Microsoft Server 2008R2 Enterprise edition (the tests described later in this section are made for this version), Microsoft SharePoint 2013 Enterprise edition with cumulative updates, Microsoft Search Server 2013, Microsoft SharePoint designer 2013, Microsoft FAST Enterprise Search, Microsoft Groove Server 2010, Microsoft Lync Server 2010, Microsoft Exchange 2010 SP2, Microsoft Project 2010 Server Enterprise. The system also includes Data storages, Databases, Data protection, Malware detection and prevention system. Video conferencing was also included. Microsoft BizTalk Server and Microsoft Forefront Server are planned to be added in the future. SharePoint is based on Windows Server feature Internet Information Services (IIS), which enables the Internet browsing features in local area network. The user control of SharePoint is designed for another Server feature called Federal identity management (FIM) which import and exports user information directly from domain.

Administration of a SharePoint is separated into two levels. The top level administrator controls the server farms, site hierarchy, search services indexing, the layouts of the

sites and information in the SharePoint infrastructure. The site administrator also controls the team sites or wiki-pages. Figure 21 below shows Central Administrator's webpage of SharePoint.

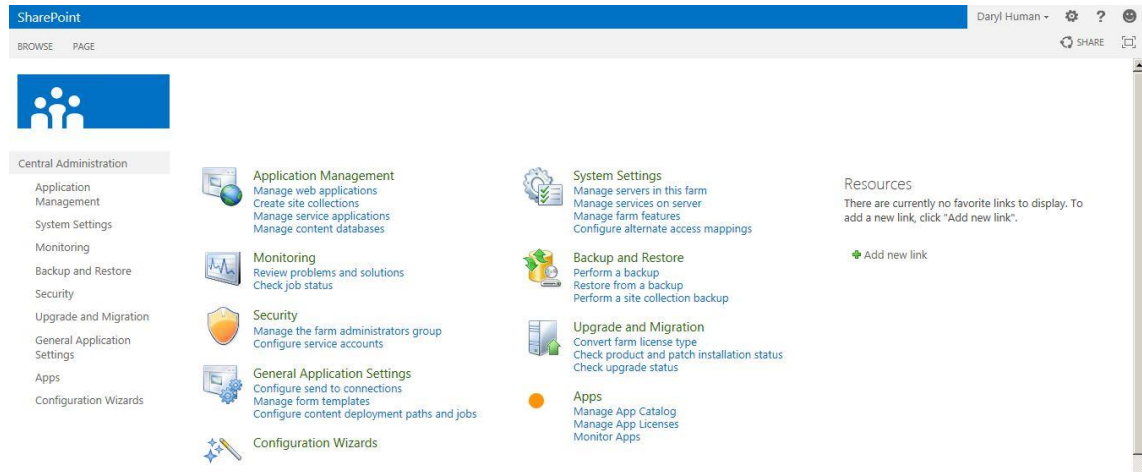


Figure 21. SharePoint Central Administration in the new collaborative system.

SharePoint Central Administration is a webpage where the main administrator is able to control 60% of SharePoint features. All available features 100% are accessible by scripting tool PowerShell and STS Admin which are part of the SharePoint and Windows Server command line tools. The Central Administration main features are Application Management, where the database for application pool can be selected or created. The application pool controls Windows Server feature IIS which points to the SharePoint Team site address. Application Management sites also managed to create sites of SharePoint. A second main feature is System Settings where Application Management can control the user management (which is Federal identity management) and Selected Search server (Microsoft Search Server, Microsoft Enterprise search Server and FAST Search Server) indexing and selection what can be indexed. Index needs installation of filter of each type of files which is need for crawling (creating indexes). Backup and Restore is the third main function for Central Administration. There can be performing backups for the created sites which are automatic or manual. Backups can also be made by the database software and by the external backup system. Security selection brings Federal identity management, SSL connection settings and service accounts. A configuration wizard helps for activating features and updates in server farm after updates. Site administrator settings are restricted to a collection of particular sites only. For every site collection, it is possible to use two site collection administrators.

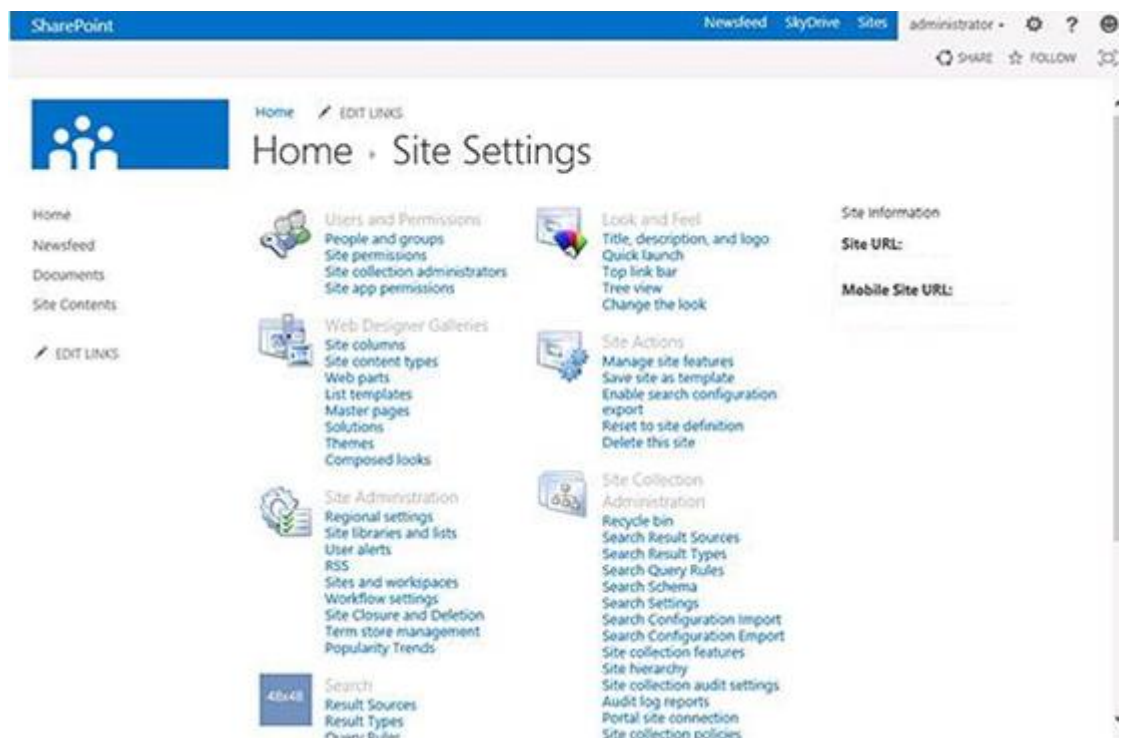


Figure 22. SharePoint site collection settings.

Figure 22 illustrates the site collection settings where the administrator can change the layout, contents, links and text of the site. All of these site features are accessible in the site collection settings. It is also possible to use SharePoint Designer for changing content of sites is possible.

User Interface of the New Collaborative System

The collaborative system *user interface* is dynamic and can be modified whenever it is necessary. Figure 23 below shows the user interface of the collaborative system for user point of view.

The screenshot shows a web application interface for a collaborative system. The page is titled "Kotisivu" and features a navigation menu with items like "Kotisivu", "Kalenteri", "Puhelinluttelo", "Lomakkeet", "Operatiivinen linja", "Defensiivinen linja", "Objektit", "Haku", and "Tutk_wiki". A search bar is located on the right. The main content area is divided into sections: "Uutiset" (News) with a table of updates, "Toimintaan vaikuttavat asiakirjat" (Documents affecting operations) with a table of documents, and "Osaston kalenteri" (Department calendar) for March 2013. The calendar shows a meeting on March 20th from 13:00 to 14:00.

