ESA STUDY CONTRACT REPORT

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Abstract: This document reports the final, detailed result of the study on current and future technologies for collaborative working environments (CWEs). The goal of this study is to analyze current CWEs and whether they and their future trends are suitable for large-scale multinational organizations. To this end, we have analyzed the structure of large-scale organizations in general, and of ESA in particular, with respect to organization, geographical distribution, and IT environments. Requirements for CWEs used in collaborative work are presented. Based on an initial list of criteria given by ESA, we have revised and extended the list to introduce a comprehensive set of criteria for evaluating CWEs. The state-of-the-art CWEs are discussed and classified. We have selected 15 representative CWE products and evaluated and compared them in detail. From the evaluation and comparison of CWE products, we have presented our findings of current issues and future trends of CWEs. In particular, existing products provide many features required by large-scale and multinational organizations but those features are not well-integrated into a single system. Due to the complexity of collaborative work within those organizations, often many CWEs are used in parallel and it is not easy to integrate those CWEs together.

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Current and Future Technologies for Collaborative Working Environments[1]

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Contents

Acronyms and Abbreviations

ACT	Advanced Concepts Team
ACL	Access Control List
AES	Advanced Encryption Standard
API	Application Programming Interface
AS	Application Server
CRM	Customer Relationship Management
CMS	Content Management System
CWE	Collaborative Working Environment
DMS	Document Management System
ECM	Enterprise Content Management
ERP	Enterprise Resource Management
ESA	European Space Agency
EU	European Union
FTP	File Transfer Protocol
GPL	General Public License
ICT	Information and Communication Technology
IIS	(Microsoft) Internet Information Server
IM	Instant Messenger / Instant Messaging
IMAP	Internet Message Access Protocol
IT	Information Technology
JAAS	Java Authentication and Authorization Service
JSR	Java Specification Request
LDAP	Lightweight Directory Access Protocol
MS	Microsoft
MSI	Microsoft Installer
NTLM	NT LAN Manager
ORM	Object Relational Mapping
P2P	Peer-to-Peer
PIM	Personal Information Manager
PBX	Private Branch Exchange
REST	Representational State Transfer
SIP	Session Initiation Protocol
SMTP	Simple Mail Transfer Protocol
SoW	Statement of Work
TUV	Vienna University of Technology
VoIP	Voice over IP
WCM	Web Content Management
WebDAV	Web-based Distributed Authoring and Versioning
XMPP	Extensible Messaging and Presence Protocol

Chapter 1

Introduction

1.1 Purpose

Recent advances in hardware and software technologies have fostered the collaborative work across administrative/organizational boundaries. Various tools are available for users to conduct joint projects, regardless of the location and the organization of the users. For example, wikis[1], SVN[2], and document management systems[3] allow different users to share and coedit documents, instant messaging[4] and voice chat[5] allow multiple users to converse online, just to name a few. With the support of existing Collaborative Working Environments (CWEs), many new concepts, such as virtual teams and communities, are introduced and realized today. Furthermore, the concept of *user participation*, such as collaborative blogs[6] and collaborative tagging [13], substantially increases the interaction model among users in collaborative teams. This phenomenon is realized by what is referred to as the Web 2.0 era[7].

However, whether the current CWEs and their future trends are suitable for large-scale multinational organizations is still an open question that motivates the work presented in this report. This report describes our study of current technologies for CWEs and their trends in the future. We particularly focus on the evaluation of CWEs suitable for large-scale, multinational organizations, such as the European Space Agency (ESA).

1.2 Objectives and Approach

The main objectives of this study [10] are

- to collect a list of state-of-the-art CWEs suitable for large-scale organizations (such as ESA),
- to review and revise proposed evaluation parameters, taking into account ESA's organization, geographical distribution and IT structure,
- to compare identified CWEs based on the evaluation parameters, and
- to identify possible future trends for CWEs.

To achieve the above-mentioned objectives, this study is split into three tasks. Figure 1.1 shows the details of our approach applied to fulfill all aimed objectives. As the study focuses on software for large-scale, multinational organizations and enterprises, first of all, in **task 1** information about the IT structure and distribution of such organizations and enterprises in general

[1] http://en.wikipedia.org/wiki/List_of_wiki_software
[2] http://subversion.tigris.org/
[3] http://en.wikipedia.org/wiki/Document_Management
[4] http://en.wikipedia.org/wiki/Instant_messaging
[5] http://en.wikipedia.org/wiki/Voice_chat
[6] http://en.wikipedia.org/wiki/Collaborative_blog
[7] http://www.oreillynet.com/pub/a/oreilly/tim/news/2005/09/30/what-is-web-20.html

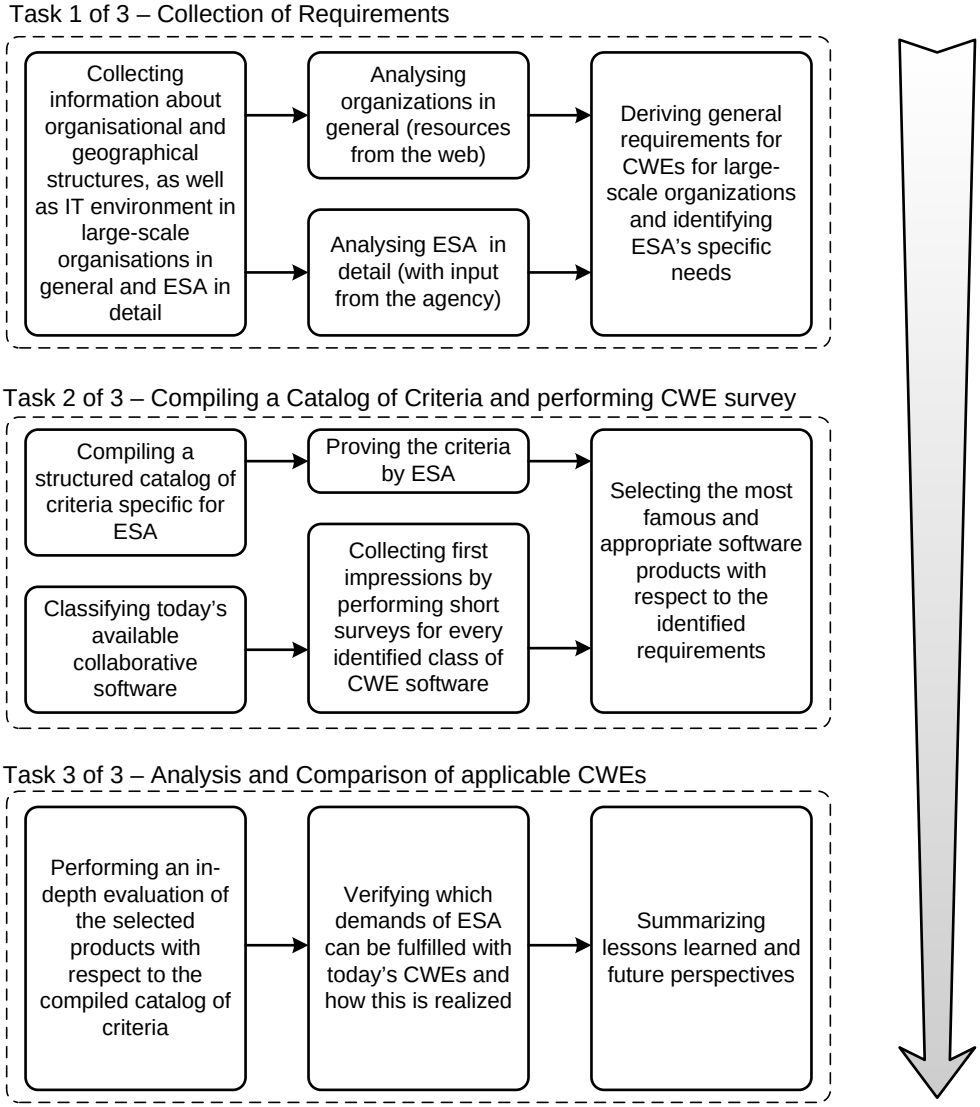

Figure 1.1: Approach of this study about CWEs

are collected. In this task, we also focus on ESA's structure and its needs for CWEs. Based on that, general requirements of CWEs for large-scale organizations and particular requirements from ESA are derived. From the requirements, **task 2** refines a catalog of criteria which is initially provided by ESA, and revises the catalog with new criteria suitable for evaluating CWEs fulfilling demands of large-scale organizations. In parallel, available CWE software is categorized and a list of state-of-the-art CWEs is presented. Next, some applicable software products are selected for an in-depth evaluation based on the finalized catalog of criteria. The detailed evaluation and comparison is conducted in **task 3**, followed by the analysis of existing issues and future trends of today's CWE software.

1.3 Structure of this Report

Chapter 2 gives an overview of common structures of large-scale, multinational organizations and general requirements for CWEs suitable for large-scale enterprises/organizations. Furthermore, specific information about ESA is mentioned and the most basic tasks which should be supported by CWE software are described. Chapter 3 presents a detailed catalog of criteria used to evaluate

CWEs. In chapter 4, we classify existing CWE software based on their capabilities and present a list of appropriate CWEs for evaluation. Chapter 5 discusses the evaluation procedure and presents the comparable evaluation between CWEs. We make a list of findings and future trends for CWEs suitable for large-scale organizations in Chapter 6. Chapter 7 provides the main conclusions and lessons learned.

Chapter 2

Structure of Large-scale Organizations and CWE Requirements

This chapter discusses the most fundamental information about the structure, distribution and organization of large-scale enterprises/organizations in general and ESA in particular. Such information is important for the study of CWE software products.

2.1 Overview of Large-Scale Enterprises/Organizations

Whether a CWE is suitable for an organization is strongly dependent on the structure of the organization which includes, for example, the number of departments/sites, user roles, and kinds of collaborative goals. For the purpose of this study, we particularly focus on the IT infrastructure, the accessibility to IT resources, and security concerns as they strongly impact on the criteria for selecting suitable CWEs.

2.1.1 IT Infrastructure

Large-scale enterprises/organizations are mostly divided into sites which are geographically distributed. Each site usually has its own IT infrastructure comprising networked services. The need for collaboration among people belonging to different sites requires the network in between to open access to certain services. To enable secure and reliable collaborative work between these sites many concerns have to be taken into account. In the simplest form, each site is connected to the Internet and secured by its own firewall, as shown in Figure 2.1. It is obvious that an appropriate security policy (e.g., accurate firewall settings, policy management for authentication and authorization, and data encryption) is needed, depending on the collaborative software's mode of operation. A more advanced connection setting is to use a virtual private network (VPN)[1] which operates on top of the public Internet and offers advanced security capabilities for accessing corporation's IT resources during teamwork.

Since collaborative work requires the involvement of people and resources across the boundaries of departments/sites, there are mainly four ways in which CWE software may operate:

- **Use of P2P software**: in the P2P (peer-to-peer) model[2], a person uses locally installed software which communicates directly with an instance of the same software, or similar interoperable software implementing the same protocol, utilized by another person in the collaboration. For example, in Figure 2.1 `User A` would directly communicate with `User B` and vice-versa. Typical scenarios for this model are voice chats or video conferences. This

[1] `http://en.wikipedia.org/wiki/VPN`
[2] `http://en.wikipedia.org/wiki/Peer-to-peer`

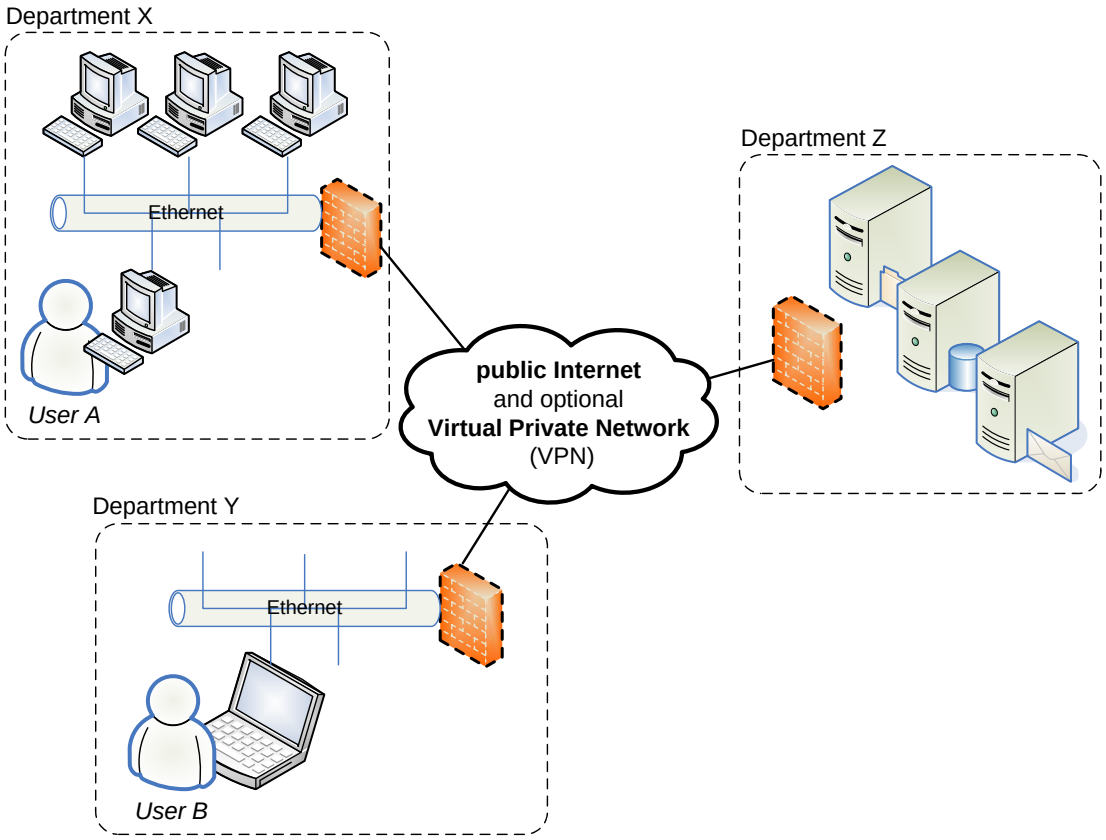

Figure 2.1: Simplified IT structure of an enterprise/organization formed by independent sites

model does not exclude the case that some services in the middle are needed to ensure the communication between the two users. For this case firewalls at both sides must be properly configured, especially the firewall of the receiving user has to allow incoming connections on a predefined port (if not using a switching server and some tricks like [14]).

- **Use of classic client/server systems**: in a classic client/server scenario each user has an instance of a client software running on his/her machine. The client software communicates directly with one or more servers. A typical example for this model is document management. This model offers the great advantage of managing all relevant resources in a central place where many important tasks, like data backups, logging, user access management and security, can be simplified. The main issues with this model are the scalability, reliability, and mobility support.

- **Use of web-based systems:** this model is similar to the the classic client/server model mentioned above. However, instead of using special client software, a web browser is all which is needed on the user's machine. In this case normally no special firewall settings are needed in the distributed sites because all communication takes place over standard, widely-employed Web protocols (like http and its secured versions). Another advantage is that no client software needs to be maintained, thus fostering the mobility aspect. However, many tasks cannot be performed via Web browsers when particular resources of the local machine are required for the collaboration, such as recording devices in voice chat.

- **Mixed client/server and P2P mode:** in this model, both client/server and P2P models are utilized. This occurs, especially, when a single model is not suitable, for example, in integrated software which offer diverse functionalities. A typical example is instant messaging or document sharing. In such a scenario a central resource is kept on a server for fast searching and simple management (e.g. a list of users currently available for

instant messaging or a list of available files in a peer-to-peer network) while the data itself is exchanged directly between the participants without using a server.

The model being used is strongly dependent on the capability of the CWE software and operational/organizational concerns. For example,

- Who configures the firewalls? Is it done by one central IT department or several administrators in every site? This question is essential to determine if software can be used which needs shared security policies to be configured properly in order to operate in a multi-site environment.
- Is there any data backup policy? How are backups managed? Is it necessary to log information in order to be aware of who accesses which resources? This is essential to determine if a distributed peer-to-peer system can be used or if only a centralized structure is really valuable.

The IT infrastructure, e.g., the communication connections between departments and sites, influences the operational mode of users, especially the accessibility (the way how users access resources in the organization's network) and security concerns (how security issues are handled). Thus, these two issues are discussed in the following subsections.

2.1.2 Accessibility

Strongly dependent on the basic IT structure of the organization are also the possible ways of access to relevant resources needed for collaborative work. The traditional, and the most common, way for a user when participating in a project is to use an office PC (Personal Computer) to access resources. However, there may be the demand for accessing personal and project related data when users are not in the office, e.g. when they are on the move or at home. In today' working styles, the four typical types of access are:

- **Access from office:** this is the common way to carry out collaborative work for most people. In this case, a machine/computer (called a PC) is permanently integrated in the IT infrastructure and it is used by a member of a department/site for his/her work.
- **Access from home via public Internet:** it is the case in which a person accesses organization's resources from his/her home PC. In this case, a limited access may be granted from outside the company for particular purpose and for specific people.
- **Access from home via VPN:** Full access can be granted when the user's home PC is considered as an internal element of the organization's network. This can be achieved by setting up a virtual private network (VPN) between a user's home PC and the organization's network. In this case, there might be no difference between office users and home users.
- **Access from mobile devices and on the move:** There are different kinds of mobile access and accessing resources on the move, depending on the machine which is used.
  - **Configured laptop:** Dependent on the network structure a configured laptop with all required software installed may behave like a home PC. The difference is that such a laptop has no fixed IP address and due its mobility it may continuously switch from one network to another. The laptop can also establish a VPN connection to the organization's network and thus becoming an internal element of the organization's network.
  - **Personal mobile phone or PDA:** For certain services, PDA or personal mobile phones can work like a home PC, e.g., when accessing resources using Web browsers or communicating using instant messaging. For typical client/server CWEs there are sometimes special mobile client editions available as well.

– **Internet corner or similar:** Access via machines where no additional software can be installed is only possible if Web browsers are used at the client side. Such access can be useful to some particular collaborative work, such as coediting wikis or checking an overall project progress.

To enable different types of access during collaborations, not only CWEs have to support diverse types of accessibility and interaction modes but also security concerns have to be addressed adequately.

2.1.3 Information Security Concerns

Information security concerns[3], such as confidentiality, authentication and authorization, are general issues that have to be dealt with, especially when collaboration spans multiple sites.

- **Confidentiality:** ensuring that information is accessible only to those authorized to have access.
- **Integrity:** ensuring that information is not altered by unauthorized persons in a way that is not detectable by authorized users.
- **Authenticity:** ensuring that users are the persons they claim to be.

Based on these common three principles of security the related following points should be taken into account during the evaluation of CWEs:

- **Authentication:** it must be ensured that every user has to authenticate whenever he/she is participating in collaborative work to guarantee confidentiality and integrity.
- **Transport encryption:** secured transport of data is essential in today's IT environment, realized by different protocols such as Secure Socket Layer (SSL) and Transport Layer Security (TLS).
- **Closed structure:** There must not be any documents, or resources in general, hosted on third party servers. For example, Google offers with its Google Docs[4], an interesting software package but keeping office documents on a server outside an organization's IT structure. This is unacceptable for many collaborations when documents are confidential and organizations do not want to expose the documents to the outsider. The same may be true for instant messaging tools which communicate directly in a P2P fashion but using a central server outside for storing contact lists.

2.2 Structure of ESA

2.2.1 Overview

The structure of ESA from an IT point of view is quite similar to the general model given in the previous section. ESA includes 7 different main sites[5]. The communication between ESA sites relies on internal network and access is controlled by security firewall. Table 2.1 summarizes the basic organizational structure of ESA based on preliminary information provided by ESA's ACT (Advanced Concepts Team)[25].

Based on this information[25] some detailed knowledge about the roles of future users and their application requirements are obtained. Table 2.2 presents user roles and groups of ESA that are important for this study. Within this study, we therefore basically consider only software products which can appropriately handle user groups of the given size as well as can support the mentioned different user roles.

[3] `http://en.wikipedia.org/wiki/Information_security`
[4] `http://docs.google.com`
[5] `http://www.esa.int/SPECIALS/About_ESA/SEMY8TEVL2F_0.html`

Questions	Answers from ESA
Number of main sites	7 (plus some extra locations with very few people in those offices)
Average number of people per (main) site	570 (varying between 170 to 3500)
Typically the structure of collaborative processes follows a hierarchical or point-to-point model?	hierarchical
Communication networks between sites located in different geographical places are typical private/VPN/dedicated or normal internet links?	The communication within different ESA sites is done via the ESA internal network (telephone and intranet) using servers protected by security firewall.

Table 2.1: Organizational structure of ESA

Generic User Roles	Concrete Examples	Users in directorate	Users per division
Coordinator	project manager, group leader	84	2
R/D staff	engineers, programmers, scientists	286	12
Assistant	secretary	30	1

Table 2.2: Generic user roles in exemplary directorate (used as reference within this study)

2.2.2 ESA's Requirements for CWEs

Besides information about future users and ESA's structure, information about tasks to be supported by CWEs are also reviewed. For that purpose Tables 2.3-2.6 which contain a structured overview about features of current CWEs, mostly taken from [12], were compiled by TUV; the importance of each feature and additional comments in the tables were provided by ESA.

Application Feature	Description	Importance for ESA
e-mail integration	normally necessary for easy integration of received external information	*high*
online discussion	textual synchronous discussion (chat, instant messaging)	*low (optional)*
	textual asynchronous discussion (forum, bulletin board, blogs)	*medium*
conferencing (streaming, VoIP)	telephone service between two persons	*high* (must have)
	audio conferencing within a group	*high* (within different groups)
	video support	*high* (within different groups)
	is the use of non-ESA external and public servers for communiation set-up or member list management allowed?	*optional*: There are some groups where this feature has high importance but usually this is not the case

Table 2.3: Task category - Communication

The features of modern CWEs can be categorized into the following groups:

- **Communication** (Table 2.3). This includes any type of communication features available in modern CWEs, e.g. textual chats, bulletin boards, point-to-point telephony or conferencing and video support.
- **Project Management** (Table 2.4). This category does not deal with project management

Application Feature	Description	Importance for ESA
project oriented organization	assign resources (e.g. tasks, files) to project for better structuring and extended access rights management	*medium*
task management	create, edit, delegate and schedule tasks	*medium*
calendar management	management of personal and group events	*high*
	shared calendar within work groups	*high*
note management	personal memos and reminders	*medium*
	shared memos and news announcement	*medium*

Table 2.4: Task category - Project Management

Application Feature	Description	Importance for ESA
file management	shared virtual drives within groups	*high*
	share online files with external users via secured accounts	*high*
	preview well-known file types like txt, pdf or rtf	*high*
	version control mechanism	*high*
resource planning	planning the use of resources like cars or rooms	*high* (especially the meeting rooms)
address management	management of personal contacts (can be used for e-mail messaging, etc.)	*high*
	share contacts within a user group	*high*

Table 2.5: Task category - Resource Management

in the traditional way in the form of Gantt-charts or work breakdown structures. Often users are involved in more than one project at the same time so that this category is more about how to support the user to answer questions related to the management of concurrent projects, such as whether resources can be reserved for a specific project or whether it is possible to create, mange and share tasks or files independently for every attending project. Moreover, basic management capabilities should be supported like shared calendars or task management and tracking.

- **Resource Management** (Table 2.5). This deals with file management in several ways, resource planning like meeting rooms reservation and address management. In short, it addresses issues related to shared resources in an organization.
- **Online Work** (Table 2.6). This covers the wide variety of concrete collaborative online work like collaborative editing, the use of virtual whiteboards, shared presentations over the web and shared desktops between group members.

Based on the information in the tables, the following observations are drawn:

- In the field of **Communication** e-mail and audio-/video-conferencing are highly needed, while the possibilities of online discussions, especially synchronous in form of chats, are only optional features.
- According to **Project Management** shared calendar management is important, other features are not absolutely needed, but would be fine.
- **Resource Management**, like management of files but also reservation of rooms and management of shared contacts, is an explicit demand.

Application Feature	Description	Importance for ESA
collaborative editing	synchronous editing: possibility of working online on the same documents (closely related to version controlled file management)	*optional.* This would be a need within ESA and would have high importance, but currently is not applied
	wiki support (or similar)	*optional.* This would be a need within ESA and would have high importance, but currently is rarely applied (in some research groups it is actively used already)
	online support for rich text editing (e.g. via Ajax) of text-, HTML documents and spreadsheets	*optional.* Online support should be within the ESA firewall
whiteboard	for collaborative discussions	*optional.* Would be needed and has high importance but is not used at the moment
shared presentation	presentations over the web	*medium* (video conference is used instead)
shared desktop	type of a window wherin every participant can see the same content	*optional.* There are some groups where it is used and has high importance

Table 2.6: Task category - Online Work

- Real **Online Work**, like collaborative editing or shared desktops, would be fine, but is not needed at the moment.

Figure 2.2 clusters the above mentioned results. All tasks, supported by modern CWEs, can be found with a symbol indicating their importance for ESA. The defined areas of communication, project management, resource management and online work are overlapping, because some of the stated supported tasks cannot be strictly mapped to exactly one type of task category. For example, on the one hand, people addresses are primarily a type of resource and often managed in a database. Thus, address management has been assigned to the field of resource management. On the other hand, address management is also supported by communication tools for instance as a list of contacts. Furthermore, common project management software may also include some type of address management for team coordination and team member notifications.

Figure 2.2 shows that ESA's interests are in the area of *sharing information* on the one side (shared files and calendars, resource and address planning all having high importance) and *communication* on the other side (e-mail integration and conferencing via audio/video links are a demand too), while *collaborative work* in the sense of corporate task management or collaborative editing are only of medium importance or optional. We can see that nearly all required features with high importance for ESA lie in the fields of resource management and project management. As the features of these two fields are mostly covered by groupware systems, we will focus on this kind of software products in this study. Furthermore, there is a high demand of real-time conferencing (like audio/video communication) which is not supported by traditional groupware systems and is covered by additional software. The concrete selection of tools for the evaluation is explained in Chapter 4.

2.3 Requirements for CWE Software

The IEEE Guide to Software Specification Requirements [9] presents most *general software requirements* which are valid for more or less every software product. However, for the purpose of this study - *CWEs software for large-scale multinational organizations/enterprises* - we focus only requirements that are important to such CWEs.

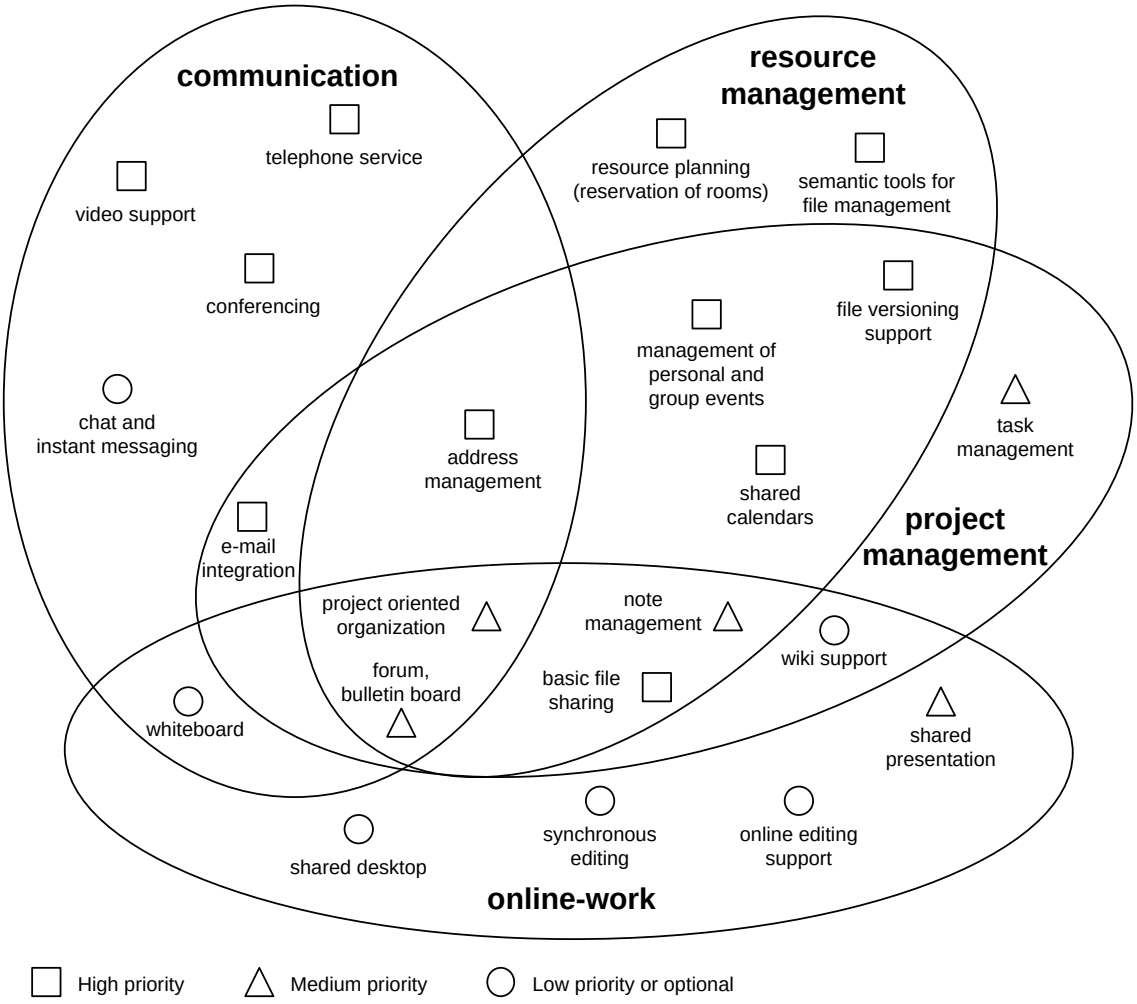

Figure 2.2: Importance of today's supported CWE tasks for ESA

In the field of enterprise software a wide range of criteria, many neglected in home user software, plays a major role to the success of the software. Examples of such criteria are *security*, because confidential data is handled, *scalability*, because the size of working groups may often change rapidly, and *functionality*, because the software has to support users in the most (cost) effective way. All these criteria are independent from the type of software or their features and are strongly considered in every evaluation in this study. In the following, we discuss requirements for CWEs used in large-scale multinational organizations. *Specific requirements for ESA* can be derived from the previous sections, based on its structure, the way communication is handled, and the composition of future users.

2.3.1 Security

Due to ESA's geographical distribution, transport security must be established by either using appropriate encryption techniques and/or a virtual private network (which does encryption on its own). In contrast to home use, where security is often neglected, this is essential in professional environments, in particular in ESA environment, where confidential and business critical data is processed. Furthermore, as mentioned above, mobile access demands an appropriate security policy (maybe limited access from the outside or similar) or a basic secure structure. Especially, an extended access rights management is needed for large-scale organizations so that they are

able to handle large amounts of users and different user roles. An access on mutual trust, like in small companies where mostly everybody is in fact an administrator, is obviously unacceptable.

2.3.2 Availability, Reliability and Serviceability (RAS)

Typical general requirements for business software systems are their high availability, reliability and serviceability[6] because the more people are connected to a system the higher is the loss of money when it does not function properly. There are many common practices to establish and increase the availability, load balancing and reliability of CWEs, such as the use of redundant systems and distribution, and the employment of (hot)back-up and recovery strategies. For CWEs being used in large scale organizations, proper backup mechanisms and policies are of course essential. Maybe hot-backups are preferred, because critical works in large companies cannot be interrupted when backup is performed like in small offices. From this point of view a centralized IT structure for CWEs has the advantage that backup operations are under control of a centralized administrative system and thus normally easier to perform and more reliable than in a distributed P2P network, where every user is responsible for backing up his/her own data.

Serviceability, also called maintainability, is required to ensure that it is easy to maintain CWEs to meet their prescribed requirements. Therefore, verifiable functioning and traceability of errors are essential to detect occurred problems and to avoid such problems in the future. For this purpose appropriate logging features are useful. From the point of maintainability a centralized structure for CWEs has an advantage, because a centralized installation like a web-system is much easier to maintain than distributed software of a P2P system. Furthermore, a valuable user account management for a large amount of people, easy integration in the existing IT environment and a comprehensive and high quality documentation improve maintainability and help saving costs.

2.3.3 Scalability

Scalability is the ability of a system to either handle growing amounts of work in a graceful manner, or to be readily enlarged [5]. In CWEs the size of working groups is often changing and is possibly large. Therefore, CWEs must be able to handle many concurrent user accesses.

2.3.4 Usability/Acceptance

Although above mentioned properties are the most important for CWE software, usability should not be neglected, especially for software which is used in multinational organizations which typically consist of a wide range of different groups of people with respect to roles, language, culture, and nationalities. CWEs should be easily used by any type of users, ranging from project manager to scientists, from secretaries to marketing experts.

2.3.5 Extensibility

Extensibility, sometimes also called adaptability, means that a system has been designed to be expandable in the future without the need for major changes on its core, e.g. by implementing software interfaces or plugin structures. This is needed to adapt a CWE to new or changing requirements or to smoothly integrate CWEs with existing applications.

2.3.6 System Integration and Supported Platforms

CWEs are mainly used in an already set up IT environment. Thus, it is important to integrate them into this environment and to establish connections to software in use, e.g. to be able to import address books from standard e-mail clients into the CWE. This requires common software interfaces, standard-based file formats and/or import/export functionalities and is closely related to the extensibility property.