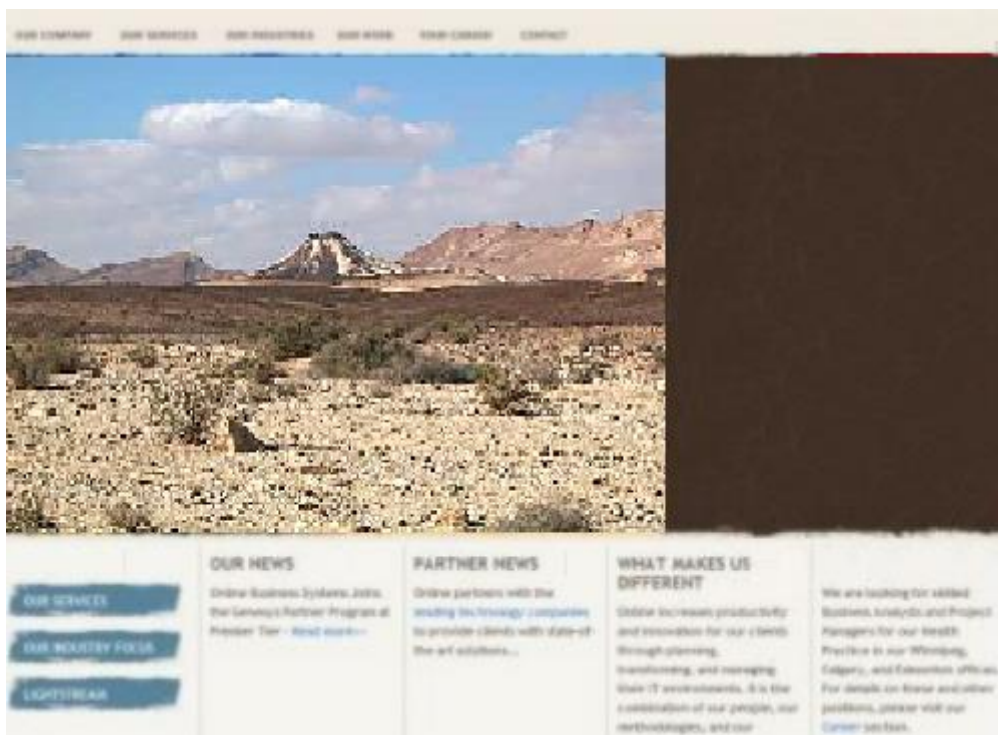


Figure 23. User interface of the collaborative system.

Figure 23 describes the chosen user interface of the new collaborative system which was put to testing at the next stage. The basic idea behind this layout is to get all related information visible for the user, so that the not to waste time on searching, although there is also an enterprise level search engine provided.

As can be seen from Figure 23, the main page contains news and documents which have long validity date and can contain agreements or regular orders. The calendar shows the department calendar with the important dates and reminders.

User interface design started in January 2013, with the default settings used at first. The layout was one of the standard interface models in the Intra sites. Design of the user interface is planned to be further improved following feedback from users. The chat can be improved by using different chat software, or it can be done by using system's internal chat interface. Discussion forum, Wikipedia, calendar, tasks and virtual meetings were all incorporated and visible using this interface.

The health of the collaborative system is designed to be invisible for the users but visible for the maintenance. The collaborative system can automatically repair some features which are under component called health analyser. It will make certain maintenance functions easier and fewer employees will be needed to support it. Communication from users to the maintenance team is also easier with real-time chat system since the maintenance can start investigating the problem online almost immediately.

Figure 24 below shows the main features of the proposed model for its user interface.

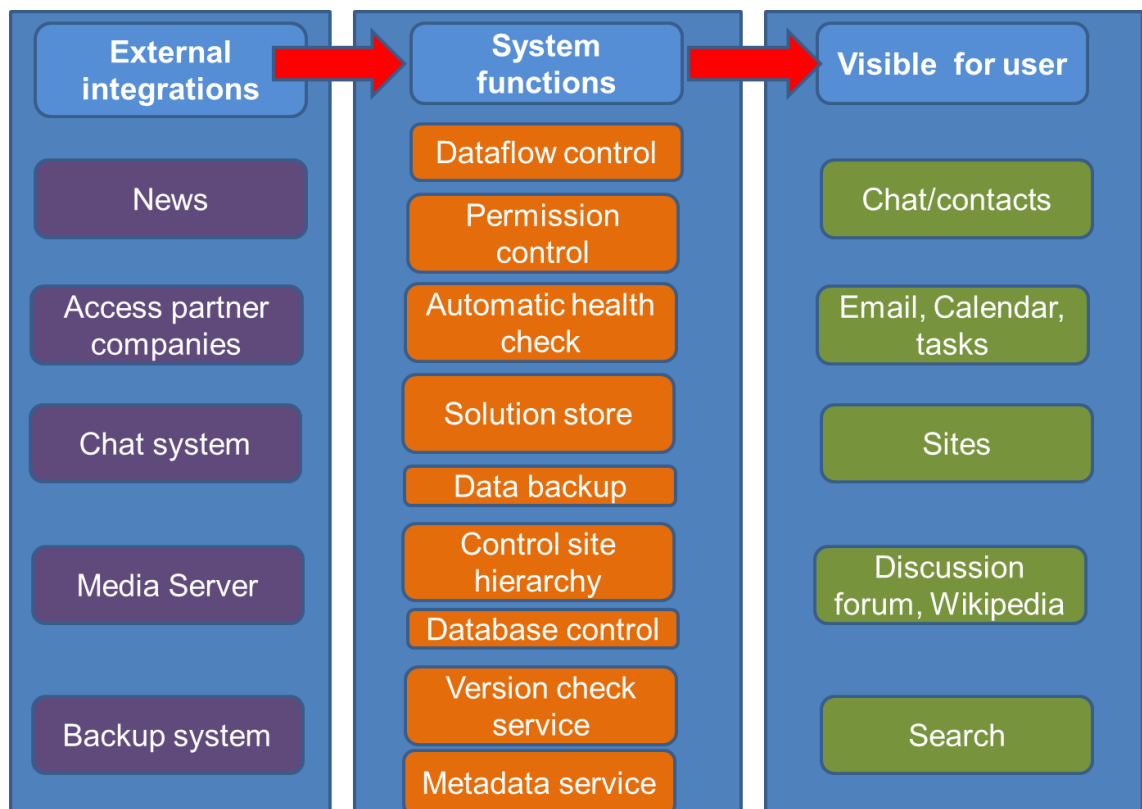


Figure 24. The proposed collaborative system.

Figure 24 describes the collaborative system that includes features which manage requests of suitable applications for the user just by clicking a button. It makes it easier to interact with maintenance team which gives instructions how to order applications. Applications are meant to be included as web-pages and software applications. Finally, the new collaborative system's metadata store is built for sourcing the data which the case company needs. Data operations such as data transfer or interacting external systems are possible through the external systems which are, in this case chat, email, and file transfer software which are procured ready-made from different vendors.

Summing up, the new collaborative system has many different interacting components which are needed directly or indirectly for improving communication and knowledge transfer. These key considerations to create conceptual framework consist of the following parts: hardware, software components, documentation and users. The new collaborative system allows for simultaneous use of the case company's employees and gives similar performance to perform daily tasks, and requires fewer resources than earlier. The collaborative system was developed following the list of requirements developed and proposed by the case company to fulfil the expectations set by its users and management. It allows for both, for the system independent use by the employees, while in the same time collaboration is possible.