[6] `http://en.wikipedia.org/wiki/Reliability,_Availability_and_Serviceability`

Further, it may be essential to establish for which computer platforms and operating systems CWE products are available. Especially, in heterogeneous environments, where, e.g., some technicians may use Unix-like operating systems while secretaries often use Microsoft Windows. In such cases, software has to be available for multiple platforms or has to be Web browser-based at all.

2.3.7 Compliance and Legal Issues

Compliance refers to ensuring that personnel are aware of and take steps to comply with relevant laws, regulations and/or standards. It is particularly important for organizations whose sites are distributed in different countries governed by different laws. Because valid compliances to regulations and standards of future users are not known during development there should be the ability to adapt the software for particular needs; e.g. set up special rules how to archive documents and how long they have to be accessible etc.

Furthermore, there are some legal aspects related to the software itself, basically license related needs. Usually the more users a system have the more license fees have to be paid. As a result, free or open source software may be preferred.

2.3.8 Mobility

Mobility in this regard means the access to a CWE via a computer not located within the company, e.g. access via a home PC or a laptop on the move. How this is realized strictly depends on the IT structure, CWE features, and the type of connection which is used. In today's working style, mobility gets more and more important, e.g. to enable the group leader to check current project status or to post some notes or comments about current tasks while traveling. Many aspects of mobility have been previously discussed in subsection 2.1.2.

2.3.9 Technical Support and Updates

The quality of technical support is relevant not only when having problems which cannot be solved without external help, but also when doing extensive adaptations of the software. Support can be available in different manners, like open internet forums, commercial telephone-/e-mail support or training courses.

CWE software will be of long-term use so that the software should feature a continuous evolution. Patches for security issues, adaptations for new operating systems and underlying software, and extensions which offer new features should be available in regular time basis.

Chapter 3

Evaluation Criteria

3.1 Criteria Description

The evaluation of CWEs is based on a detailed list of criteria. In the following we discuss in detail the list used to evaluate CWEs suitable for multinational organizations like ESA. Each criterion is described briefly and the following information is provided:

- Name of the criterion.
- Short description including some information why it is important (in general or in particular for ESA) to investigate this criterion.
- The method in which this criterion is evaluated, e.g. by measurement or studying documentation, or the combination of different methods.
- Importance of the criterion (weighting); there may be criteria which are not relevant in general but may be important for ESA and vice-versa.

3.2 Catalog of Criteria

The following catalog of criteria has been elaborated especially for this study and adapted to ESA's needs with respect to the requirements figured out in Chapter 2. Most of the mentioned criteria are obtained from the initial draft [10], others from [16] and [2]. For a better overview the criteria are grouped into six sub-categories:

- **General Information** - provides a short overview about the product to be evaluated. See Table 3.1.
- **Software Development and Organizational Criteria** - includes all available information about the software's evolution and the vendor. See Table 3.2.
- **System Prerequisites and Installation** - contains all relevant knowledge to get the system up and running. See Table 3.3.
- **Overall System Properties** - is about all general properties like nearly every software system have. See Table 3.4.
- **Application Criteria and Task Support** - is about CWE specific properties and which tasks are supported by the software.
- **Usage** - gives some information about the overall usability and customizability of the product. See Table 3.5.

Furthermore, ESA provided [24] its interest in each of the listed requirements. Due to the short project run-time, it was not possible to examine all the criteria in detail, especially those which require installed and completely configured systems.

3.2.1 General Information

General information provides a short overview and gives an introduction to a particular product. This information will be provided for every selected CWE software and obtained from official home pages and available documents.

Information	**Comments**
name and version	identification of the product
vendor	who is the developer and who is responsible for the product this may also include some kind of contact information
category	product category and type of application
focus	who should use this product for what purpose in which context?
key features	the most relevant features only for a short overview
motivation	why evaluating this product? why using this product?

Table 3.1: General information about CWEs

3.2.2 Software Development and Organizational Criteria

Software development and organizational criteria are surveyed over the software's evolution, legal issues, popularity of the product, project organization and support available (see Table 3.2). This information can be obtained by studying corresponding Internet resources and available official documentation.

Criteria	**Sub-Criteria**	**Sub-Sub-Criteria**	**ESA interest**
Product related	development progress	development status	low
		latest (stable) version	*high*
		number of previous versions	*low*
		average rate of change (as an indication of rate of development)	*low*
		new features introduced in last release (as an indication of the overall software evolution)	*medium*
	legal issues	licensing, license type	*high*
		free and/or open source (yes/no)	*medium*
		if commercial: cost/fee	*medium*
	popularity	some success stories (if available)	*medium*
vendor related	project organization	companies and organizations involved	*high*
		some information about the companies and organizations and their relationship	*low*
		approximate number of developers	*low*
	support	type of official support (by phone, e-mail, forum)	*medium*
		costs of support and support contracts	*low*
		support by independent organizations (like user communities)	*low*
		availability of official documentation	*high*

Table 3.2: Software Development and Organizational Criteria

3.2.3 System Prerequisites and Installation

System prerequisites and installation, shown in Table 3.3, are mostly studied from official documentation and user forums. However, specific information about particular software dependencies on the one side and the grading of the installation process on the other side is only possible with evaluation by installation and thus time-intensive.

Criteria	Sub-Criteria	ESA interest
additional software	list of other required frameworks or additional software products	*high*
	software dependencies (if known)	*high*
installation	complexity of installation process	*low*
	type of installation (client-/server-based)	*low*
supported platform	operating system(s)	*high*
	supported computer architecture(s) and hardware requirements	*high*

Table 3.3: System Prerequisites and Installation

3.2.4 Overall System Properties

Overall system properties (see Table 3.4) can be mostly examined through available documentation. It would be interesting to examine some of the points through experimental measurements, especially properties concerning scalability. However, due to short project duration this is not included.

Criteria	Sub-Criteria	ESA interest
application integration	available interfaces to external applications	*medium*
	integration of other applications (e.g. e-mail integration, mapping of local drives into the system, WebDAV)	*high*
bandwidth requirements	some estimations and conclusions based on the used technologies	*medium*
basic architecture	basic architecture of the product (like web-based, client/server, SOA)	*medium*
collaboration model	synchronous model, all participants must be available	*medium*
	asynchronous	*medium*
data backend	supported types of data backends	*high*
	default data backend and interfaces to other DBs	*medium*
extensibility	availability of plugin interfaces	*medium*
scalability	some estimations and conclusions based on the used technologies	*high*
security	access rights management	*high*
	encryption of communication	*high*
	user authorization	*high*
programmability	specific protocols	*medium*
	web services	*medium*
workflow support		*medium*

Table 3.4: Overall System Properties

3.2.5 Application and Task Support Criteria

The criteria used to evaluate a CWE are listed in Chapter 2. Software products will be basically selected for evaluation, when they either cover most of the demands with high importance or when they offer special capabilities in one of the essential fields another software does not have and is therefore worth a closer look.

It should be mentioned here that application criteria are strongly dependent on the type of applications to be surveyed. For example a software product for communication cannot be easily compared with typical software supporting collaborative editing. Nevertheless, we apply the same application criteria to all software products to allow a quick feature comparison.

3.2.6 Usage Criteria

Most of the usage criteria, basically covering mobile use and usability, can be in general evaluated by reading documentation. However, some of them concerning overall usability are closely related to application and task support criteria and have, therefore, to be evaluated by testing on real systems (e.g. by using installed version or Web demos, if available). Semantic capabilities are often part of an advanced search system, (semi-)automatic indexing support or interface to other semantic products.

Criteria	**Sub-Criteria**	**Sub-Sub-Criteria** (or further comments)	**ESA interest**
mobility	mobile access	(support for mobile devices)	*high*
	data export	(which data can be exported (e.g. calendar, e-mail, contacts) and how does it work)	*high*
semantic web	integrated semantic capabilities	semantic search, annotation, extraction	*medium*
	interfaces to semantic tools or databases		*medium*
usability	overall information handling	typical effort for publishing, finding and retrieving information	*high*
		types of exchanged information	*high*
		effective search tools	*high*
		ease of use	*high*
		unicode support	*medium*
	individual customization	UI customization (branding)	*medium*
		programming capabilities (including SOA features and/or webservices)	*medium*
	access types	anytime/anywhere access (for office and home usage)	*high*
		offline access	*high*
	identity/user management	user and user role management	*high*
		group building	*high*

Table 3.5: Usage

Chapter 4

Classification and Selection of CWEs

In this chapter common CWEs are categorized and a list of state-of-the-art CWEs suitable for large-scale and multinational organizations is presented.

4.1 Classification

There exist different classification models for collaborative software products in literature. A detailed list of common taxonomies with their intentions can be found in [12]. However, as our study is focused on evaluating concrete existing products, a more practical approach is better suitable. Therefore, based on an Internet survey and several Web pages which collect extensive lists of collaborative software [26], [1], and [31], the following classes for CWEs have been defined in this study:

- **File management systems:** those systems are used for proper handling of file based resources. Version control systems (VCS) are well-known and widely used today, not exclusively but basically as source code repositories in the field of software development. Other approaches like modern document management systems (DMS) extend the basic versioning capabilities of VCS systems by adding more advanced features, such as metadata handling, indexing and advanced search capabilities, which are needed for comfortable and efficient handling of text and binary documents.
- **Groupware systems:** they focus the communication between project participants on the one side and the management of common information, like contact data, notes, project progress and news, on the other side.
- **Real-time office applications:** they are stand alone or Web applications which basically provide the same features like traditional office products: word processor, spreadsheets and/or presentation software, but with additional collaborative capabilities like integrated chat, or real synchronized editing. Mostly this kind of software is hosted on third party servers (like GoogleDocs) and not within organizations (e.g., ESA).
- **Real-time audio, video and data collaboration systems:** commonly known as instant messaging tools for audio and video communication; maybe with integrated whiteboard, shared presentation or similar data collaboration. Focusing on clients with open standard protocols like the "Extensible Messaging and Presence Protocol (XMPP)", "Secure Internet Live Conferencing (SILC)" or "Session Initiation Protocol (SIP)" guarantees maximum interoperability and independence from specific vendors and proprietary software products.
- **Wiki-based coediting systems:** those systems are used for creating, coediting and linking web pages.

Note that the boundaries between all these systems are blurred and it is possible to have some more categories. For example, Enterprise Resource Planning (ERP) software which still have capabilities of the mentioned groupware systems. However, the main features of ERP systems lie more in the field of traditional project management, including budget planning, sales and marketing issues, supply chain management, just to name a few tasks. These tasks are of course performed in a collaborative manner but they are not in the focus of this study and, therefore, ERP systems are not taken into account. There is also a smooth transition between simple file management (or the more complex document management) and Enterprise Content Management (ECM). File management can be seen as a part of ECM, but ECM usually offers much more capabilities, not part of this study (e.g., form processing and web content management). Furthermore, most Customer Relationship Management (CRM) software offer basic groupware functionalities. However, CRM systems are mainly focusing sales, marketing, event management, project management and finance. Thus CRM systems, such as SAP products, are not addressed in this study.

4.2 Brief Surveys

In this section state-of-the-art CWE software in the above defined classes are briefly examined to provide a basic list of CWEs from which the most interesting software products will be selected for the final in-depth evaluation.

4.2.1 File Management Systems

As mentioned above, we group file management systems in version control systems (VCS), including famous CVS and SVN, and document management systems (DMS) which offer further capabilities.

Version Control Systems

Version control systems (often also called revision control systems) can be categorized based on their architecture into classic client/server systems and distributed revision control systems[1]. An extensive survey of today's version control systems and their features would need its own report, therefore, in this section there are basically referenced external resources which list some results of comparison [3, 30]. According to Chapter 2 there is the need of extended versioning support for files and in the SoW [10] of this activity it is intended that this support is desired not only for text, but for binary files as well. Table 4.1 shows a list of common version control system.

Document Management Systems

These products are well-known for their document management capabilities and additional features like support for meta-data annotations, easy archiving, extended rights management, automatic file-type conversion, versioning support, change notifications and so on. Some of these systems offer support for typical groupware features as calendar management, forum discussions or task and resource management too.

Optaros Inc. surveyed open source document management products in 2006 and summarized the results in a whitepaper [20]. They updated their work with a presentation in September 2007 [21] and identified the major players in this field with their specific strengths and weaknesses. We use this report as one source of information in selecting enterprise-ready document management systems.

Of course there are much more systems capable of document management, but due to time limitations not all of them can be treated in this survey. Most popular and often mentioned on Web sites are listed in Table 4.2, where open source and commercial products in this field are taken into account.

[1] `http://en.wikipedia.org/wiki/Distributed_revision_control`

client/server systems	
AccuRev	http://www.accurev.com
Borland StarTeam	http://www.borland.com/us/products/starteam
Concurrent Versions System (CVS)	http://www.nongnu.org/cvs/
Fossil	http://www.fossil-scm.org/
IBM Rational ClearCase	http://www.ibm.com/developerworks/
Microsoft Visual Studio Team System	http://msdn2.microsoft.com/en-us/vsts2008
Perforce	http://www.perforce.com
Plastic SCM	http://www.codicesoftware.com/xsfront.aspx
Polytron Version Control System	http://www.serena.com
QVCS	http://www.qumasoft.com/index1.html
Subversion (SVN)	http://subversion.tigris.org
Vesta	http://www.vestasys.org
distributed systems	
GNU arch	http://www.gnu.org/software/gnu-arch/
ArX	http://www.nongnu.org/arx/
Bazaar	http://bazaar-vcs.org
Bitkeeper	http://www.bitkeeper.com
Code co-op	http://www.relisoft.com/co_op/index.htm
Codeville	http://codeville.org
Darcs	http://darcs.net
Git	http://git.or.cz
Mercurial	http://www.selenic.com/mercurial/wiki/
Monotone	http://monotone.ca
Sun WorkShop TeamWare	http://docs.sun.com/source/806-3573
SVK	http://svk.bestpractical.com/view/HomePage

Table 4.1: Version Control Systems

As mentioned in the beginning of this section the precise distinction between document management and content management in general is quite impossible. Thus, if the focus is relaxed to content management in general then hundreds of tools can be found which are more or less capable of content management. A well maintained list of current available software in this field can be found at [23], where more than 850 tools can be compared against each other.

4.2.2 Groupware Systems

Most products of this group consist of a server installation and browser-based client software, where in principle no additional software is needed on the user computers. Sometimes there are dedicated clients for the most popular operating systems, often for mobile devices as well. Groupware's strengths are basically personal organization like calendar-, contact- and task management; and communication in form of integrated e-mail and some simple textual discussion. However, they often lack valuable document management on the one side and (integration of) real time instant messaging (textual and audio/video) on the other side.

The categorization of groupware systems is quite difficult. There are several methods published on the Web, all with their individual advantages. We favor the further explained classification based on hierarchy and used technologies, mainly a tradeoff between classifications done in [31] and [26].

- **Commercial Enterprise Suites.** The distinction between commercial enterprise suites and other products makes sense, because there are much more differentiating factors than the legal issues and the price. Commercial enterprise suites often (but not necessarily) feature well developed but proprietary structures using vendor-dependent technologies. Nearly all global software vendors, see table 4.3, provide a bundle of software for communication,

open source	
Alfresco	http://www.alfresco.com
Contineo	http://contineo.sourceforge.net/index.html
Epiware	http://www.epiware.com
Knowledge Tree DMS	http://www.knowledgetree.com
Nuxeo	http://www.nuxeo.com/en/
OpenDocMan	http://www.opendocman.com
OpenKM	http://www.openkm.com
Open sTeam	http://www.open-steam.org
OWL	http://owl.sourceforge.net
Plone	http://plone.org
Xinco DMS	http://www.xinco.org
commercial	
BSCW Shared Workspace System	http://www.bscw.de/english/index.html
Capita SwordfishEDM	http://www.capita-ds.co.uk
ColumbiaSoft DocumentLocator	http://www.documentlocator.com
EMC Documentum	http://www.emc.com
IBM Filenet	http://www-306.ibm.com/software/
Laserfiche DM	http://www.laserfiche.com
Microsoft Sharepoint	http://office.microsoft.com/en-us/
Meridio	http://www.meridio.com
Open Text Corporation	http://www.opentext.com
Perceptive Software	http://www.imagenow.com
Questys DM Solutions	http://www.questyssolutions.com
Redwood Report2Web	http://www.redwood.com/
Saperion AG ECM Edition	http://www.saperion.com/en/produkte
SpringCM DM	http://www.springcm.com/

Table 4.2: Document Management Software

collaboration and coordination of small to large teams within one group or a whole company. These software bundles usually integrate each member *of the same company* in a more or less valuable way, but is not open to other software products. When using such a bundle a well integrated software package which covers nearly all possible requirements can be expected. The disadvantages of purchasing enterprise suites are the full dependency on one vendor, significant costs for licenses and, probably, difficult integration with tools from other vendors or open source projects.

IBM Lotus Notes/Domino	http://www.ibm.com/developerworks/lotus
Microsoft Exchange and others	http://www.microsoft.com/servers/business.mspx
Novel Groupwise	http://www.novell.com/products/groupwise/
Oracle Collaboration Suite	http://www.oracle.com/technology/products/cs

Table 4.3: Groupware: Commercial Enterprise Suites

- **Hosted Web Collaboration Systems.** There are a couple of vendors who do not sell collaborative software itself, but host it on their own servers and lease this full featured up and running software to companies. They continuously maintain the systems and further take care of backups. Thus, this option may be interesting for small and maybe medium sized companies which do not want to operate their own business servers. This option might not be suitable for large-scale organizations which are able to maintain own systems and concern about confidential and legal issues. For the sake of completeness a list of currently offered hosted services can be found in [26].

- **Low Priced or Free and Open Source Web Collaboration Systems.** This class contains all software download- and installable on own systems for free or low price. The list on [26] itemizes several products which may be grouped again based on their underlying technology in LAMP[2]-, Java- and other products.
  - Most *LAMP products* offer similar services and functionalities. They are different mostly in usability and user interface but other criteria like scalability, use of standards or adaptability are similar. The LAMP framework is very popular in the open source scene.
  - *Java/Ajax based products*
  - *Other products* may be based on technologies like Perl or Python.

  An interesting review of open source groupware tools in the Linux Magazine [18] can be useful for selecting products of this category as well.

Open source products and most low priced commercial products are mostly based on open standards and well tested frameworks, which guarantee stability (though their maturity), better maintainability and adaptability (though their well-known standards and technical documentation) for low or no price. High adaptability is one of the key features to permit modification of software to match particular needs. Because large organizations normally have a comprehensive IT department which is able to perform such modifications, this is the reason why we will focus this kind of group in our survey.

Although the number of groupware projects is quite enormous we have distilled out some of the most popular[3] solutions, separated based on their technical realization into client/server based systems, Web based products and P2P software. It must be mentioned here, that it is completely impossible to list almost all available software products of this class. Moreover the term "groupware" is not strictly defined, so it is hard to say, as mentioned above, what is groupware and what is more about project-, customer relationship- or content management; or just an e-mail client with additional capabilities.

Client-/Server-based and Web-based Systems

Most of today's groupware systems are based on client/server model. This means that all data is managed on a central server and accessed by clients. Clients are either Web browsers or dedicated software, but often both types are possible. Thus, we merge these two sub-categories of groupware systems into one section. The identified products are listed in table 4.4.

P2P Systems

In the case of P2P systems there are no central servers; every user has a locally installed software which communicates directly with instances of the same program (or similar program implementing the same communication protocol) on other computers.

4.2.3 Real-time Office Applications

Real-time synchronous editing is either provided by pure online services like GoogleDocs[4], or by integrating additional features into traditional applications like Microsoft Groove[5] for MS Office products. Today, hosted online office applications[6] are emerging in private and commercial use.

[2]LAMP = Combination of **L**inux operating system, **A**pache web server, **M**ySQL database and **P**HP programming language and runtime

[3]popularity is "measured" by counting their occurrence in a number of CWE lists, reports and previous evaluations on the internet

[4]`http://docs.google.com`

[5]`http://grv.microsoft.com`

[6]This is a new type of business model. It is not only for document sharing but for other type of services, such as computing resources hosted by third party companies.

Citadel	http://www.citadel.org/doku.php?id=start
eGroupWare	http://www.egroupware.org
Group-E	http://www.group-e.info
Group Office	http://www.group-office.com
Horde Groupware	http://www.horde.org/groupware
I-sense	http://www.nextgroupware.com
Kolab	http://www.kolab.org
Open Xchange	http://www.open-xchange.com
Open Goupware	http://opengroupware.org
PHP Projekt	http://www.phprojekt.com/index.php?\&newlang=eng
phpGroupWare	http://www.phpgroupware.org
Simple Groupware	http://www.simple-groupware.de/cms
TUTOS	http://www.tutos.org/homepage/index.html
Zimbra Collaboration Suite	http://www.zimbra.com/products

Table 4.4: Client-/Server-based and Web-based Systems

Collaber	http://www.collaber.com
Collanos Workplace	http://www.collanos.com

Table 4.5: P2P Groupware Systems

But due to security concerns, e.g. confidential documents must not be stored on servers outside of large organizations, such systems have to be used with care. Nevertheless, online offices can be useful for co-editing and sharing low-security data.

pure online services	
Google Docs	http://docs.google.com
ThinkFree	http://www.thinkfree.com/common/main.tfo
Zoho Office	http://www.zoho.com
enhanced traditional applications	
CoOffice	http://cooffice.ntu.edu.sg
Microsoft Groove	http://grv.microsoft.com

Table 4.6: Real-time Office Applications

4.2.4 Real-time Audio, Video and Data Collaboration Systems

Common features of this kind of tools are textual chats, telephony service and audio-/video conferencing. The subcategory of data collaboration typically covers whiteboarding over XMPP, like Coccinella[7], some types of screen sharing or similar.

Real-time communication tools can be classified in several ways, based on their features, their technology and their use. One of the most comprehensive classifications is presented in [28] resp. [27]. There the following groups are defined:

- **Video Conferencing and Conference Calling.** This class includes all tools which mainly focus video communication (and of course offering audio-only communication as well) for calls between two persons or discussions within a group. Such tools often run in background permanently like classic textual instant messaging systems (e.g. the famous ICQ[8]) and basically offer the ability to contact persons whenever they are online. In [28] a well-maintained list of these software products can be found; further there is a valuable site which allows comparison of such tools [22].

[7] http://coccinella.im
[8] http://www.icq.com

- **Real-time Web Conferencing.** These products are used for predetermined meetings over the web. This means communication is not initiated ad-hoc (like in the other category), but the number of participants and their identity are normally known before. Furthermore such products often combine several forms of communication like audio/video, textual, whiteboarding or file transfers. A list with such tools can be found in [27].

Some reports about traffic analysis on Internet, e.g., [15], show that Skype[9] is currently the most popular VoIP tool. The reason for this probably is its ease of use and resilience in restrictive network environments. While VoIP software based on standards like SIP need accurate network and firewall configuration, Skype offers the ability to establish connections also in secured networks in several ways. This is a feature appreciated by users who need not care about firewall configuration, but unmeant by administrators in large organizations where Skype may weaken security policies due its unpredictable traffic.

It should be stated here that the use of open standards has the advantage of independence from specific software vendors. Moreover audio-/video communication tools usually need a central server provided by the vendor, which manages user lists and handles connection setups (like Skype or ICQ), so the availability of the whole communication service depends on the availability of these machines. When using software implementing open standards there is no need for using an external server. Then, an infrastructure can be set-up which may be fully located within the own organization.

4.2.5 Wiki-based Systems

A wiki engine, usually running on a webserver, is a type of collaborative software that typically allows web pages to be created and edited using a common web browser. Especially, wikis are effective when used to gather collective knowledge from a large group of people [19]. The webpage [7] provides a list of currently available open source wiki engines. Further, a comprehensive comparison of different wikis is provided by the WikiMatrix site[10].

Nevertheless, it should be mentioned here that some of the most popular wiki engines are MediaWiki[11], developed for the Wikipedia project, and the Mindtouch Deki Wiki[12], extended by many features other wikis don't offer. For MediaWiki a semantic add-on[13] is also available, which turns the WikiMedia into Semantic WikiMedia and enables the user to add semantic annotations to a text. This shall simplify the structure of the wiki and permit better search capabilities.

4.3 Selection Limitations

There are two opposed ways for selecting the CWE projects and products for the evaluation:

1. If one CWE package is preferred, one of the available groupware projects may be the best solution, although most of these projects lack on certain capabilities, e.g., mainly real-time communication capabilities and sufficient file management. This solution has the advantage of consistent look and ease of use on the one side and the disadvantage of limited capabilities on the other side.

2. The opposed way is to build a CWE based on a bundle of different tools for document sharing, communication, task planning and so on. For every area, the most suitable utility can be selected to be included into the bundle. This way offers the most powerful tools for the user (as long as they allow interaction/integration among each other), but the handling is more complex and may be refused by future users. Furthermore, such a bundle is even hard to maintain due to intricate update scenarios.

[9] http://www.skype.com
[10] http://www.wikimatrix.org/
[11] http://www.mediawiki.org/wiki/MediaWiki
[12] http://wiki.mindtouch.com
[13] http://semantic-mediawiki.org/index.php/Main_Page

We think the best solution is therefore a tradeoff between the two ways. This means we search for a tool which covers most of the requirements and add or integrate one or two additional utilities which can be used for unsupported tasks. Nevertheless, such a decision is closely related to the organization where the new software should be used, its future users and demands.

4.4 Selection Summary

Referring to Figure 2.2 in Chapter 2 most of ESA's requirements with high importance can be satisfied with modern groupware systems or document management systems offering additional groupware capabilities. Only extended real-time communication demands are often not covered by these kinds of tools. For this purpose an additional software product seems to be indispensable.

Nevertheless to keep this report more general we also select some software products which only meet some of ESA's requirements, but may be interesting for large-scale organizations in general, since the chosen tools should be common and widely used on the one side and may be enterprise-ready on the other side. Furthermore, the above mentioned categorization of current CWE products was sent to ESA for gathering ESA's interest in specific product groups. The results can be found in Table 4.7.

Product Group		**ESA interest**
File management	Classic version control systems	*high*
	Document management	*high*
Groupware systems	Client-/server-based	*medium*
	Web-based	*medium*
	Peer-to-peer	*low (forbidden within ESA)*
Hosted online office applications		*high (but raises security issues...)*
Real-time audio, video and data collaboration		*medium*
Wiki engines		*high*

Table 4.7: ESA's interest in available product groups

As expected ESA's interest in a product category is the higher, the more of their requirements are covered by products of this class; but additional information can be derived by the provided information. First, as already known, suitable file management seems to be one of the highest demands. Second, peer-to-peer groupware software is forbidden within the organization. Third, ESA has still high interest in hosted online office applications but there are already mentioned security concerns. Fourth, real-time communication is a high demand, but interest in additional software to cover only this single requirement is medium. Therefore, we are eager to find file management software or groupware which integrate such tools. Fifth, for collaborative editing wiki engines seem to fit well.

For selecting tools to be surveyed in the next chapter we focus basically groupware systems and document management software; both are most related to the classic vision of CWEs. But although real time communication tools, online offices and wiki engines are basically not comparable with groupware or DMS in the traditional sense and satisfy only part of ESA's collaborative requirements, they are of high interest in the wide sense[14] and therefore examples of these product groups are examined as well.

[14] and probably for ESA in the future

Chapter 5

Evaluation

We evaluate the selected CWE software with respect to the list of criteria in Chapter 3. The aim of the following evaluation is to provide a comprehensive and broad overview of available groups of collaborative tools and their basic features instead of evaluating only some particular products in detail.

5.1 Evaluation Procedures and Scope

There are basically four different distinguished types of evaluation:

1. **Evaluation by Installation.** This includes all information which can be retrieved just during the installation process, like ease of installation or certain software dependencies. This type of evaluation is of course only possible if there is a free version available on the web and can be time-intensive.

2. **Evaluation by Measurement.** This can be done after installing the system and includes measurement of some typical system parameters like scalability or measurement of required bandwidth by appropriate means. That's only possible if the software is freely available and can be successfully installed. Moreover some typical scenarios have to be set up to establish a real system environment. For that purpose maybe some additional software to simulate user interactions have to be developed and set up. *Thus this evaluation method is extremely extensive and is therefore not used in this study.*

3. **Evaluation by Performing Tasks.** This means performing some typical tasks like planning a meeting, publishing memos, sharing some documents and recording the effort, steps and time needed to do that. Some common tasks can be performed with installed software or also with use of public available web demos. In some cases web demos may not be appropriate if some features are not available or the installation is restricted in any other way.

4. **Evaluation by Reading Documentation.** This means doing some examinations of official documents (like manuals, FAQs, user forums) from the developer or other unofficial resources available on the Web. *This method is the main evaluation procedure agreed in the statement of work [10].*

Due to the nature of this study the following restrictions for evaluation exist:

- **Test Environment.** It is hardly possible to set up a test system which matches real conditions, this means using the same real (distributed) servers with optimized operating systems and the same type of network connections which shall be used in productive phase as well and simulate real user behavior. We could carry out performance tests pretty well if the system offers web services for which test clients could be developed. But it might be hard to establish a real user scenario, particularly when the real user behavior is unknown at the time of performing this study.

- **Evaluation Coverage.** It is not possible to test all features of the selected tools or to take all criteria into account. There may be commercial add-ons or tricky time-intensive installation procedures which prevent a detailed analysis.
- **Server Installation.** Because we are not using real server hardware (multi-core CPUs and gigabytes of RAM) it is not be possible to simulate the load which would occur in large multi-national organizations, even when the software interface allows us to write dummy clients as mentioned before. Therefore we will try to find trustworthy performance case studies of every particular software platform used in the products.
- **Commercial Products.** Commercial products can only be partially considered, especially if there are no free test versions or if their functionality is limited in any way.
- **WorkFlow Systems.** According to [16] work flow systems can be part of modern CWE software. They allow the flow of information according to automated processes, where it has to be reflected who is involved in resolving some tasks, what applications are required to support the management of information and how all of them are combined in the interplay of the whole process. While it is easy to determine if a certain product has a work flow system at all, it is currently nearly impossible to evaluate if it is appropriate (or if it can be adapted to be so) for ESA. This would need a deeper examination of work processes which cannot be performed in the short project run-time.

5.2 Final list of products to be surveyed

Based on the identified general requirements of large-scale organizations on the one side and ESA's specific interests on the other side we narrow the list of pre-surveyed products presented in the previous chapter and choose the products mentioned in Table 5.1 for taking a closer look. Furthermore, a short comment describing why we think the particular products might be suitable for evaluation, is provided.

File Management Systems	
Alfresco (open source)	winner of several comparisons on the internet
BSCW (commercial)	simple and widely used
Plone (open source)	famous and matured open source product
MS Sharepoint (commercial)	popular because of good MS Windows/Office integration
Subversion (open source)	(most) popular version control system
Groupware Systems	
Collanos	using interesting P2P approach
eGroupware	one example for popular PHP-based collaboration software
Oracle Collaboration Suite	example for a commercial product
Simple Groupware	wide-range of add-ons and supported features
Real-time Office Applications	
CoOffice	MS Office add-on for synchronous real-time editing
GoogleDocs	most famous online office product
Real-time Audio, Video and Data Collaboration Systems	
Coccinella	Jabber client for IM with whiteboarding features
Skype	well-known VoIP software
Wiki based Systems	
MediaWiki	used in Wikipedia thus one of the highly distributed wiki engines
Mindtouch Dekiwiki	based on the famous Mediawiki[1], extended with add-ons for enterprise usage

Table 5.1: Selected products for final evaluation

It has to be stated that commercial software is in our case harder to evaluate than open source projects. Our main evaluation method is gathering information by official documentation, reports, comparisons and other papers on the internet. For commercial products it is much more difficult to find trustworthy sources and retrieving reliable facts and not collect marketing statements or "soft facts" from sponsored reviews. Of course there is the possibility to change evaluation method to evaluation by testing. This could be done if there is a full-featured evaluation version available. But time for installing, running and testing a complete system (instead of only some capabilities) is too short in the proposed project duration.

We perform the survey by evaluating the selected products according to the compiled catalog of criteria, where ESA annotated their interest for every single point (see Chapter 3 for details). We further apply a methodology where, all criteria marked with *high* importance must be evaluated, these with *medium* priority shall be and points with *low* priority should (or could) be evaluated. Based on ESA's feedback some low-weighted concerns are merged to provide a better overview.

For some criteria giving a grade does not make sense, e.g. platform details or specific customer focus. In these cases we just mention the desired information. All the other criteria are reviewed using the following classification:

- *low.* This means a feature is still supported, but not very well or the overall quality is poor.
- *medium.* This grade is applied to criteria which are basically supported.
- *high.* A product fulfills a requirement excellently.
- *field left blank.* A certain criterion is not rateable because there weren't found any trustworthy information on the web and it was not possible for us to figure out some results in any other way. Another reasons may be that grading isn't useful at all in a particular context.

We point out that there are smooth transitions between the above defined grading groups as unique characteristics for every class cannot be named explicitly, because of the diversity of the products to be evaluated. Thus, the assignment of gradings is performed by use of the expertise of our own knowledge.

5.3 File Management Systems

5.3.1 Alfresco Enterprise Content Management

Alfresco is one of the matured, widely used and often mentioned open source document management systems with professional customer support and winner of several comparisons in respective IT magazines[2]. Focusing key features in the fields of document management, enterprise content management, collaboration, knowledge management and web content management, Alfresco is currently used by medium-sized and large-scale companies[3].