The selected software as a platform is suitable for the case company and addresses the communication and knowledge transfer needs. On the platform there is also a possibility to include external systems which would use the collaborative platform as a place where all interactions are directed to their right places. Altogether, it is a fully functional collaborative system with dynamic features which can be further expanded in the future. The system integrates appropriate resources and has a well-structured user interface. All requirements recognized for the system development were based on the interviews, workshops, observations and the brainstorming session. When the collaborative system started running, these features were enabled and users started testing the system. The test environment and testing procedure are described in the next subsection.

6.3 Testing the Collaborative System

The testing phase contained three phases where the environment and the system itself were evaluated for meeting the requirements of the case company's networks and organizational culture. The tests contained pre-made questions, and the test team gave answers to these questions and document the answers. The tests used agile methods combined with the waterfall model where all phases were standardized. At the later stages, different other test methods can be used in addition, if desired.

The user interface of the collaborative system was evaluated by a separate test targeting the communication of the system. In the testing phase, all the tests over the testing period were made in the test environment close to the production environment. Next, in the piloting stage, the system was tested in the real production environment. This section describes the testing procedures and overviews the results which were analysed in the after-the-tests brainstorming sessions and the meetings with the test personnel.

6.3.1 Overview of Testing

In this study, testing was part of the development process, as well as part of action research cycle in the research process (as introduced earlier in Figure 3, Section 2). The purpose of testing was to ensure that the collaborative system does work and all communication and knowledge transfer tools are working as planned. Testing in this context refers to checking for reliability of the newly built system and improving the user interface, and establishing better communication. A test procedure for communication and knowledge transfers checked if the system exceeded or failed to meet the stated requirements. Figure 25 below shows the place of the testing procedure on the timeline of this study.

THE TIMELINE OF THE STUDY

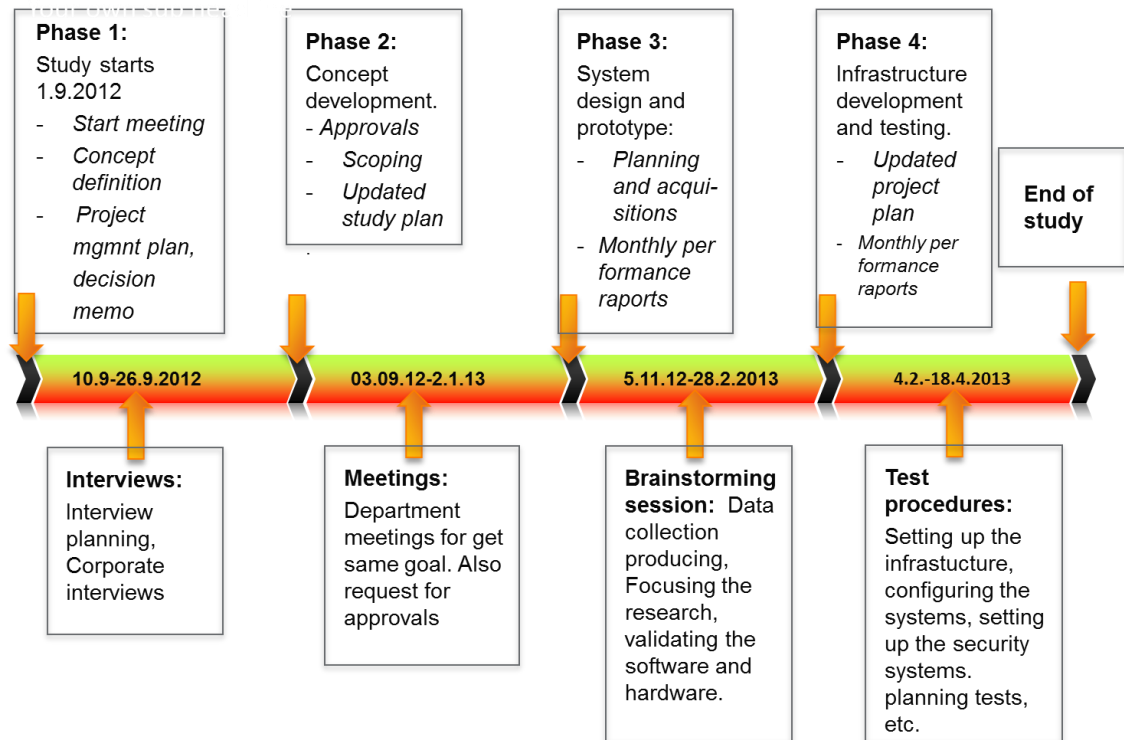


Figure 25. Timeline of the study: testing.

Figure 25 describes the testing and piloting stages of the study. It is also the stage at which the Thesis ends. The test and piloting procedures aimed at improving communication in the newly built collaborative system and customer experience in this communication. The test procedures were conducted to reach the target requirements for improved communication and enable knowledge transfer to meet the criteria set in the planning stage.

In this study, the testing was planned in three phases. *The first testing (Phase 1)* started when the platform was launched. This was done for verification to ensure that the system was suitable for the case company's networks and for inspection of the physical and visual aspects for the system equipment meet the criteria. After the installation, this testing procedure checked that all the installed components worked as they should. The testing was a one day task. The piloting started with one person who verified one feature at a time. This phase went on for a month. After all the features were launched into operation, this piloting phase was also over.

The second testing (Phase 2) contained the customer acceptance testing. This testing was used to evaluate the system communication tools. The people who were doing the tests were asked to verify that all specified features were delivered. The questions were formulated in advance for the test team members to answer. The test employees verified that the system met the functional, performance, design and implementation requirements identified in the initial specifications. These tests were documented and the data collection was based on this test documentation. Testing was performed using a specially developed testing methodology. This testing methodology contained methods of waterfall and agile testing. Customer acceptance testing was done by a couple of volunteers using the system for a week and reporting every issue which they encountered.

The third testing phase will include further customer acceptance testing. It will be performed after the Thesis is over. The test questions will be built around the issues discovered during the data collections Round 3 (during the testing and piloting). The questions for this further round of testing will also available in advance, before the test will begin. During the testing, the test team will be testing the features related to the revealed communication needs specifically. All the actions will be documented and, at the same time, the testing will also collect the data to produce FAQ information and training material. Test documentation is important in the study because it will lead to the concrete action plan for further improvements in the collaborative system. The revealed problems will be resolved and this documentation can be used to address the frequently asked questions (FAQ information). This Round 3 of data collection will complete the Implementation phase of the action research cycle.

6.3.2 Testing Procedure

The tests were conducted in two phases. Phase 1 was done when the system was set up, and Phase 2 was conducted for customer acceptance testing.

Phase 1 of the testing started when hardware and software were installed. It focused on the tests for certain procedures of the collaborative system, including technical details. Functional testing, regression testing, black-box testing and white-box testing were all implemented with the help of the test personnel, with the focus on functional testing.

In the testing phase, all the tests over the testing period were made in the test environment close to the production environment, since the testing was meant to measure and simulate the actions of the production environment. During the testing, there were possibilities to find issues, document the features and benchmark the system for development purposes. The implemented testing process is described in Figure 26 below.