Name:	Alfresco Enterprise Content Management
Vendor:	Alfresco Software Inc., 428 University Avenue, Palo Alto, CA 94301, USA
Classification:	Document Management System
Webpage:	`http://www.alfresco.com`
Hosted Trial:	`http://www.alfresco.com/products/ecm/hostedtrials/`
Evaluation:	Alfresco documentation and webpage, hosted trial version

[2] `http://www.alfresco.com/about/awards/`
[3] `http://www.alfresco.com/customers/`

Criteria	Support/Features	Grading	Comment
latest stable version	Community: 2.9.0B Enterprise: 2.1.1		commercial version offers professional support, a controlled release model, upgrade support and is certified for use in critical environments
overall development progress	continuously development progress with a quarterly release interval resp. SVN access to daily changes	high	progress is faster for community edition, because only stable features are integrated into commercial version
licensing	Community: GPL Small Business and Enterprise Editions: commercial		versatile licensing scheme
popularity		medium	list of customers, mainly from the USA, is maintained on the Alfresco homepage[4]
companies and organizations involved	Alfresco Team and Community; some popular partners like JBoss, MySQL, Novell		
support	customer portal (includes access to technical advice, notification of and access to product upgrades, bug tracking and case management) and special Alfresco service (includes problem resolution, compatibility and migration advice and upgrade support)	high	special treatment of users of commercial editions including real 24/7 support

Table 5.3: Alfresco - Software Development and Organization

Criteria	Support/Features	Grading	Comment
additional software requirements			minimum configuration is the platform below
installation process	setup programs available	high	professional installation support for enterprise edition
supported platforms	OS: Linux, Microsoft Windows, Unix, MacOS Application Server: Apache Tomcat, JBoss AS, J2SE 5.0 (JRE 5.0) Portal: JBoss Portal, Liferay Portal, JSR-168 Browser: Firefox, Internet Explorer	high	

Table 5.4: Alfresco - System Prerequisites and Installation

[4] `http://www.alfresco.com/customers/`

Criteria	Support/Features	Grading	Comment
integration and supported interfaces	CIFS/SMB Microsoft File Share Protocol, JSR-168 Portlet Specification, JSR-127 Java Server Faces, File Transfer Protocol (FTP), Network File System (NFS), WebDAV, Web Services, REST	high	
bandwidth requirements			
basic architecture	Java based technology hosted on an AS with the Hibernate ORM persistence layer; uses Spring, ACEGI; libraries for pdf export, text search, indexing etc.		
collaboration model	asynchronous		
data backend	any database supported by Hibernate	high	recommended are MySQL or Oracle
extensibility	APIs for Java, PHP, Ruby and .NET	high	active developer community provides several add-ons
scalability		high	performance benchmark [29] conducted by Unisys
security	several authentication methods, authorization based on roles and group management, transport security based on application server underneath (e.g. SSL, TLS), authentication via LDAP or Active Directory	high	

Table 5.5: Alfresco - Overall System Properties

Criteria	Support	Grading	Comment
e-mail integration	yes	medium	until current version only interface to IMAP servers; major upgrade of e-mail capabilities and integration in the next release
synchronous discussion (chat)	no		may be extended in the near future
asynchronous discussion (forum)	yes	medium	simple web forum module which allows creation of new threads and topics
audio conferencing	no		
video conferencing	no		
project oriented organization	yes	medium	organization with independent spaces
task management	yes	medium	to-do lists and simple workflows are possible
calendar management	yes		supported as part of the project space
note management	yes	medium	via to-do-lists and built-in forum
file management	yes	high	Alfresco's major strength

resource planning	no		no reservation of rooms, cars etc. seen so far
address management	yes	low	other Alfresco users can be searched; but not valuable for external contacts
collaborative editing	yes	medium	no real simultaneous support, but sophisticated versioning of files and integration of wiki module
whiteboard	no		
shared presentation	no		
shared desktop	no		none in the traditional sense, although shared project and document space within Alfresco

Table 5.6: Alfresco - Application and Task Support

Criteria	Support	Grading	Comment
mobility	no		although web interface is accessible from any browser, there is no special mobile support, like optimized user interfaces for displays with low-resolution, export of personal calendar and contact data in a standardized format or similar
semantic capabilities	yes	medium	features for categorizing and tagging documents
easy information handling for end-users	yes	high	separation into different workspaces, aspect oriented use, clearly arranged UI
individual customization	yes	low	fully possible but mostly directly in source code
multiple access types	yes	medium	web interface, WebDAV, FTP, but no special mobile support
identity/user management	yes	high	supports the concepts of individual users, groups and roles

Table 5.7: Alfresco - Usage

5.3.2 BSCW - Basic Support for Cooperative Work

BSCW is a software package hosted on a webserver which basically offers document management capabilitites but furthermore also some groupware features like communication within a team, time schedules and task planning. It is selected for evaluation because of its wide distribution, especially in Central Europe, and its usage by TUV itself.

Name: BSCW - Basic Support for Cooperative Work
Vendor: OrbiTeam Software GmbH & Co. KG, Germany
Classification: Document Management System with some Groupware features
Webpage: `http://www.bscw.de/english/index.html`
Hosted Trial: `http://public.bscw.de/en/index.html`
Evaluation: official homepage, using installed system

Criteria	Support/Features	Grading	Comment
latest stable version	4.4.2		
overall development progress			
licensing	basically commercial; free educational licenses for schools and universities (without professional support)		distinguishing between purchase (licenses for 20, 100 or 1000 users)[5] and hosting by the vendor (pay per user)[6]
popularity	list of customers in Germany[7] and world-wide[8]	medium to high	highly used in Central Europe, especially in Germany
companies and organizations involved	Fraunhofer-Institut FIT, OrbiTeam (Germany)		list of further partners on the webpage[9]
support	installation support, training, help forum, FAQs	high	combined support contracts available[10]

Table 5.9: BSCW - Software Development and Organization

Criteria	Support/Features	Grading	Comment
additional software requirements	SMTP server, sendmail; Python		for e-mail capabilities
installation process	setup programs available	medium to high	webserver and Python[11] must be downloaded and installed separately before
supported platforms	OS: Windows, Unix (Solaris, Linux, HP-UX etc.) Webserver: Apache, MS IIS	high	hosting on Apache is recommended by vendor

Table 5.10: BSCW - System Prerequisites and Installation

Criteria	Support/Features	Grading	Comment
integration and supported interfaces	WebDAV, MS Outlook synchronization, XML-RPC	medium	for WebDAV Apache webserver has to be used; no further open standards/interfaces found
bandwidth requirements			
basic architecture	Python based technology, hosted on a webserver, own database backend		

[5] http://www.bscw.de/english/bscw_server.html
[6] http://www.bscw.de/english/bscw_hosting.html
[7] http://www.bscw.de/english/references_germany.html
[8] http://www.bscw.de/english/worldwide.html
[9] http://www.bscw.de/english/partner.html
[10] http://www.bscw.de/english/support.html
[11] http://www.python.org/

collaboration model	asynchronous		
data backend	own BSCW database server		no external standard database server; BSCW's solutions seems to be related to BerkeleyDB
extensibility			very limited; seems to have a monolithic structure
scalability			
security	SSL and LDAP support, Single Sign On, X.509 Certificates, role based access rights	high	

Table 5.11: BSCW - Overall System Properties

Criteria	**Support**	**Grading**	**Comment**
e-mail integration	no		no integration of e.g. IMAP mailboxes; but some e-mail features like notifications or daily reports; sending documents via e-mail directly from workspace
synchronous discussion (chat)	no		
asynchronous discussion (forum)	yes		threaded forums
audio conferencing	no		
video conferencing	no		
project oriented organization	yes		file management within different repositories; discussions, polls etc. placed in different folders
task management			
calendar management	yes	medium	simple personal time management tool with appointment functions
note management	yes		basic implementation for personal use; reminder service within the calendar module; integrated blog module
file management	yes	high	BSCWs major strength: file versioning, locking and archiving within a repository
resource planning			
address management	yes	medium	contact management within a group; import and export via vCard format
collaborative editing	no		only some simple mutual exclusive HTML editing
whiteboard	no		
shared presentation	no		
shared desktop	no		

Table 5.12: BSCW - Application and Task Support

Criteria	**Support**	**Grading**	**Comment**

mobility	yes	high	supports mobile devices such as PDAs and SmartPhones with WAP and mobile web browser interfaces
semantic capabilities	yes		document annotations, tagging mechanisms, indexing and meta-data handling for better search capabilities
easy information handling for end-users	yes	high	simple and well structured UI
individual customization			none found so far; maybe basic branding for larger companies
multiple access types	yes	high	basically web-based interface; for larger amounts of files dedicated client: BSCW Uploader[12], WebDAV
identity/user management	yes		sophisticated and extensible role management with rights inheritance

Table 5.13: BSCW - Usage

5.3.3 Plone CMS

Plone CMS is basically a leading content management system (CMS), which is used for hosting many popular webpages[13]. Due to its openness, modular structure and great community support, there are hundreds add-ons[14] available which may turn it into a full-featured groupware. The aim of this evaluation is to verify if this is generally possible. Plone CMS is selected for this study as an example of a widely-used and majored, but quite free product.

Name: Plone CMS
Vendor: Plone Foundation, USA
Classification: Content Management System (file management in the wide sense)
Webpage: `http://plone.org/`
Evaluation: official web page, several community pages

Criteria	Support/Features	Grading	Comment
latest stable version	Plone 3.0.6 (Feb 16, 2008)		
overall development progress	project start in 1999 version 1 in 2001 version 2 in 2004 current version 3 in 2007	high	steady development since nearly ten years with major releases approx. every three years and continuous minor releases every few weeks
licensing	GNU General Public License		
popularity	list of Plone users and contributers on webpage[15]	high	probably one of the most majored and distributed free software products in the field of web based content- and file management

[12] `http://www.bscw.de/english/bscw_upload_helper.html`
[13] `http://plone.net/sites`
[14] `http://plone.org/products/`
[15] `http://plone.net/providers`

companies and organizations involved	see above list		
support	overall community support (mailing lists, chats, forums)[16], many commercial companies offering training or customization; Plone conferences	high	great support also for large enterprises; often needed because of its wide variety of available add-ons

Table 5.15: Plone - Software Development and Organization

Criteria	**Support/Features**	**Grading**	**Comment**
additional software requirements	requires Zope 2.10.5 and Python 2.4.4 already installed		although there are install-packages including all required additional software
installation process	setup programs available	high	installers with or without required third party software; basic system relatively easy to install; add-ons aren't considered
supported platforms	OS: Linux, Windows, Mac OS X, FreeBSD, Solaris Webserver: Apache, IIS, Zope	high	

Table 5.16: Plone - System Prerequisites and Installation

Criteria	**Support/Features**	**Grading**	**Comment**
integration and supported interfaces	FTP, RSS, WebDAV		add-ons are developed in Python and integrated into the basic system; further interface support depends on used add-ons (e.g. communication with IMAP server for e-mail integration or file management via external SVN)
bandwidth requirements			
basic architecture	web based application; based on Zope[17]; implemented in Python		massively extensible, so software structure depends on used frameworks
collaboration model	basically asynchronous with some synchronous add-ons		Plone is basically a CMS, although some synchronous add-ons for communication purposes are available
data backend	Zope ZODB, most SQL-Databases	high	default is ZODB

[16] `http://plone.org/support`
[17] `http://www.zope.org/`

extensibility			massive extensibility with use of more than 700 free add-on tools
scalability	supports load balancing, caching (Squid[18]) for web content, ZEO (Zope Enterprise Objects)		information taken from FAQ[19]
security	SSL, authentication with LDAP or Active Directory	high	several add-ons available but not evaluated (e.g. for Kerberos support)

Table 5.17: Plone - Overall System Properties

Criteria	**Support**	**Grading**	**Comment**
e-mail integration	yes		via add-ons for accessing IMAP servers like mxm IMAP Client[20]
synchronous discussion (chat)	yes		via add-on like PloneChat[21]
asynchronous discussion (forum)	yes		via add-ons like zForum[22]; integrated blogs
audio conferencing	no		possible integration of Skype possible[23]
video conferencing	no		see above
project oriented organization	yes		dependent on used structure
task management	yes		also part of some add-ons for project management[24]
calendar management	yes		iCal support for instance via PloniCalendar[25]
note management	yes		not in the traditional sense but via blogs or similar
file management	yes	medium	add-ons for simple versioning support available[26], but far away from beeing as sophisticated as common CVS or SVN solutions. Thus extensions to enable Plone accessing SVN servers are available like Plone SVN Access[27].
resource planning	yes		via add-ons for booking definable items like PloneBooking[28]
address management	yes		also several add-ons (including vCard support) like Upfront Contacts[29]
collaborative editing	yes		via wiki
whiteboard	no		

[18] http://www.squid-cache.org/
[19] http://plone.org/documentation/faq/scalability
[20] http://plone.org/products/mxm-imap-client
[21] http://plone.org/products/plonechat
[22] http://plone.org/products/zforum
[23] http://plone.org/products/plone-skype
[24] http://plone.org/products/by-category/project
[25] http://plone.org/products/ploneicalendar
[26] http://plone.org/products/by-category/versioning-staging
[27] http://plone.org/products/plone-svn-access
[28] http://plone.org/products/plonebooking/?searchterm=booking
[29] http://plone.org/products/upfrontcontacts

shared presentation	no		
shared desktop	no		

Table 5.18: Plone - Application and Task Support

Criteria	Support	Grading	Comment
mobility	yes		WAP support
semantic capabilities	yes		us of meta-data; dependent on modules used
easy information handling for end-users	yes	high	easy-to-use web interface; but in detail also dependent on installed add-ons
individual customization	yes	high	due to many add-ons very extensible; web UI fully customizable
multiple access types	yes		web UI, FTP, WebDAV; offline support via several synchronization interfaces (dependent on used add-ons)
identity/user management	yes	high	sophisticated role management

Table 5.19: Plone - Usage

5.3.4 Microsoft Sharepoint

Microsoft Sharepoint unifies basically two different products: (1) Microsoft Windows Sharepoint Services (WSS), which is a technology framework for collaborative processes and (2) Microsoft Office Sharepoint Server (MOSS), which utilizes WSS and is designed to be a full-featured end-user product. In the latest version, Sharepoint 2007, many new features were included and some insufficiencies which avoid enterprise readiness, seems to be eliminated. The product is selected for further evaluation because of its wide distribution and interesting new features.