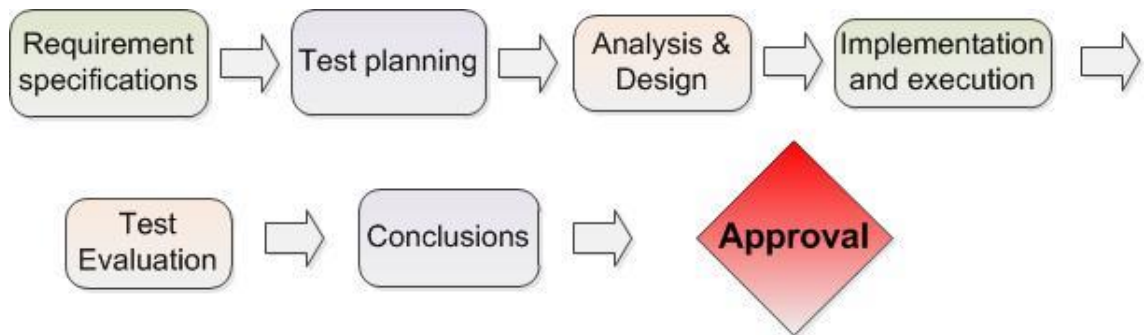


Figure 26. Description of the testing process in this study (based on the Waterfall model).

In both phases of testing, the test process started with specifying *the testing requirements*, which were meant to focus on the system basic functions. The second action of the process contained the detailed *planning* of the testing. At this stage, the resources of the test team were gathered and the test questions and test criteria determined. For these purposes, special test documentation was created which made it easy to fill in and analyse the results.

The Analysis & design phase of the test process focused on the test design and preparation for its execution. All information about the software and system design was provided for the test team and a training session were conducted for the members of the test team.

The implementation phase of the test process consisted of the actual test execution. This phase included all the tests described in the documentation and the production of the test documentation for further analysis. The testing team was reinforced with consultants invited by software vendors. The consultants for the collaborative system and software developers helped fix some issues related to the source code. The created documentation was used as part of data collection (Round 3).

The *test evaluation* phase of the test process evaluated the test documentation and results of the testing. All the information collected from the test was used for evaluation. The documentation was also useful for the later stages, when training materials, instructions and other system documentation were generated. Finally, *the Conclusion* phase and *Approval* of the collaborative system for piloting were done at the last phase of the testing. Conclusions are separate summarized and interpreted for the management approves the system for piloting in the next stage.

Testing periods (Phase 1 and Phase 2)

The first testing period (Phase 1) focused on ensuring the working condition of the functionalities of the components which were installed. The second testing period (Phase 2) concentrated on the check that all the features enabling the communication and knowledge transfer were facing no issues. The questionnaires for both Phase 1 and Phase 2 can be found in Appendix 2. Table 10 contains the steps taken to test the system.

Table 10. Test steps (adapted from: Wu et al.: 13).

Category	Test steps
Software and hardware	Check functionalities
Network	Check functionalities
Communication features	Check feature is working

As seen from Table 10, the testing procedures aim to identify problems in all three areas. First, software or hardware component might not do the activities which were defined as component of the test tasks. Secondly, software or hardware functionality might not meet the requirements. Thirdly, software or hardware functions might not be providing services for smooth real-time communication and knowledge transfer. Testing used all possible usability or functionality for ensuring that all the components are working properly.

Preparation for Testing

The tests were planned to check all the normal working procedures in the new collaborative system. Preparations for the testing required launching the functional collaborative environment and choosing suitable testers from different departments who were contracted for the time of the testing procedures. Questions for the test procedures are

given in Appendix 2. The scope of the test questions covered the system in general and the communication enabling tools to check the criteria set in the planning phase.

Testing Phase 1

The testing Phase 1 intended to validate the settings of the IT-infrastructure to adjust the active network components for use in the collaborative system. Firewalls, switches and routers need to find where the new equipment is located virtually. Also external systems planned for use in the new collaborative system needed to recognize the location for activating their contact lists.

Testing Phase 2 (Customer Acceptance Testing)

Customer acceptance testing is part of the ITIL-processes with the purpose to validate the needs of users in all of the scoped features. Six Sigma's statistics were employed in this test which is characterized by the practise of the issues being fixed at the same time as these issues are raised. For the customer acceptance test, the most experienced employees were selected, according to the practice of ITIL in which usually trainers or experts are employed since they know what need to be tested. For the maximum result, the test manager created a set of suitable tasks which were necessary to complete during the testing. As a result of this phase of testing, the first version of the user instructions was also created. Customer acceptance testing also contained screen video or screenshots for faster problem solving. The consults had the technical possibility to for it, as well as were given the right to check the source code if necessary for faster problem resolution.

Testing of software source code also offers an objective point of view on the quality of the written code by revealing code errors. The testing of the code ensured that software was meeting the software/services commercial and technical requirements and includes all the software features and abilities integrated in the system. This part of testing, the code test, was divided into two parts: the first part was done by the suppliers' representatives for the suppliers' facilities and their environment. The quality testing of the code was also done by the supplier. The purpose of this testing period was to ensure that every documented feature was available and working as described. The second part was done by the case company specialists, led by the researcher, in cooperation with the maintenance unit.

6.3.3 Data Collection Round 3: Test Results

The scope of the test was formed to ensure, first, the overall functioning of the system and mostly focused on its technical architecture. Secondly, the tests ensure that communication and knowledge transfer tools were fully functional and met the criteria set in the planning phase. The communication features of the collaborative system and the user interface were tested in default settings. During the activation of the collaborative features, the system integrations started to work properly and no unidentified issues were found on the system logs. With the help of the test personnel, the communication and knowledge transfer features of the system were also tested as planned.

Results from Testing Phase 1

The first testing was needed because new components for the new environment need a port opening requests from a Local area network and routing determinations. Nowadays, complex structures of system design resolve these problems simply by conducting tests. During the test, the maintenance team got valuable data on the system functionality at the same time when the firewall and router ports were opened. The platform's integration pipes were transferring data properly from the system to other destinations, and components were doing what they are documented to do. The documents met the requirements and the platform's functionality was suitable for environment. All technical details were covered and, at the end of the test Phase 1, there were no network or server errors on the logs.

Results from Customer Acceptance Testing (Phase 2)

Customer acceptance testing contained answering the pre-planned questions. The purpose of the testing was to check the documented features and possible issues. The output from the testing period was that the selected components of the entire collaborative system suited the case company environment and simplified the working processes in communication and knowledge transfer. Overall, the test cases were passed and no issues were open when this testing phase was over.

These tests were also able to produce additional value for the company since they revealed the results of measurements of the consumed time for the page loading, statistics on the approximate document sizes, and the number of data collections. The test personnel were also able to give several tips on the general user interface. They also suggested separate testing for different page templates and finding best suitable solu-

tion to represent the data for employees, managers and customer service. Additionally, the tests also examined the updates which are checked annually at this point of planning. As a result of the test Phase 2, the system has now all the latest updates and future updating is possible easily. The communication platform is developing rapidly and, if social media options are needed to use in company later, this is now possible.

Summing up, the main issue was to during the tests were to ensure the quality and functionalities of the new collaborative system. Test questions were formed to check its availability, integrity and confidentiality. Availability means that the system usability must be easy and fast. A *single-sign on* feature now allows for only once password for all the functionalities and activates the user' access rights when the computer is turned on and authenticated. Integrity means that documents are safe in the system, also against a possible power failure, hard disc issues and accidental files deletion. Confidentiality means the users are secured from identity thefts, unauthorized accesses and other anomalies. Two rounds of testing made it possible to call security audition in the future.

Thus, the test results were promising because there were no issues which were left unresolved. The system functionalities were enabled for collaborative interaction, communication and knowledge transfer. Virtual team work options were also enabled through virtual meeting rooms, with members of different teams being able to work all over the world.

After the both tests were approved, the system was ready for user trainings and learning to use new system abilities. Before these massive trainings, there was also a round of several employees piloting the system. Their task was to find possible usability issues and develop the training manual. During the piloting stage, the same procedure for document collection and analysis was employed as it was done during the testing stage. The frequently asked questions (FAQs) were also documentation and put to use during the piloting session.

The piloting stage is described in the sub-section below.

6.3.4 Piloting in the Production Environment

Piloting was conducted under normal working procedures which are supposed to be used in the new collaborative system on a regular basis. The procedure for the piloting tested the communication abilities of the collaborative system between two offices in the real-time production environment. For the piloting, Wikipedia page, publishing portal and the corporate wiki page were used which represented the data storage. The communication tools used were, first of all, the telephone, which started the testing; second, the chat tool, which was used as an alternative communication tool; and third, the virtual work space for virtual team work.

The piloting started by a telephone call, and the test employees were using chat and virtual work space and data storage at a same time as a regression testing was conducted. The regression testing was conducted to check the amount of network traffic consumed by all these resources. While trying to make an overload for the server and network, the task for the test employees was to develop the first variant of instructions for the collaborative system and represent these documents in the system for everyone to see. After a while, the chat system features were piloted to conduct a group chat where the instructions documents were discussions for a while. Some issues about by logging onto a system were found, and after a short investigation, it was recognized as the SharePoint known issue which was recognized and raised discussion already in the Internet.

Knowledge transfer in the document store was a difficult task which became a success. The pre-made customized team site was activated for the document storage. The test employees were able to store the document without external help and, at the same time, some usability improvements were found. Because of the possibility to put short introduction in the text of the document, the possibility to find the document was considerable increased, as the test employees mentioned. When the virtual team dashboard was in use, the blank word document was used to demonstrate how team work can be conducted. The blank document was also saved in the team web-site, where at the same time the version history and Wikipedia functionality were tested to link the document in the Wikipedia page.

Overall, the results of the piloting were encouraging. Before the piloting, the test employees had been confident that the system would be difficult to use. After the piloting,

the general feeling was the collaborative system is easy to use and offers numerous opportunities to simplify and make communication and knowledge transfer easier in the case company. The communication before the collaborative system and after the piloting was reported as two different experiences. In the test team observations, the normal communication in the case company was described as face-to-face and via the telephone; while in the collaborative system, the communication with a telephone and a chat system at the same time was possible, even though there was a little problem with multi-tasking. Through the chat system, the test employees were able to send direct links of the documents to each other and these documents were available exactly there and then, where they were supposed to be. Thus, the test period awakened the management to see what the increased communication might be in the future.

Additionally, the piloting session results also included some valuable suggestions on how to further improve the system, as well as produced the instructions and improved the user interface to meet the web-page standards even more. As a result, the tests proved that the users were able to communicate even during the phone calls. The knowledge transfer also proved working, with the documents easily found in the SharePoint site, which decreased the face-to-face communication inside the company but increases the communication between the company and its customers.

7 Discussions and Conclusions

This section summarizes the results of the study on the development of the new collaborative system and presents a proposal of an action plan for further improvements to the newly built collaborative system.

7.1 Summary

The needs for better communication and knowledge transfer are increasingly evident in many organizations. Especially the needs for real-time collaboration and communication have become critical. This need can be facilitated by using a collaborative system in an organization. The case company of this study has identified this need, and aims at developing an efficient real-time collaborative IT system.

The objective of this study was to develop a collaborative system which would increase the possibilities for communication and knowledge transfer in the case company. The study was based on best practice of knowledge management, project management and available knowledge on building collaborative systems. This study was part of a project to build such a new infrastructure in the case company which spans the period from the system planning, through the trial launch and piloting procedures, up to the proposal of an action plan for further improvements after this first iteration of the system development.

Action research was adopted as a research approach to conduct this study and analyse the data. During the case company interviews, meetings, observations and brainstorming sessions, nine main categories of the users' needs were indicated to be addressed in this new collaborative system. After that, according to the findings from literature and the results from the current state analysis, a collaborative system was developed and launched for tests to help the case company improve their communication and knowledge transfer.

The main features related to the improvement of communication and knowledge transfer in the newly built collaborative system were as follows. The first component for implementation was the email server. The installation process was long because the old emails were difficult to put in the new email database. As a result, there were two email

servers running side-by-side for a while. Chat tools were implemented on a server and they were appreciated by the test team during the piloting stage. Virtual chat rooms were still under the tests when this study ended. Discussion forum were also made available, and Wikipedia got its first information and also seemed to suit the case company needs. The first versions of the websites for the case company's teams were also ready, with the aim to increase the internal and inter-team communication. Also the mobile platform testing produced encouraging results, although business intelligence tools and IP-phone system are still waiting for implementation. The supportive IT systems enabled the workflows and integrated the email system as part of the overall collaborative system, with notifications of changes visible for user. The collaborative system also enabled features of video conferencing, voice conferencing and usage of different sites for communication and data storage. Finally, the system now allows for a dynamic change, in case the case company makes changes, for example, to its strategy or organizational structure.

After the development stage, the system was put to test. For the testing period, there was a testing form developed which made possible not only the regular testing but also tested some usability features of the system. The tests were a valuable place for gathering data and making documentation for late use in the production stage. The testing period has produced the data collection *Round 3* aimed at further development, and also resulted in the creation of user guides for the administrators and users. At the end of the testing period, there was enough documentation for the training and detailed instructions which would be needed for the collaborative system roll-out in the summer of 2013. At the moment this Thesis ends, the system is in the finishing stage of the piloting phase.

Overall, this study, first, evaluated the current IT tools used for collaboration and communication in the case company; then, it compared different kinds of collaborative systems through benchmarking against the needs of the case company and investigated the available knower on collaborative systems; and third, it developed and tested the new collaborative system. Additionally, over the final testing and piloting stages, it collected the data for further improvements to the newly built system. These data were used to produce an action plan to further improvements (see below). It was necessary since the company environment is constantly evolving, which creates the need to smooth, real-time communication and knowledge transfer.

Based on the results from the testing and piloting stages, an action plan was suggested for further improvements to the new collaborative system. The Practical Implications below suggest how the communication and knowledge management can be further improved.

7.2 Practical Implications

Based on the results of the testing and piloting stages (data collection Round 3), certain measures could be suggested as an action plan how to improve the collaborative system. The table 11 below describes the list of action pots for the collaborative system development in the near future.

Table 11. Action plan for further development of the system.

Action	Description	Responsibility	Duration
<p><i>1. A complex of changes to the communication tools</i></p> <p>For example, to structure and define the data collected in Round 3 on the communication and knowledge transfer needs to develop a precise list of changes to the system.</p>	<p>The data point to the needs for more diverse communication tools. Already now it points to the need for better video stream, pictures, and voice. All relevant media types must be easily accessible.</p>	<p>Maintenance team some specified users.</p>	<p>12 months. The actions are needed to be done in sprints which make it possible to check the results and fix issues in an on-going mode.</p>
<p><i>2. A complex of changes to the knowledge transfer tools</i></p> <p>For example, the document search time must be reduced.</p>	<p>The collaborative system should meet the target of the fully real-time communication, including the retrieval and transfer of documents and other data</p>	<p>Maintenance team</p>	<p>6 month</p>
<p><i>3. A complex of chang-</i></p>	<p>The collaborative</p>	<p>Maintenance</p>	<p>Regularly, every 2</p>

<p><i>es to the user interface</i></p> <p>For example, implementation of regular updates of the user interface</p>	<p>system frequently gets new updates and fixes. The process must be established how the user interface will be updated.</p>	<p>team</p>	<p>months. The first iteration done in the following two months.</p>
<p>4. <i>A complex of changes to the external system integration</i></p> <p>The need to further develop and integrate of the external systems</p>	<p>Because the information has started to flow to the system, the interface needs further changing. For example, some more external system should be integrated, such as video stream, logistics, ERP-systems and other data.</p>	<p>Maintenance team, with the help of managers of other teams</p>	<p>12 month</p>

The purpose of these improvements is to increase quality of communication and knowledge transfer to meet its criteria for business development. For example, the collaborative system and its interface must be updated at least every other month, the period suggested by the managements and users. Additionally, due to several different systems integrated into the new collaborative system, the need for further integrations with the other systems was also indicated in the after-the-tests meetings. Finally, the external systems which are ERP-system and logistics system also need to be further integrated with the collaborative system.