Name: Sharepoint Server
Vendor: Microsoft
Classification: Document Management System with some Groupware Features
Webpage: `http://www.microsoft.com/sharepoint/`
Evaluation: official webpage, Windows Sharepoint Services Evaluation Guide [17], several reports on IT portals

Criteria	Support/Features	Grading	Comment
latest stable version	2007 (December 2006)		
overall development progress	SharePoint Portal Server 2007 SharePoint Portal Server 2003 SharePoint Portal Server 2001	high	major release every two years with minor bugfixes and servicepacks in between; however between major releases the products are fully redeveloped and influenced by many other projects[30]
licensing	Microsoft EULA		end user license agreement[31]

[30] `http://www.joiningdots.net/blog/2006/08/sharepoint-history.html`
[31] `http://office.microsoft.com/en-us/products/HA102103171033.aspx`

popularity	widely used due to Microsofts popularity in the field of operating systems; customer stories and scenarios on webpage[32]	very high	
companies and organizations involved	Microsoft and commercial partners; free community of add-on developers		
support	free community[33] blogs, FAQs and tutorials; solution center[34]; several commercial support offers by Microsoft	high	

Table 5.21: Microsoft Sharepoint - Software Development and Organization

Criteria	**Support/Features**	**Grading**	**Comment**
additional software requirements	Internet Information Services (IIS), .NET Framework 2.0 and 3.0; Sharepoint Server 2007 requires Sharepoint Services 3.0; MS SQL Server 2000+		
installation process	setup programs available	high	partly integrated into operating system
supported platforms	server OS: Windows Server 2003, (Windows Server 2008) client: Level 1 Browsers (Internet Explorer 6 and 7 on Windows), Level 2 Browsers (Firefox, Mozilla, Netscape on Windows/Linux/MacOSX)	low	only Microsoft Server Families (Standard, Enterprise, DataCenter, WebEdition) supported; Level 2 Browser may work but are not recommended[35] by Microsoft

Table 5.22: Microsoft Sharepoint - System Prerequisites and Installation

Criteria	**Support/Features**	**Grading**	**Comment**
integration and supported interfaces	close integration with MS Office 2007 web services: SOAP feeds: RSS e-mail: SMTP/POP, IMAP data exchange: WebDAV, iCal, vCard	medium	integrates best (and most features only) with Microsoft family products

[32] http://www.microsoft.com/sharepoint/prodinfo/evidence.mspx
[33] http://sharepoint.microsoft.com/sharepoint/default.aspx
[34] http://support.microsoft.com/ph/11373
[35] http://office.microsoft.com/en-us/sharepointserver/HA101945391033.aspx

bandwidth requirements	farm deployment: 100 Mbps client to server: 56 Kbps		farm deployment is basically a distribution of particular system parts over several physical machines
basic architecture	Sharepoint Server runs on top of Sharepoint Services 3.0; modular architecture based on ASP.NET 2.0 and 3.0; MS SQL database as backend		
collaboration model	basically asynchronous with synchronous add-ons		synchronous features by use of MS Communicator which presence state is integrated into Sharepoint
data backend	Windows Internal Database, SQL Server 2000+; integration of other data sources via Business Data Catalog (BDC)[36]	low	Windows Internal Database for small installations; MS SQL Server recommended by vendor
extensibility	via web services powered by MS Sharepoint Services[37]; own Forms and Fields via Sharepoint Designer; event handlers; ASP.NET 2.0		extensible basically with Microsoft technology
scalability	load balancing by distributed SQL servers		several deployment scenarios possible due to modular architecture; designed for server farms with clustering support
security	transport security via SSL; pluggable AuthN (LDAP, Active Directory etc.); role-based access rights with granular access control (ACLs); single sign on		

Table 5.23: Microsoft Sharepoint - Overall System Properties

Criteria	**Support**	**Grading**	**Comment**
e-mail integration	yes		tight connection to MS Exchange Server; use of standard protocols for connection to other products
synchronous discussion (chat)	yes	high	integrated presence service shows availability for MS Communicator[38]
asynchronous discussion (forum)	yes		discussion boards
audio conferencing	yes	high	integrated presence service shows availability for MS Communicator
video conferencing	yes	high	integrated presence service shows availability for MS Communicator

[36] http://msdn2.microsoft.com/en-us/library/ms563661.aspx
[37] http://office.microsoft.com/en-us/sharepointtechnology/FX100503841033.aspx
[38] http://office.microsoft.com/en-us/communicator/default.aspx

project oriented organization	yes	high	by use of separated workspaces
task management	yes		task management synchronization with MS Outlook; workflows by use of Windows Workflow Foundation[39]
calendar management	yes		also synchronized with MS Outlook
note management	yes		
file management	yes	high	includes shared document spaces, check-in/out, versioning
resource planning	yes		as part of the calendar module
address management	yes		people and group lists
collaborative editing	yes		via integrated wiki
whiteboard	no		
shared presentation	no		
shared desktop			not part of this product but offered by the same vendor is Microsoft Windows Remote Assistence[40]

Table 5.24: Microsoft Sharepoint - Application and Task Support

Criteria	**Support**	**Grading**	**Comment**
mobility	yes		mobile-specific version of webpages; offline document library support in MS Office 2007
semantic capabilities	yes		can handly meta-data, advanced search capabilities
easy information handling for end-users	yes	high	through individual customization
individual customization	yes	high	via Sharepoint Designer and Masterpages for CMS; modular UI
multiple access types	yes		web interface; access via Outlook
identity/user management	yes	high	role- and group-based user management; account management in Active Directory (or others)

Table 5.25: Microsoft Sharepoint - Usage

5.3.5 Subversion

SVN is just one of many available revision control systems, although beside CVS currently the most popular one. Because the survey focuses products supporting widely accepted standards, Subversion (SVN) has been selected for evaluation, which includes the better part of features of the famous but already outdated concurrent versions system (CVS) [11] and extends them where needed.

Name: Subversion

Vendor: CollabNet, Inc.

Classification: File Management resp. Revision Control

[39] `http://msdn2.microsoft.com/en-us/netframework/aa663328.aspx`
[40] `http://support.microsoft.com/?scid=kb%3Ben-us%3B300546\&x=12\&y=8`

Webpage: http://subversion.tigris.org
http://www.collab.net

Evaluation: official homepage, experience using the software

Criteria	Support/Features	Grading	Comment
latest stable version	1.4.6 (December 21, 2007)		
overall development progress	infromation about release history on website[41]	high	approx. 4 to 5 versions a year
licensing	Subversion License		similar to Apache/BSD license
popularity		high	widely used in software development, but also common document management
companies and organizations involved	CollabNet		CollabNet is the major contributor
support	free[42] support by several mailing lists, community pages and user forums; commercial[43] support available as well; many printed books	high	

Table 5.27: Subversion - Software Development and Organization

Criteria	Support/Features	Grading	Comment
additional software requirements	Apache 2 webserver for WebDAV, Python		
installation process	built from source, binary releases from third party organizations	medium	binary relases are not officially endorsed or maintained by the vendor, thus system has to be built up from source code, or one of several third-party binary packages[44] is used
supported platforms	Unix, Win32, BeOS, OS/2, MacOS X (and others)	high	uses Apache Portable Runtime[45] library, as a portability layer, which is available on the mentioned platforms.

Table 5.28: Subversion - System Prerequisites and Installation

Criteria	Support/Features	Grading	Comment

[41] http://subversion.tigris.org/project_status.html
[42] http://subversion.tigris.org/links.html
[43] http://subversion.tigris.org/commercial-support.html
[44] http://subversion.tigris.org/project_packages.html
[45] http://apr.apache.org/

integration and supported interfaces	open SVN commands, WebDAV		
bandwidth requirements			depends on usage
basic architecture	client/server based		
collaboration model	asynchonrous		
data backend	native file system (fsfs), BerkeleyDB	medium	fsfs standard since version 1.2 SQL respoitory backend is a long-term goal[46]
extensibility	list of add-on scripts on homepage[47]		
scalability			possibility of repository mirroring
security	SSL		use of SSL is optional

Table 5.29: Subversion - Overall System Properties

Criteria	**Support**	**Grading**	**Comment**
e-mail integration	no		
synchronous discussion (chat)	no		
asynchronous discussion (forum)	no		
audio conferencing	no		
video conferencing	no		
project oriented organization	yes		use of separated repositories
task management	no		
calendar management	no		
note management	no		
file management	yes	very high	the main (and only) use of subversion: strong versioning, locking mechanisms, branching, merging etc.
resource planning	no		
address management	no		
collaborative editing	yes		for textfiles merging is possible
whiteboard	no		
shared presentation	no		
shared desktop	no		

Table 5.30: Subversion - Application and Task Support

Criteria	**Support**	**Grading**	**Comment**
mobility			no special mobile support but browser based access available

[46] `http://subversion.tigris.org/roadmap.html`
[47] `http://subversion.tigris.org/tools_contrib.html`

semantic capabilities			can handle meta-data
easy information handling for end-users	yes		basically easy to use once the concepts have been understood; further depends on used client software
individual customization			also depends on used client software
multiple access types	yes		via several clients, browsers via HTTP (and HTTPS), WebDAV/DeltaV
identity/user management	yes		centralized account management on server

Table 5.31: Subversion - Usage

5.4 Groupware Systems

5.4.1 Collanos Workplace

Collanos is a freely available peer-to-peer based groupware product, which needs no server and should therefore allow teams to work together ad-hoc without the need of centralized management. It is selected for evaluation because of its interesting approach and its rich feature list[48] including audio-/video conferencing. Typical customers are small companies or particular departments in large-scale enterprises.

Name: Collanos Workplace
Vendor: Collanos Software, offices in San Francisco and Zurich
Classification: P2P Groupware
Webpage: `http://www.collanos.com/`
Evaluation: official homepage

Criteria	Support/Features	Grading	Comment
latest stable version	1.2		
overall development progress	1.0beta in June 2006 1.0 in December 2006 1.1 in May 2007		
licensing	Freeware		core functionalities shall remain Freeware whereas for the near future some commercial services are announced
popularity	list of customers available on webpage[49]	low	basically mentioned in the media in USA and Switzerland[50] (where the headquarters are located)
companies and organizations involved	Collanos Software, translumina.net		

[48] However, there are similar tools based on the same frameworks available like `http://www.collaber.com` which contain more features like shared calendars, polls, integrated wikis or backup-tools, but no real-time audio-/video communication support

[49] `http://www.collanos.com/en/community/team_spotlight`

[50] `http://www.collanos.com/en/company/media`

support	official documentation, FAQ, user forum[51]		commercial support announced for the near future

Table 5.33: Collanos Workplace - Software Development and Organization

Criteria	Support/Features	Grading	Comment
additional software requirements	Java Runtime 1.5 or later		
installation process	setup programs available for different platforms	high	
supported platforms	Windows Vista, XP, W2K MAC OSX 10.4.2 and later Linux (Ubuntu, Suse, Fedora, Redhat tested by vendor)	high	

Table 5.34: Collanos Workplace - System Prerequisites and Installation

Criteria	Support/Features	Grading	Comment
integration and supported interfaces			
bandwidth requirements			probably highly dependent on network structure and team sizes
basic architecture	P2P software, Java based programs, JXTA[52] core component		seems to need a central server for member invitations because team members are registered by Collanos itself
collaboration model	asynchronous, synchronous		asynchronous features like note or task management synchronous features like discussions
data backend			files keep stored in local workplaces on every PC
extensibility	Collanos Phone		currently not much add-ons; comnpany plans to develop further components
scalability			
security	256-Bit AES		all transfered data is encrypted

Table 5.35: Collanos Workplace - Overall System Properties

[51] http://www.collanos.com/en/help/workplace
[52] http://www.jxta.org

Criteria	Support	Grading	Comment
e-mail integration	no		
synchronous discussion (chat)	yes		instant messaging between single users; team discussions (multi-user chats); XMPP based IM via Collanos Phone
asynchronous discussion (forum)	no		
audio conferencing	yes		enabled by Collanos Phone add-on via SIP protocol
video conferencing	yes		3-way conference calls via Collanos Phone
project oriented organization	yes	high	separation of workspaces
task management	yes	low	some kind of note management with additional meta-data; no workflow support or similar
calendar management	no		
note management	yes	high	notes can be placed in every workspace and subfolders; notifications supported
file management	yes	low	currently users can overwrite each others files. For the next releases some type of file versioning including locking mechanisms and check-in/out of files are announced.[53]
resource planning	no		
address management	no		registration and management of team members on central Collanos server
collaborative editing	no		Collanos recommends using an external wiki engine and posting links in respective workplaces
whiteboard	no		
shared presentation	no		
shared desktop	no		not in the traditional sense but synchronized workspaces which contain files, notes, tasks, links, discussions etc.

Table 5.36: Collanos Workplace - Application and Task Support

Criteria	Support	Grading	Comment
mobility	no		
semantic capabilities			
easy information handling for end-users	yes	high	easy to learn, easy to use because of its simple user interface and project oriented organization
individual customization	yes	medium to high	UI based on Eclipse Rich Client Platform[54]

[53] http://www.collanos.com/en/help/workplace/faq#label5_3
[54] http://wiki.eclipse.org/index.php/Rich_Client_Platform

multiple access types			by nature excellent offline support, because all files keep stored locally and are synchronized whenever you go online; as files are shared directly via the software, there are no other methods to access data than using Collanos Workplace itself (like web interface, third party lcients etc.)
identity/user management	yes		every user has to register itself at Collanos; resource access rights are managed by members themselves who decide which content they want to share

Table 5.37: Collanos Workplace - Usage

5.4.2 eGroupware

eGroupware is an example for one of many available groupware server solutions implemented in PHP running on top of a webserver. They have all a very similar behavior and typically similar strength and weaknesses, although some of them are more advanced than others. The eGroupware project is selected for evaluation because of its good language support, possible customization, broad functionality and availability of add-ons. Furthermore, it was well graded by the Linux Magazine [18]. It supports typical collaborative features like managing e-mails, appointments, todo-lists, contacts and very basic file management.

Name: eGroupware
Vendor: Open Source community driven[55]
Classification: Groupware
Webpage: `http://www.egroupware.org/Home?lang=en`
Hosted Trial: `http://egw-demo.stylite.de/currentversion/login.php`
Evaluation: official web site, hosted trial, several third party reports

Criteria	Support/Features	Grading	Comment
latest stable version	1.4 (May 2007)		
overall development progress	version 1.4 from May 2007, next version (1.6) in first half of 2008; SVN access to daily snapshot	low to medium	based on older roadmaps on the webpage approx. one new stable version a year;
licensing	GNU General Public License		
popularity	list of references[56] and success stories[57] available	medium	distributed mainly in Europe
companies and organizations involved	eGroupware community, Outdoor Unlimited Training, Metaways Infosystems, CWTech, Stylite		some IT companies located in Germany; no famous affiliates

[55] Current Project Admins are Ralf Becker, Miles Lott and Pim Snell; see `http://www.egroupware.org/contact`
[56] `http://www.egroupware.org/references`
[57] `http://www.egroupware.org/?category_id=101`

support	official documentation available; also printed versions Community Support via mailing lists, forums, IRC[58] Commercial support by German companies[59]	medium	all partners for commercial support are located in Germany

Table 5.39: eGroupware - Software Development and Organization

Criteria	Support/Features	Grading	Comment
additional software requirements			detailed platform requirements see below.
installation process	webserver and PHP installation, then eGroupware installation by using provided scripts	medium	basicyll easy installation, but dependent on used modules extensive configuration
supported platforms	OS: every OS running PHP and an appropriate webserver Webserver: tested are Apache, MS IIS, Roxen PHP: 4.3+ resp. 5.1+ recommended Database: MySQL, PostgreSQL, MaxDB, MSSQL, Oracle (not fully supported yet) Mailserver: several IMAP servers Browser: several like Firefox, Konqueror and Internet Explorer	high	recommended are the newest versions of PHP and MySQL

Table 5.40: eGroupware - System Prerequisites and Installation

Criteria	Support/Features	Grading	Comment
integration and supported interfaces	eGroupware web interface, XML-RPC, SOAP, SyncML, iCAL, IMAP, WebDAV	high	
bandwidth requirements			
basic architecture	runs on top of a PHP enabled webserver, database as storage, accessed by users via browsers or third party clients like MS Outlook		

[58] `http://www.egroupware.org/communitysupport`
[59] `http://www.egroupware.org/commercialsupport`

collaboration model	asynchronous		
data backend	MaxDB, MSSQL, MySQL, Oracle, PostgreSQL	low	recommended MySQL 5.0; all other supported DBs having problems with certain modules
extensibility		medium	many feature-rich modules already available, thus good customizability[60]
scalability			
security	account management via SQL and LDAP, rights management via ACLs for single users and groups, transport security dependent on webserver	medium	

Table 5.41: eGroupware - Overall System Properties

Criteria	**Support**	**Grading**	**Comment**
e-mail integration	yes	medium	connection to several IMAP servers, officially supported are Courier-IMAP, Cyrus-IMAP, UW-IMAP and MS Exchange IMAP access (5.5)
synchronous discussion (chat)	no		
asynchronous discussion (forum)	yes	medium	no forum in the traditional sense but some functions for putting comments on items and an FAQ based knowledge management is provided
audio conferencing	no		
video conferencing	no		
project oriented organization	yes	low	basic project manager, but no separated workplaces for different projects
task management	yes	medium	todo lists and tasks can be managed; basic workflows supported
calendar management	yes	high	well-integrated calendar module
note management	yes	medium	todo lists, knowledgebase, wikis
file management	yes	low	simple file sharing but no versioning support
resource planning	yes	medium	reservation for self-defined items (like meeting rooms); well-integrated into calendar module
address management	yes	medium	well-integrated; export as LDIF, CSV or VCard, administration via SQL or LDAP
collaborative editing	yes		wiki support
whiteboard	no		
shared presentation	no		
shared desktop	no		

Table 5.42: eGroupware - Application and Task Support

[60] `http://www.egroupware.org/applications`

Criteria	Support	Grading	Comment
mobility	yes	high	native web interface; furthermore, several synchronization capabilitites[61] like via SyncML; iCal export for mobile phones and PDAs
semantic capabilities	no		some categorization of items, but no real semantic features
easy information handling for end-users	yes	medium	basically easy to use although accessing all features via web UI is sometimes confusing due to too many options (e.g. resource planning)
individual customization	yes	medium	customizable via several add-ons and in source code directly
multiple access types	yes	high	offline support via several synchronization capabilities; access via web interface or favorite groupware client (Kontact, Evolution, Outlook), WebDAV; mobile support
identity/user management	yes	medium	supports concepts of single users and groups; rights management via ACLs

Table 5.43: eGroupware - Usage

5.4.3 Oracle Collaboration Suite

By releasing Oracle Collaboration Suite 10g, the three products Oracle Content Services, Oracle Real Time Collaboration and Oracle Unified Messaging were merged into one consistent package to provide support for all collaborative processes within a company. Although the three mentioned products are still available as stand alone packages, only the combination forms a full featured groupware solution. This product is selected for evaluation because of Oracle's popularity as one of the major software vendors and the spreading of Collaboration Suite primarily in large-scale organizations.