As for the further plans, at the piloting stage, the study will end, the project however will continue till the end of 2013. As the scope of the study was limited to the communication and knowledge transfer needs, there is still much to do in other areas of the system. As its development is an iterative process, the lifecycle management, development of the technology, and feedback and innovation from the users will keep the track on the further needs for the system features.

There are still many development ideas for the future. Globally, the communication is increasing widely and social media has stepped forward in communication methods. Although the case company did not want at this point any social media tools, however, in the future it might become a requirement. Advertisements and sales need to go there where the people are; virtual technology is also developing rapidly.

The development of a collaborative system is not fully finished. The process model is needed for a more precise model for improvement for today's needs. After that, the first audits will come later along the development process. Hopefully, this study can be used as a detailed report on the first development iterations. It proves that with a narrow scope even minimum resourcing could still produce a lot of change.

7.3 Managerial Implications

The main expectation from the management side is that it should give its managerial support to the development of the new collaborative system. This support can be granted in four possible ways.

Table 12. Action plan to support the collaborative system for the managers.

Action	Description	Responsibility	Duration
1. Support the culture of frequent use of standard IT	The collaborative system can be consolidated by active use of: <ul style="list-style-type: none"> - Data input process - Data mining process - Change management process - Reporting process 	Each team leader, each department manager	Six month, Review time after 1 month, 2 months, 3 months, 6 months
2. Support regular feedback and planning meetings for defining the service levels and further needs	Users of the collaborative system will give feedback and suggestions on the strengths and weaknesses of the collaborative system	IT-manager, team managers	Monthly, duration 6 months
3. Establish and	BI knowledge which will be	Management,	12 months

support business Intelligence practices and utilize them for decision-making	gathered from different locations and made visible in the collaboration system can be utilized for decision making. Forecasts for the future will be easier to create and upgrade	Maintenance team	
4. Support the move for more data gathering from customers	Customer data can be collected and located into the collaborative system	Management, Maintenance team	12 month

As Table 12 suggests, the management is expected, first if all, to support the organizational culture of frequent use of standard IT. It will help to gain competitive advantage in the ever faster world of business communication. Additionally, for improving business intelligence the business intelligence tools could be used which would support the decision making. This tool is yet to be implemented in the production environment. Next, the management has identified to need for services for the internal customers. The new service would require the data collection which could be based on interviews, meetings and observations. The future results will be integrated into the system with the improvements made directly to the systems used. Finally, the new collaborative system could allow for more data from customers gathered and made available in the new collaborative system. This opportunity also waits for strategic support from the management side.

In addition to the suggestions discussed in Table 12, the management in the case organization has identified the need for establishing the processes around the services to provide more value. But these processes should avoid unnecessary tasks to increase performance. Monthly based service level meetings could help focus on issues around the services, especially those addressed in the collaborative system, and if any issues or improvements are suggested, the fixing process can start immediately.

The management of the company has been satisfied with the current actions. In practise, the management should recommend using the collaborative system at the entire organisation level, and support the system continuous development in a long term perspective. With these management actions, the collaborative system will be subject to

continuous improvement and thus will serve the needs of the staff in the best possible way.

7.4 Evaluation of the Study

The case company recognized the need related to improving the communication and knowledge transfer in the work of the employees. The company needed real-time, smooth communication and information flow to improve its business opportunities. Previously, the communications between the employees were at times low or slim to none. Thus, there was a need to improve the missing communication in the case company with a tool which would be a business enabler and could be expanded in the future.

Firstly, the number of requirements from the interviews needed to be refined and categorized. The interviews produced a lot of requirements and suggestions, and the interview results were documented in a detailed way to reflect the real needs and opinions of the persons interviewed.

Secondly, special efforts were placed to collect the widest possible pool of data from the users and the management. But at this stage, only the employees and the management of the case company participated in the interviews, not the external customers, but those interviewed were asked in several iterations, so that there was a fair chance to collect all the requirements and suggestions from the user and management side. At present, though, not all of them were possible or necessary to be implemented, but the collected data will be utilized at the later improvement iterations.

Thirdly, concerning the chance for the study to produce the same results, if the study was repeated, the interviews would have definitely brought different results if the interviewed persons had used some kind of different kinds of test collaborative systems before. At the moment, some of the interviewed persons were still not very advanced in using IT technologies and thus could not suggest anything specific for the system in the development. This situation will, however, change with the time and more experience in using the collaborative systems. Therefore, the study could produce different results if held by other researchers or at a different point in time.

Fourthly, the results of the study are difficult to evaluate at the moment, but after more use of this new collaborative system the real benefits of improved communication actu-

ally will become more visible. This may lead to the creation of a new system and/or new development process and better data collection. In the best case scenario, the new collaborative project will be started, and with the knowledge and data from the first project, the results might even more promising. To secure this possibility, the research and data documentation were made in the most detailed way possible, taking into consideration the time and resource limitations.

Finally, the researcher was an active member in the development of the collaborative system and participated in all the stages of the project. He, however, made all possible efforts to avoid any bias by giving space for the users and the management to express their needs and expectations, and by following their requirements. However, most of the interviews during the study there from the ICT-side and the most interests from the ICT management. This may put some limitations on the requirements formulated for the collaborative system, but in the future other units will hopefully participate more after the launch of the collaborative system into production. In the learning organization, organizational culture is constantly evolving and in couple of years the communication and knowledge will be at a much more advanced level. Thus, subsequent data collection ideations will make the requirements based on more representation from the case company.

During the collaborative system installation, there was possibility to renew active network components which could allow for more data moving through the system. At the same time, a step for a security architecture was taken when four recommendations from the National Criteria for Security Auditing (basic level) were applied to the infrastructure. When the user acceptance tests begin and specialists started to check the collaborative system functions, the need for improved communication gained increased interest among the test employees. The implementation of user interface for testing purposes was a demanding task because the layout needs to be simple but functional although the official user interface is just about in the planning phase.

The results of the testing and piloting stages indicate that the proposed collaborative system platform would meet the criteria set by the case company and reflected in the research question. The system has proved to improve communication and knowledge transfer from customers to the case company and inside the case company. Implementing the proposed system would also affect the organizational culture by increasing communication flow in a positive way.

Overall, the new collaborative system was evaluated as suitable for the needs of a small size company. If the number of employees increases another development iteration might be needed for improving the performance of the collaborative system. However, the system is designed to accommodate more users than today's number in the case company.

7.5 Reliability and Validity of This Study

The study researched the way to improve the communication and enable the knowledge transfer in the case company. The case company needed a reliable research and the final collaborative system with a stable performance. While the research objective has been achieved and new collaborative system progressed from phase to phase, the study also paid attention to the reliability and validity of the research, results and data collection.

From the start of the study, the researcher aimed at reducing the researcher bias. First, the researcher used his experience in the IT sector. The researcher has altogether nine years of professional experience in different kind of collaborative tools, including their developing and maintenance. In the early years, the researcher also participated in the projects to improve CRM-system communication. The researcher hopes that this professional experience secured him against possible mistakes on the technological side and project management approach, and helped for a making holistic view of the problem.