Name: Oracle Collaboration Suite
Vendor: Oracle Corporation, USA
Classification: Groupware: Commercial Enterprise Suite
Webpage: `http://www.oracle.com`
Evaluation: official homepage, review reports [8] and [4]

Criteria	Support/Features	Grading	Comment
latest stable version	10.1.2.4.2 (Feb. 2007)		
overall development progress	previous major releases: Oracle CS 10g R1 in July 2005 Oracle CS R2 in June 2003 Oracle CS R1 in July 2002		with minor releases between mentioned major versions and up-to-date bugfixes
licensing	commercial		

[61] `http://www.egroupware.org/sync`

popularity	list of customers on the website[62]	medium to high	although Oracle is well-known, the popularity of Collaboration Suite is not that high than e.g. Oracle's database engine
companies and organizations involved	Oracle, several technology partners, companies for training or hosting Oracle applications. see webpage[63]		
support	free web forum by Oracle[64], several possibilities for commercial support[65] and certified training programs	high	

Table 5.45: Oracle Collaboration Suite - Software Development and Organization

Criteria	Support/Features	Grading	Comment
additional software requirements	none		complete and fully setup-driven software package including database, web server, mail server and required frameworks provided by Oracle
installation process	setup programs available	medium to high	easy installation, but due the size of the product it takes extraordinary long compared to other products; some configuration effort
supported platforms	AIX, HP-UX, Linux, Microsoft Windows, Solaris	high	

Table 5.46: Oracle Collaboration Suite - System Prerequisites and Installation

Criteria	Support/Features	Grading	Comment
integration and supported interfaces	e-Mail usage: IMAP4, POP3, SMTP Real Time Communication: XMPP, SIP (over RTP), PBX Mobile Access: Push-IMAP, SyncML, VoiceXML[66], WAP File Access: FTP(S), WebDAV Others: RSS, Web Services, several Java SDKs		

[62] http://www.oracle.com/customers/products/collabsuite.html
[63] http://www.oracle.com/partners/index.html
[64] http://forums.oracle.com/forums/categoryHome.jspa?categoryID=84
[65] http://www.oracle.com/support/index.html
[66] http://en.wikipedia.org/wiki/VoiceXML

bandwidth requirements			depends on used modules and services
basic architecture	based on Oracle Database and Application Server; web based interfaces and dedicated clients for several features (like IM)		detailed structure depends on used modules and services
collaboration model	synchronous, asynchronous		
data backend	Oracle 10g Database		
extensibility	Java API SDK, Web Services API [67]		APIs for developing further add-ons or integrating products into existing environment
scalability	multithreading, caching, replication, load balancing	high	in all modules of Collaboration Suite care has been taken to support massive scalability by using well-known techniques. details in respective technical papers[68]
security	SSL/TLS (HTTPS), Single Sign On, SASL	high	encryption of all data traffic possible (several documents concerning application security and configuration available); several common user authentication methods

Table 5.47: Oracle Collaboration Suite - Overall System Properties

Criteria	**Support**	**Grading**	**Comment**
e-mail integration	yes	high	via integrated Oracle Mail[69];
synchronous discussion (chat)	yes	high	via integrated Oracle Real Time Collaboration[70]
asynchronous discussion (forum)	yes	high	via integrated Oracle Discussions[71]
audio conferencing	yes	high	via integrated Oracle Real Time Collaboration; incorporates standard telephones via PBX[72]
video conferencing	yes	high	via integrated Oracle Real Time Collaboration
project oriented organization	yes	high	via Oracle Workspaces[73]
task management	yes		via Oracle Workspaces
calendar management	yes	high	via integrated Oracle Calendar[74]
note management			not applicable; assumable that it will be part of Oracle Workspaces

[67] http://www.oracle.com/pls/cs101/portal.portal_cs?selected=5
[68] http://www.oracle.com/technology/products/cs/index.html
[69] http://www.oracle.com/technology/products/oemail/index.html
[70] http://www.oracle.com/collabsuite/rtc.html
[71] http://www.oracle.com/technology/products/odiscussions/index.html
[72] http://en.wikipedia.org/wiki/Private_branch_exchange
[73] http://www.oracle.com/collabsuite/workspaces.html
[74] http://www.oracle.com/technology/products/ocal/index.html

file management	yes	high	as part of Oracle Content Services[75]; support versioning, worklfows, free text search (including meta-data of files)
resource planning	yes	high	as part of Oracle Calendar, which allows reservation of shared resources
address management	yes		as part of the communications and e-mail module
collaborative editing			not applicable; maybe via shared desktop or similar
whiteboard	yes		by sharing the desktop or only a particular application with Oracle Web Conferencing
shared presentation	yes		by sharing the desktop or only a particular application with Oracle Web Conferencing
shared desktop	yes	high	via Oracle Web Conferencing as part of Oracle Real Time Collaboration module; sharing of single applications or the whole desktop is possible

Table 5.48: Oracle Collaboration Suite - Application and Task Support

Criteria	**Support**	**Grading**	**Comment**
mobility	yes	high	Browser based access with optimization for small displays; e-mail via P-IMAP; calendar and contacts can by synchronized over SyncML or similar; further mobile access via short text commands (SMS, e-mail) or voice control. For details see technical white paper from Oracle[76].
semantic capabilities			
easy information handling for end-users			
individual customization			
multiple access types	yes	high	Browser-based access; access with favored PIM[77]; several mobile access methods
identity/user management	yes	high	role based access control

Table 5.49: Oracle Collaboration Suite - Usage

5.4.4 Simple Groupware

Simple Groupware is, against its name, another feature-rich open source groupware systems in the traditional sense. Like others it is completely based on common open source products like PHP and MySQL and well maintained with releases every few weeks. Although not the popular one, it is selected for evaluation because of its high use of open standards, good integration of

[75] `http://www.oracle.com/collabsuite/content-services.html`
[76] `http://www.oracle.com/technology/products/owireless/pdfs/10gR1_Mobile_Collaboration_TWP.pdf`
[77] Personal Information Manager like Outlook

common services (e-mail, file server, etc.) and interesting features; also honored by the Linux Magazine [18].

Name:	Simple Groupware
Vendor:	Simple Groupware Solutions Thomas Bley, Germany
Classification:	Groupware
Webpage:	`http://www.simple-groupware.de`
Evaluation:	official webpage, Linux Magazine [18]

Criteria	Support/Features	Grading	Comment
latest stable version	0.321 in January 2008		
overall development progress	v0.1 in December 2004 v0.2 in April 2006 (after a couple of beta versions)	high	minor releases every few weeks. see homepage[78]
licensing	GNU GPLv2		
popularity		low	seems to be low, because only some press articles found[79]; no success stories on official homepage
companies and organizations involved	Simple Groupware Solutions Thomas Bley		
support	official documentation[80], user forum on homepage, support e-mail address	low	no commercial support contracts available

Table 5.51: Simple Groupware - Software Development and Organization

Criteria	Support/Features	Grading	Comment
additional software requirements	PHP 5.1.x and higher on Server; JRE for optional Groupware Client		
installation process	installation scripts for server	high	no installation on Client needed (basically Browser access)

[78] `http://www.simple-groupware.de/cms/`
[79] `http://www.simple-groupware.de/cms/Main/Press`
[80] `http://www.simple-groupware.de/cms/Main/Documentation`

supported platforms	OS: Linux, Windows, Solaris, FreeBSD, MacOS, etc. Database: at least MySQL 5, PostgreSQL 8.1, Oracle 9.2 Webserer: Apache 1.3.x or 2.x and higher, IIS 5.1 and higher Client Browser: Firefox 1.x and higher, Opera 7.5 and higher, Safari 2.x, Internet Explorer 6.0 and higher	high	

Table 5.52: Simple Groupware - System Prerequisites and Installation

Criteria	**Support/Features**	**Grading**	**Comment**
integration and supported interfaces	Services: LDAP, WebDAV, SyncML etc. Data Handlers[81]: IMAP, SMTP, POP3, iCalendar, RSS, vCard, XML, CSV, LDIF, CIFS, Firefox Bookmarks etc. Data Export[82]: HTML, CSV, XML, RSS, iCalendar, vCard, LDIF, Spreadsheet (OpenOffice Spreadsheet / MS-Excel), Text document (OpenOffice Writer / MS-Word)	high	service communication via mount points
bandwidth requirements			
basic architecture	implemented in PHP, hosted on a webserver, accessed via Browser or dedicated clients		
collaboration model	asynchronous, synchronous		
data backend	MySQL, Oracle, PostgreSQL	medium	
extensibility	many open standards, sgsML[83]		already many features provided; own sgsML language for faster development of new module; completely open source thus extensions and adaptations directly in code is possible too

[81] `http://www.simple-groupware.de/cms/Main/DataHandlers`
[82] `http://www.simple-groupware.de/cms/Main/DataExport`
[83] Simple Groupware Solutions Markup Language

scalability			PHP based, so should be basically as scalable as any other product using this framework (resp. the whole LAMP[84] stack)
security	SSL/TLS; authentication with LDAP, Active Directory, NTLM, extensible by using authentication API	high	

Table 5.53: Simple Groupware - Overall System Properties

Criteria	**Support**	**Grading**	**Comment**
e-mail integration	yes	high	using either IMAP, POP3 or SMTP
synchronous discussion (chat)	yes	medium	chat rooms
asynchronous discussion (forum)	yes	medium	threaded forum
audio conferencing	no		integration of Skype, but only contact data
video conferencing	no		see above
project oriented organization			
task management	yes	medium	including GANTT view; synchronization with Outlook; no workflow engine found but planned for the future[85]
calendar management	yes	high	sophisticated module with support for private, public and team calendars, supports open standards for importing/exporting data from/to other applications
note management	yes		
file management	yes	medium	basic file versioning support including locking mechanism; access to file servers like Samba, Windows or NetApp from within Simple Groupware; ability of previewing office files, images and archives without downloading
resource planning	yes		via the inventory module
address management	yes		contact information can be imported from several sources including Outlook, Skype, Windows Mobile and LDAP or Active Directory
collaborative editing	no		no real collaborative editing but Spreadsheet module integrated in the platform; basic file versioning
whiteboard	no		
shared presentation	no		
shared desktop	no		

Table 5.54: Simple Groupware - Application and Task Support

[84] http://en.wikipedia.org/wiki/LAMP_(software_bundle)
[85] http://www.simple-groupware.de/cms/Main/Features

Criteria	Support	Grading	Comment
mobility	yes		synchronization of e-mails, contacts and calendar data using SyncML
semantic capabilities	yes		supports custom meta-data for all kind of file types; automatic indexing of stored files for advanced search capabilities
easy information handling for end-users	yes	medium to high	modules arranged as tree view, thus excellent hierarchical overview, although some modules seem to be feature overloaded; good support for meta data handling and possibility of highlighting or annotating items
individual customization	yes	high	theme support
multiple access types	yes	high	Browser based access from anywhere; standalone Java based client to use all Simple Groupware contents offline on the Desktop or any Windows Mobile phone; for offline use SynchML compatible clients (Outlook, Thunderbird, etc.)
identity/user management	yes		rights management for single users and groups; account management via LDAP, Active Directory and others

Table 5.55: Simple Groupware - Usage

5.5 Real-time Offices

5.5.1 CoOffice

CoOffice is a product developed to demonstrate research results of the Nanyang Technological University[86]. Currently it is a set of tools which add real-time editing features to the common office tools MS Word and MS Powerpoint. Similar to Microsoft Groove[87] it allows real synchronous editing and people working on the same files. As this software is currently in an early development stage, many new features like a web interface and better file management are announced for the next release, thus cannot be taken into account in this study. CoOffice is selected for evaluation because of its quick and small installation, easy handling and free availability combined with its major expected strength of real-time text document editing.

Name: CoOffice
Vendor: Prof. Chengzheng Sun, Nanyang Technological University, Singapore
Classification: Real-time add-on for traditional MS Office
Webpage: `http://cooffice.ntu.edu.sg/coword/`
Evaluation: official homepage, installing and using the software

Criteria	Support/Features	Grading	Comment
latest stable version	1.0		

[86] `http://cooffice.ntu.edu.sg/coword/research.html`
[87] `http://grv.microsoft.com/default.htm`

overall development progress	next release announced for early 2008 1.0 in May 2007		
licensing	Free for public use		
popularity		very low	because CoWord is currently more a technical demonstration than a full-featured end-user product
companies and organizations involved	School of Computer Engineering, Nanyang Technological University		
support	FAQ on webpage, user forum[88]	low	

Table 5.57: CoOffice - Software Development and Organization

Criteria	**Support/Features**	**Grading**	**Comment**
additional software requirements	none		
installation process	setup programs available	high	
supported platforms	OS: Windows MS Word: 2000, XP, 2003 MS Powerpoint: 2000		as this is an add-on for MS Office, it will obviously only run under Windows

Table 5.58: CoOffice - System Prerequisites and Installation

Criteria	**Support/Features**	**Grading**	**Comment**
integration and supported interfaces	fully integrates in MS Word and Powerpoint; no open interfaces, no open standard/protocols	low	the basic framework is available for building own real-time collaboration applications
bandwidth requirements			
basic architecture	client/server structure with a proprietary file repository and synchronization server		central server repository for file management; MS Office and additional clients on every user PC
collaboration model	synchronous		
data backend	proprietary file repository	low	
extensibility			this product is an extension for MS Word itself
scalability			basically only a small amount of users work concurrently on the same document

[88] `http://cooffice.ntu.edu.sg:10025/forum/`

security	password secured server repository, special version for VPN[89]	low	no further information applicable; probably no further security features (like transport encryption), but special server version for VPN available

Table 5.59: CoOffice - Overall System Properties

Criteria	Support	Grading	Comment
e-mail integration	no		
synchronous discussion (chat)	no		
asynchronous discussion (forum)	no		
audio conferencing	no		
video conferencing	no		
project oriented organization	no		
task management	no		
calendar management	no		
note management	no		
file management	yes	low	collaborative document repository browser for sharing files to edit, uses MS Word's versioning mechanism
resource planning	no		
address management	no		
collaborative editing	yes	medium	this is the main feature of CoOffice; however some editing functions currently suffer from limited support[90]
whiteboard	yes	low	via CoPowerpoint
shared presentation	yes	low	via CoPowerPoint
shared desktop	no		

Table 5.60: CoOffice - Application and Task Support

Criteria	Support	Grading	Comment
mobility	no		
semantic capabilities	no		
easy information handling for end-users	yes	high	every user who is familiar with MS Word can use this tool easily
individual customization	no		not useful for this kind of tool
multiple access types	no		
identity/user management	no		unfortunately everyone who has access to the collaboration server may edit all documents

Table 5.61: CoOffice - Usage

[89] `http://cooffice.ntu.edu.sg/coword/FAQ.html`
[90] `http://cooffice.ntu.edu.sg/coword/CoWord%20Features.htm`

5.5.2 Google Docs

Google Docs is a free and web-based application offering typical office features like word processor, spreadsheet, and presentation application. Several other applications offered by Google, commonly known as Google Apps[91] (Google Talk, Google Calendar, GMail, etc.) can be integrated or can be connected in valuable ways with Google Docs. This software is evaluated as one of the more famous examples for the continuously emerging market of hosted online applications.