Regarding the *reliability* of this study, all interview sessions were conducted face-to-face in the Finnish language, the native tongue of the interviewees, but were then translated into English. Some of the interviews included notes which were also put in the mind map for the brainstorming session. The purpose of these interviews and short agendas sent in advance was to notify the interviewees about the questions and stress that preparations would benefit the interviewees. Additionally, a list of general questions was used during all interviews (documented in Appendix 2 and 3).

During each interview session, the scope of improvements to the communication and knowledge transfer was discussed from various perspectives, formulated with different

questions utilized to collect and analyse the most complete data possible. After documenting by the researcher, the collected data was always sent for validation to the informant.

Regarding the *validity* of this study, the developed system and improvements action plan were based on the planning, researching and data gathering from the interviews and a range of other source of data collection (observations, internal documents, meetings and discussions, etc). This approach was based on the qualitative methodology, complemented with best practise and available resourcing. Once the system was developed, it was sent back for validation with the selected specialists in order to maximise the benefits of the value and for getting the latest technology in use for the case company. The subsequent assessment was used to determine how measurements can be done for the new collaborative system and what to measure to ensure that the new system meets the customers' needs and addresses the research objective defined at beginning of the study. Overall, pursuing the research objective in this Thesis helped for the study to stay on track and directly address the objective of, first, developing the new collaborative system and, second, further improving its communication and knowledge transfer.

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Appendix 1.**Communication improvement model**

Communication improvement model was introduced during the interviews when the need of communication was defined. During the interviews this model was shown which was describing individual social behaviour. The definition is positive versus negative behaviour and it suits the example for the research question. Table below describes Noonan's research.

Appendix table 1. (Noonan 2001: 4).

Positive behaviour	Counterproductive Behaviour
Attend and actively participate in social opportunities with co-workers. Finds people and talk to them on a personal, yet appropriate level	Avoid social work-related functions. If attending, stay secluded and talk to when needed.
Give others attention when they wish to talk about their lives and interests	Stay focused on work that individuals and their needs are ignored
Attend morning coffees, eat lunch the staff lunchroom and talk to the others in the halls when appropriate	Schedule meetings to avoid social events. Eat lunch daily alone. Look away when walking through hallways to avoid interaction

Appendix 2.

Test tasks – Testing Phase 1

Unauthorized access for case company's systems might cause lack of confidentiality among the other companies. The result for this action would be that case company will lose business opportunities to others and in worst case scenario lose the markets. This action can be prevented by using some security standards in the company. The usage of security standard need always support of the management.

This Finnish National Security Authority's published KATAKRI version two will give suitable actions for prevention unauthorized access with limited resources. By performing this list below it will give as a result hardened IT-infrastructure for the base level four. If needed the security level can be increased in the future by following the list. It is also helpful when the need is to get audition for other security standards.

The questions are based on National Security Auditing Criteria's requirements for the base level four. To be approved the answer to the questions is need to be yes or the question's answer must be fulfilled. (Finnish National Security Authority, 2011: 71-104). In a case company security is in background. The availability questions are opposite for the security and questions are formed to simplifying the collaborative system use by users' point of view.

Security Question (network)	Availability question (Network)
Is collaborative system behind the firewall or segmentation?	Should Network traffic be balanced if traffic goes through nodes so traffic would not slow down?
Is the network switches and routers unused settings disabled and unauthorized traffic?	Disabling ports and protocols needs to be tested with system and offices. IP-address must go fastest route with no issues. Tested?
Is the firewall traffic filtered so that communication systems are allowed to pass through?	Test system components (integrations) that every office has same availability and also for the customer point of view if necessary. Tested?
Is the network traffic analysers enabled for new system?	Is the network speed tested and measured with new system?
Is the active network adapters' unused features disabled?	Disabling settings unused features decrease network traffic. Is this tested?

Security Questions (System)	Availability question (System)
Are the users authenticated when they log in the systems? Are all passwords in the system encrypted?	Single-sign on service need to in use so user logs in the services only once. Activated?
Are the computers unused settings disabled?	Communication tools must be checked in the testing period. Tested?
Are there preparations for prevention of malware?	Antimalware software settings need to check that software is allowing normal communication traffic. Tested?
Is the log gathering system enabled?	Logs are needed only certain actions and gathering need to be controlled.
Is there a mechanism to protect data from disaster?	If data is accidentally or by purpose deleted, there must be data recovery system in use. Tested?
How is ensured that crypto products are recent?	The certificates which authenticate with the server need to be updated by maintenance. Tested?
Does the case company have password policy?	The lost password must be recovered quickly. Tested?
Security Questions (Document safety)	Availability question (Document safety)
Does the company classified documents? Is there instruction how to handle?	Classified documents need to be secured location and mark the suitable way

Security Questions (usability)	Availability question (Usability)
Does the documentation cover all major functions and issues of the new system?	If users have an issue there must be instruction on paper to follow
Is there separate testing and production environment?	Maintenance team can check the problems separated system instead of production environment
Is the other system compatible with other systems?	Collaborative system purpose is that everything is available through one interface.
Is the communication devices secured?	All microphones and head set etc. devices need to be fully functional at the company's networks

Test tasks - User agreement testing – Testing Phase 2

User agreement testing is focused to test features of the software

Question	Task
How to sign in to the system	Sign in to the system. Check that single-sign on works as planned.
Where are communication tools?	Find communication tools and get familiar with them. Report issues
Where are file transfer tools	Use tools to send files others. Use also other offices if available. Report issues
Where are knowledge transfer tools	Find data storage and get familiar its abilities. Report all issues
Are all required features on the system and working as planned?	Check communication tools, contact your colleague and use long sentences, use connection with video picture, microphone and other required systems. Report all is-

	sues.
How do you sent assignment from the system?	Find workflow. Create users for workflow users and make tasks. Confirm the task when you receive it and use every function. Close task when finish. Report all issues.
How does the team calendar work?	Form a team calendar and share it. Make many calendar markings and check all features. Report all issues.
Find business intelligence tools	Go to the business intelligence tools. Check the parameters and settings. Set your email address for receiving weekly report. Change parameters and repeat. Check also BI pages. Report all issues.
How to use document storage?	As knowledge transfer create document for the test you are about to make. Delete document and restore it. (With procedure). Make classified document. Store it informed location. Delete document. Retrieve it by informed way. Make new version and save the file. Open earlier version. Open current version. Close. Use restriction for document. Use sent announcement via email feature. Report all issues.
How to make aware of changes	Make team pages and make notification to your email address
how does your mobile access work	Access with your mobile device for communication services. Report issues

Appendix 3. Round 1. Results of Data Collection

Original questionnaire was done in Finnish. Here is translated version of questions and answers collected in Round 1 of data collection. The questions and answers are divided into three parts. The categories are set by their similarity of the department's answers. The first section contains questions from management; second row contains questions from marketing, customer service and sales. The third row contains questions from production. The last row contains the questions and answers from maintenance.

Table of interview questions	Answers
<p>Business Requirements In the interviews, the questions are categorized in several sections. First issue: What are the requirements of the collaborative system? Is the collaborative system needed? Are there alternatives for recommended one? How does the system help user in their daily work? How the new system brings value for marketing, sales and production side? Are you need to perform measurements between systems? Is any project milestones reached and approved? How the system is approved for use? Does the system need to be auditable? How much money and time I have in use? Can I have resources for the project?</p>	<p>Management answers The company has been in the market many years. The communication tool has been fixed phone now the mobile phones are in use. The need for us is to get full benefits of the Information technology. The basic need for us is to have real-time communication which would enable openness in the company and makes this company more effective. The marketing is currently very effective in the point of our view. There has been seen too much slow motion between sales and production. The increased communication would make the operations more flexible and customers may be even satisfied. The measurements how the benefits are measured are coming from times how much orders are late and how customers feels change (indirectly). The calculations how fast order is processed from sales to the supply chain is one measurement. The project approvals are needed whenever the funding is needed. It is also requested that our users will approve the collaborative system in use. The system is need to build that it is security auditable later on and if the business functions grows in the foreign countries there has to be possibility to use same system. The resources are all in use at a moment. There is possibility to use one user but the user has no technical background.</p>
<p>Communication needs in the company?</p>	<p>The need for improve a communication for a technical way is needed for to use IP-phones more instead of mobile phones. The costs are lower when IP-phones are used. The use of task system will help to assign tasks for employees and follow up their activities. The email calendar for meetings and organizational calendar would be pleasant feature. Also need for business intelligence tools are identified. Email system is still potential communication tool in our company. The modern fea-</p>

	tures and abilities should be updated.
<p><i>Customer service, sales and marketing section's questions (from employees questions)</i></p> <p>Does the system contain required features to gain workflow?</p> <p>Is the user interface simplified and fast use?</p> <p>Does the system have reliability, speed and backup issue?</p> <p>Does the system bring value for customers?</p> <p>What are the current issues of contacting the company?</p> <p>Do you have any "maintenance" person in your team?</p> <p>Communication needs in the company?</p>	<p><i>Answers from customer service</i></p> <p>At a moment there is identified a problem which is related to the communication. At a times there is a situations where is needed to get answer in a second. Chatting tool will help to provide the information which might have forgotten to document earlier. The news, the market situation and possible customers are important to us.</p> <p>The sales need also information much faster to achieve the goals which business has set.</p> <p>Our employees do not have technical background so it is needed that all communication functions are easy to use. There is also need a storage for documents, instructions and orders which may be used as a training material. There is also need to communicate with production department people because at times the order information will change and in that time the immediate reaction is important.</p> <p>Customer service and sales are based on communication so it is critical function for us.</p> <p>The customer service does not have maintenance itself but the maintenance section will help if needed.</p> <p>The main communication tools which are used in daily basis are mobile phone.</p> <p>In our company are raised needs for use IP-phone, Chat system and improve the email system. Teams would need also the sites of their own where would be located their own documentation. There would be also need for place for organizational documentation. For the problems and knowledge sharing purposes there is need for discussion forum and Wikipedia.</p>
<p><i>Employee questions (production)</i></p> <p>Is the new system user interface carefully planned and implemented?</p> <p>Does the system all needed features?</p> <p>Does the system use contain training and documents?</p> <p>Do you need large amount of storage space?</p> <p>What kind of requirements do you have about the communication and knowledge transfer tools?</p> <p>What are current issues and how they are identified?</p> <p>Communication needs in the compa-</p>	<p><i>Employees from production answers:</i></p> <p>In the production we make pack the orders for shipments and deliver what customer is expect to have. Our quality is important to us.</p> <p>For the documentation there is need for big storage room where all documents can be stored for later use.</p> <p>The communication needs to be easy to use and the need is currently for the email, chat and news forum where people can check the latest events or requirements.</p> <p>The current system issues are that email storage is ran out long time ago. The system does not offer anything at a moment and the server capacity is in the limits. The system is slow and it may fail in some day.</p> <p>The production department may be busiest place in the company along with the sales.</p> <p>The current need for using communication is to use</p>

ny?	mobile phone. The shipping companies and vendors are using mobile phones and emails. In the future there is need for chatting system and task system which generates a workflow. This could enable improved quality when communication is increased.
<p>Maintenance requirements What are your resources for maintenance? Can you maintain the new collaborative system? What are the requirements for your point of view? What issues are at a moment in the current system? What are your requirements for the new collaborative system?</p> <p>Communication needs in the company?</p>	<p>Maintenance answers At a moment the time is going on updating laptops and computers. The Server is old needs attention. The current systems features are outdated. The possibilities of maintaining modern system are easier because of remote functions which enable minor updating and repairing from desk of my own. Users complain much about the lack of communication and all communication is handled by mobile phone which requires one hand in use. If the company would have chat system then more conversations could have be done without mobile phone and work related material could be sent over network. There is not much news sites either so mobile phone call for colleague is needed. Discussion forum for example maintenance questions would be useful for getting answers the questions that can be solve independently. A chat for maintenance could also save working time for something else if solution is get in a real-time instead of sending email and waiting for answer.</p> <p>At a moment there is use mobile phone and email system. The email is always full and every day there must be delete older emails away. In the future there are need to improve real-time performance by using chat system, discussion forum and news sites to communicate better with the users.</p>

Questionnaire for Partner Company visits

Questions	Answers
What useful communicational features and tools were found at partner company systems?	(test employee) It seems that email system is similar but the latest technology. I didn't see chat system or it was not in use during the presentation. Discussion forum was useful and it seems that communication with workflow is quite easy ((Maintenance) This system look very modern. The maintainability is however possible and it make more flexible time frame to do maintenance and updates. From user point of view the team sites of the company were useful.
What notifications did you make?	(test employee) The blog entries were empty. It seems that there could be more features than it is necessary. However if the "blog" entries are changed for the informative way

	<p>such as “news of the week” it could be more suitable for us.</p> <p>(maintenance) The communications with synchronizing the calendars were quite useful and when it is possible to see virtual team working was seen suitable for the case company.</p>
<p>What communicational features would be needed for in the case company?</p>	<p>(test employee) Most definitely the latest version of the email software because the employees are familiar to use it. Chat system is also needed although it was not shown in the visit. Discussion forum is useful for the production department where the processes are quite stable.</p> <p>(Maintenance) The communication tool box where is virtual meeting room and possibility to make the document virtually almost everywhere is definitely good solution for our business persons. Discussion forums were also good examples and their data storages which were organized well.</p>
<p>Was this company visit useful?</p>	<p>(Test employee) It was because now in the testing there is known how certain features are working so comparing the functionalities of the visited company saves time. It is however totally different environment so basically quite few ideas are possible to use in the case company.</p> <p>(Maintenance) The infrastructure is quite different than in the case company. The purpose of the features of the collaborative system is at times different than ours.</p>

Appendix 4. The examples of cases

Cases where the case company's improved communication with a collaborative system can be useful (Based on the interviews and given case examples)

Situation 1. Customer calls for sales and orders a product. The sales make an order to production and the production will produce the product. When collaborative system is enabled and the order is found for the production lists, the production state can be monitored and it can be seen immediate when product is in cargo container.

Situation 2. Customer calls and changes the order which has just received by sales. The sales can contact to the production and make changes in a real-time in order.

Situation 3. The parts, the products, installation and tools are managed and ordered by different teams in the production environment. The manufacturing and installation time can be reduced when all teams knows other teams status in the working place.

Situation 4. The management has a meeting but all members of the management have different appointments elsewhere. With a collaborative system they can set a virtual meeting and even see each other no matter what the location is.

Situation 5. The marketing section has an offer in a new organization and there is grown a business opportunity. The need for getting sales to take that opportunity while new organization has interested for product is important. It requires all relevant data for needs and possibilities which can sell to the new organization.

Situation 6. Customer service receives a call from a customer who needs help or has a question. With a communication tools customer service can ask question and receive answer during a phone call.

Situation 7. In the case company has started new employee and training is going on. During the training the employee can learn existing documents all relevant data and ask questions which are related to the work. When the employee starts being on its own the employee can ask immediately if a problem occurs or check the company documentation.

Situation 8. The management of the case company has a decision to make. For the decision there is needed all relevant data which makes easier to predict the future and help for decision making process. The communication and use of gathered data will help to prevent making wrong decisions even if field of business would change after the decision making.

Situation 9. The employee has several works to be done at same time or employee is focusing on wrong work. The management can communicate easier with the employee. Also notifications about company events are possible through communication channels.