Name:	Google Docs (with additional Google Apps)
Vendor:	Google Inc., USA
Classification:	Online Office and Collaboration Software
Webpage:	`http://docs.google.com`
Evaluation:	using the service, Google homepage, third party articles

Criteria	Support/Features	Grading	Comment
latest stable version	beta	low	development progress is high but software still in an early phase
overall development progress	first public release 2006 since then continuously evolving	high	application under heavy development, thus currently suffering from several limitations (file sizes, number of files, file organization, compatibility to other office programs etc.)
licensing	proprietary		service is free to use
popularity		medium	while Google's popularity is quite unquestioned, Google Docs isn't as widely distributed.
companies and organizations involved	Google Inc.		
support	free support via a wide variety of forums, blogs and online documentation; premier package of Google Apps with 24/7 phone support	high	Google seems to be interested pushing the service thus providing valuable support resources

Table 5.63: Google Docs - Software Development and Organization

Criteria	Support/Features	Grading	Comment
additional software requirements	supported Browser on the client side		
installation process	fast online registration	very high	
supported platforms	Client Browser: Internet Explorer 6+, Firefox 1.07+, Mozilla 1.712+, Netscape 7.2+	high	Browser with enabled JavaScript and Cookies

[91] `http://www.google.com/a`

Table 5.64: Google Docs - System Prerequisites and Installation

Criteria	Support/Features	Grading	Comment
integration and supported interfaces	integration with many other Google services; open web interfaces		
bandwidth requirements			
basic architecture	fully online hosted services		
collaboration model	synchronous and asynchronous		
data backend			unknown, maintained by Google; not relevant for the user
extensibility	integration of Google Apps		
scalability			systems maintained by Google thus unknown
security	optional SSL (HTTPS), no extended rights management for sharing documents	medium	default is HTTP only; some sources express security concerns according to cross site scripting[92]

Table 5.65: Google Docs - Overall System Properties

Criteria	Support	Grading	Comment
e-mail integration	yes		via attachement import/export in Gmail[93]
synchronous discussion (chat)	yes	low	chat window when users are editing same files (currently only for spreadsheets, not for text documents)
asynchronous discussion (forum)	yes	high	possible by using Google Groups[94], but not directly integrated into the platform
audio conferencing	yes	medium	using Google Talk[95]; not directly integrated
video conferencing	yes	medium	see above.
project oriented organization	no		some basic organization of documents in folders, although no real separation of contacts, calendar or similar (except using different accounts for every project)
task management	no		
calendar management	yes		part of Google Apps (Google Calendar)
note management	no		
file management	yes	low to medium	basic versioning in Apps; online file management
resource planning	no		

[92] http://en.wikipedia.org/wiki/Cross-site_scripting
[93] http://mail.google.com
[94] http://groups.google.com/
[95] http://www.google.com/talk

address management	yes	low	Google contacts can be managed for simple invitations to join document editing
collaborative editing	yes	high	editing the same document at the same time
whiteboard	no		but collaborative editing of presentations may serve as whiteboard
shared presentation	yes	medium	as part of the presentation application other Google Docs users can be invited to join; early version, so no animations yet
shared desktop	no		

Table 5.66: Google Docs - Application and Task Support

Criteria	**Support**	**Grading**	**Comment**
mobility	yes	low	documents can be read on Windows Mobile, Blackberry and Apple iPhone/iPod touch devices[96]; may be improved in the future
semantic capabilities	yes		some sort of tagging support for documents
easy information handling for end-users	yes	high	handling is similar to common office products
individual customization			also dependent on used Google Apps
multiple access types	yes	medium	service can be accessed from any PC with a compatible Browser; limited support for mobile devices; offline access is not available but currently discussed[97]
identity/user management	yes	low	only with simple invitations for readers or collaborators; no further role or access rights management

Table 5.67: Google Docs - Usage

5.6 Real-time Audio, Video and Data Collaboration Systems

5.6.1 Coccinella

Coccinella is one of many[98] XMPP[99] enabled instant messaging clients (also known as Jabber clients) currently available. It is exemplarily selected for evaluation due to its use of open standards, available multi-platform versions, file transfer capabilities and mainly its whiteboard feature.

Name: Coccinella
Vendor: Open Source community driven
Classification: Instant Messenger
Webpage: `http://thecoccinella.org`

[96] `http://googledocs.blogspot.com/2007/10/docs-on-go.html`
[97] `http://blogoscoped.com/archive/2008-01-28-n40.html`
[98] `http://en.wikipedia.org/wiki/Comparison_of_instant_messaging_clients`
[99] `http://en.wikipedia.org/wiki/Extensible_Messaging_and_Presence_Protocol`

Evaluation: official web site

Criteria	Support/Features	Grading	Comment
latest stable version	0.96.4.1 (January 9, 2008)		
overall development progress			
licensing	GPLv3		
popularity			popularity of especially Coccinella seems to be low due to the availability of many other IM clients; although use of Jabber clients seems to increase currently
companies and organizations involved	Coccinella Team[100]		
support	user forum, some documentation for developers		as this is simple software normally no detailed documentation is needed

Table 5.69: Coccinella - Software Development and Organization

Criteria	Support/Features	Grading	Comment
additional software requirements	Tcl/Tk[101]		needed to compile; not for precompiled packages
installation process	setup programs available for Windows, Linux and Mac	high	can be compiled from source on other platforms supporting Tcl/Tk
supported platforms	Windows, Linux, Mac OS X 10.2+	high	

Table 5.70: Coccinella - System Prerequisites and Installation

Criteria	Support/Features	Grading	Comment
integration and supported interfaces	XMPP, SIP		
bandwidth requirements			based on network structure
basic architecture	client application for Jabber network		
collaboration model	synchronous		
data backend			no data backend needed
extensibility			

[100] `http://thecoccinella.org/people`
[101] `http://tcl.activestate.com/`

scalability			dependent on used Jabber network
security	SSL/TLS, SASL		

Table 5.71: Coccinella - Overall System Properties

Criteria	Support	Grading	Comment
e-mail integration	no		
synchronous discussion (chat)	yes	high	
asynchronous discussion (forum)	no		
audio conferencing	yes	low to medium	via Jingle[102] with AIX support[103] (currently only beta)
video conferencing	no		
project oriented organization			contacts can be organized in separated lists
task management	no		
calendar management	no		
note management	no		
file management	no		simple file transfers possible
resource planning	no		
address management	yes		contact information availabel as vCards
collaborative editing	no		
whiteboard	yes		shared brushing areas; some preliminary SVG support
shared presentation	no		
shared desktop	no		

Table 5.72: Coccinella - Application and Task Support

Criteria	Support	Grading	Comment
mobility	no		no explicit Coccinella mobile edition, but may compile on mobile platforms if Tcl/Tk is supported
semantic capabilities	no		
easy information handling for end-users	yes	high	common behavior as any other IM
individual customization	yes		skinable
multiple access types			yes, in the wide sense: as Coccinella utilizes the Jabber network, this can be accessed also without installing standalone clients by using web-based solutions[104]
identity/user management	yes		via contact lists

[102] `http://www.xmpp.org/extensions/xep-0166.html`
[103] `http://www.xmpp.org/extensions/xep-0179.html`
[104] `http://jwchat.org/`

Table 5.73: Coccinella - Usage

5.6.2 Skype

Skype is currently ***the*** VoIP software for private and also commercial use. It features a sophisticated synchronous messaging support, either by text, audio or high-res video and is further capable of multi-user video-conferencing. It is selected for evaluation due to its publicity, widely distribution and easy handling.

Name:	Skype
Vendor:	Skype Technologies SA (Subsidiary of eBay Inc.), Luxembourg
Classification:	Real Time Audio-/Video Communication Software
Webpage:	`http://www.skype.com`
Evaluation:	official homepage, using the full-featured software

Criteria	Support/Features	Grading	Comment
latest stable version	3.6.0.248 (Windows) 2.7.0.257 (Mac OS X) 1.4.0.118 (Linux x86) 2.2.0.36 (Windows Mobile)		all major operating systems are supported, but certain (mostly newer) features are only available for Windows
overall development progress		high	fast development and introducing new features quickly (especially in the Windows version) made Skype the market leader
licensing	Freeware (with some commercial features like SMS, calls to public telephone network etc.)[105]		terms and policies to the different areas of operation can be found on the webpage[106]
popularity	some case studies on the webpage[107]	very high	currently the most popular VoIP (video-)chat software available; widely distributed
companies and organizations involved	eBay Inc., Skype Technologies SA		Skype became a subsidiary of eBay in Oct 2005.
support	user guides, knowledge base, troubleshooter, user forums [108]	high	for this easy-to-use software normally no continuous support is needed; possibly help is needed for setting up in secured environments, although Skype is famous for handling most such situations on its own.

Table 5.75: Skype - Software Development and Organization

[105] `http://www.skype.com/intl/en/prices/`
[106] `http://www.skype.com/intl/en/legal/`
[107] `http://www.skype.com/intl/en/business/casestudies/`
[108] `http://support.skype.com/`

Criteria	Support/Features	Grading	Comment
additional software requirements	none		
installation process	setup programs available	high	MSI for Windows for easy distribution in larger IT environments
supported platforms	Windows, Linux x86, Mac OS X, Windows Mobile; Nokia N800/N810, SkypePhone	high	

Table 5.76: Skype - System Prerequisites and Installation

Criteria	Support/Features	Grading	Comment
integration and supported interfaces	integrates with common anti-virus software and firewalls; can integrate outlook contacts	low	sometimes Skype itself is integrated by other software products
bandwidth requirements		medium to high	dependent on features used (textual instant messaging, audio chat, video conferencing)
basic architecture	peer-to-peer software with dynamically elected super nodes; uses proprietary closed communication protocol		
collaboration model	synchronous		
data backend	none on client side		
extensibility		medium	several third-party add-ons like Skype Recorder or Skype Answer Machine [109]
scalability		high	distributed p2p structure; it was reported that there were more than 12 million concurrent users online in February 2008[110]
security	RSA for key negotiation, AES to encrypt conversations	high	some criticism because of the closed protocol

Table 5.77: Skype - Overall System Properties

Criteria	Support	Grading	Comment
e-mail integration	no		
synchronous discussion (chat)	yes	high	instant messaging, group chats, public chats

[109] `http://www.powergramo.com/`
[110] `http://www.glimfeather.com/borderless/OnlineNow.htm`

asynchronous discussion (forum)	no		
audio conferencing	yes	high	Skype's major strength: Skype-to-Skype, call phones and mobiles, call forwarding, call transfer, conferences; see feature list on webpage for details[111]
video conferencing	yes	high	video calls, video conferencing
project oriented organization	no		
task management	no		
calendar management	no		
note management	yes	medium	not in the traditional way, but via Skype VoiceMail
file management	yes	low	files can be exchanged over network
resource planning	no		
address management	yes	medium	contact management; can use MS Outlook contact list
collaborative editing	no		
whiteboard	no		
shared presentation	no		
shared desktop	no		

Table 5.78: Skype - Application and Task Support

Criteria	**Support**	**Grading**	**Comment**
mobility	yes	medium	edition for Windows Mobile; also support for some Nokia devices
semantic capabilities	no		no such capabilities as Skype is primarily an audio-/video-communication tool
easy information handling for end-users	yes	high	easy-to-use simple UI
individual customization	yes	medium	some type of skinning
multiple access types	yes	medium to high	can be accessed via every standard PC on which the software is installed, but also by some mobile devices like larger phones or PDAs featuring Windows Mobile; of course there is no browser based access as this makes no sense for most of Skype's features
identity/user management	yes	medium	contact list management, closed user groups possible; no LDAP interface, but outdated third-party Skype intranet server edition[112]

Table 5.79: Skype - Usage

[111] http://www.skype.com/allfeatures/
[112] http://www.exformatics.com/koncepter/intranet-skype/index.html

5.7 Wiki based Systems

5.7.1 MediaWiki

MediaWiki is the most popular web-based wiki software application which serves the projects of the Wikimedia Foundation, including the well-known Wikipedia Encyclopedia, where it is widely used by many concurrent users in a high scalable environment. We also select MediaWiki for evaluation, because today it is furthermore deployed by large-scale enterprises (like Novell[113]) as an internal knowledge management solution or as a content management system.

Name:	MediaWiki
Vendor:	Wikimedia Foundation
Classification:	Wiki Engine
Webpage:	`http://www.mediawiki.org`
Evaluation:	official homepage, experience with the software, wikipedia, wikimatrix [6]

Criteria	Support/Features	Grading	Comment
latest stable version	1.11.1 (Jan. 2008)		
overall development progress	eleven major releases[114] until now 1.11 in Sept. 2007 1.1 in Dec 2003	high	approximately two to three major releases a year with minor updates in between
licensing	GNU General Public License		
popularity		very high	provides the basics to the wikipedia encyclopedia
companies and organizations involved	Wikimedia Foundation		
support	community support via support desk[115]: handbook, FAQ, forum, technical references etc. commercial third-party support[116] including training, hosting, customizing etc.	medium	no printed documentation, no commercial support from Wikimedia Foundation itself

Table 5.81: MediaWiki - Software Development and Organization

Criteria	Support/Features	Grading	Comment
additional software requirements	PHP, database		
installation process	script based installation and configuration	medium	

[113] `http://developer.novell.com`
[114] `http://en.wikipedia.org/wiki/MediaWiki`
[115] `http://www.mediawiki.org/wiki/Project:Support_desk`
[116] `http://www.wikimatrix.org/consultants/MediaWiki`

supported platforms	OS: Windows, Linux, Mac OS X Webserver: any with PHP support	high	mostly recommended webserver: Apache, IIS

Table 5.82: MediaWiki - System Prerequisites and Installation

Criteria	Support/Features	Grading	Comment
integration and supported interfaces	export: Raw, HTML, XML, PDF (optional) feeds: RSS, Atom	medium	many extensions for integrating particular content (Adobe Flash, YouTube etc.)
bandwidth requirements	basically low, because no real-time communication or massive web interface		but still depends on used features and add-ons
basic architecture	implemented in PHP runs on top of a webserver; SQL database backend		
collaboration model	basically asynchronous, but is able to resolve synchronous (concurrent) changes		
data backend	MySQL, PostgreSQL, Oracle	medium	basically MySQL, but PostgreSQL (8.1 or better) can be fully used since version 1.8; Oracle support currently dropped
extensibility	extensible via callback functions (hooks) without the need to modify the core code	high	nearly 1000 extensions listed on mediawiki webpage[117]; many examples and specific solutions due to a huge and active community
scalability	distribution, database replication, caching	high	used successfully in wikipedia encyclopedia
security	transport encryption: SSL, TLS authentication: HTTPAuth, LDAP[118], Active Directory, SSL Certificate, Kerberos and others; Single Sign On extensions	high	several well-maintained third-party authentication extensions available; security wiki[119] provides further information

Table 5.83: MediaWiki - Overall System Properties

Criteria	Support	Grading	Comment
e-mail integration	no		no reading or writing of e-mails; only some notification mechanisms when pages are changed
synchronous discussion (chat)	no		

[117] http://www.mediawiki.org/w/index.php?title=Category:All_extensions\&
[118] http://www.mediawiki.org/wiki/Extension:LDAP_Authentication
[119] http://www.mediawiki.org/wiki/Manual:Security

asynchronous discussion (forum)	yes	medium	basic threaded discussions attached to every wiki
audio conferencing	no		
video conferencing	no		
project oriented organization	yes	high	by using different wikis; furthermore, namespaces are supported
task management	no		
calendar management	no		
note management			not explicitly, but wiki itself can be used for publishing notes
file management	yes	medium	wikis are well versioned with merging support if concurrently edited; attachments are supported, but no traditional file management like shared folders or similar
resource planning	no		
address management	no		
collaborative editing	yes	high	synchronous editing with conflict resolution[120]
whiteboard	no		
shared presentation	no		
shared desktop	no		

Table 5.84: MediaWiki - Application and Task Support

Criteria	**Support**	**Grading**	**Comment**
mobility	no		although browser based, there is no special mobiel support
semantic capabilities	yes		tagging, relations, attributes, RDF via SemanticWiki add-on[121]
easy information handling for end-users	yes	medium	basically easy to use editing software, once the basic wiki language has been understood, but no integrated WYSIWYG editor[122]; learning the markup language may be an initial barrier dependent on user experience
individual customization	yes	high	via custom stylesheets and client-side JavaScript
multiple access types	no		no mobile support, no offline support
identity/user management	yes	medium	various authentication methods; authentication role- and group based user management; no Access Control Lists for particular namespaces (like other wikis have)

Table 5.85: MediaWiki - Usage

[120] http://en.wikipedia.org/wiki/Wikipedia:Technical_FAQ
[121] http://semantic-mediawiki.org/wiki/Semantic_MediaWiki
[122] http://www.mediawiki.org/wiki/WYSIWYG_editor

5.7.2 Mindtouch DekiWiki

Mindtouch is a company focusing enterprise needs related to wiki engines, like sophisticated rights management, easy and secure administration and web service interface for integration in existing IT environments and for easy customization to specific needs. Originally based on the famous MediaWiki it has become an independent project utilizing an exiting new service based architecture.

Name:	DekiWiki
Vendor:	MindTouch, Inc.
Classification:	Wiki Engine
Webpage:	`http://wiki.mindtouch.com`
Evaluation:	official homepage, wikimatrix [6]

Criteria	Support/Features	Grading	Comment
latest stable version	Hayes++ (Jan. 2008)		
overall development progress	fork of MediaWiki first version "Gooseberry" in July 2006, successor "Hayes" in July 2007		
licensing	GPL, partly LGPL		
popularity		medium to high	some high profile customers (including heavy weights like Microsoft, Fujitsu, British Petroleum, Stanford University, and Mozilla). list of success stories on webpage[123]
companies and organizations involved	Mindtouch, open source community[124]		
support	free community support; commercial support[125] includes training, e-mail real-time chat;	high	

Table 5.87: DekiWiki - Software Development and Organization

Criteria	Support/Features	Grading	Comment
additional software requirements	PHP, Mono[126] or .NET, database		
installation process	scripted installation; VMWare certified images	high	very easy when using VMWare images
supported platforms	OS: Windows, Linux, BSD, MAC OS X Webserver: Apache	medium to high	

[123] `http://wiki.mindtouch.com/Case_Studies`
[124] `http://wiki.opengarden.org/`
[125] `http://wiki.mindtouch.com/Deki_Wiki/Product_Support_Pricing`
[126] `http://www.mono-project.com/Main_Page`

Table 5.88: DekiWiki - System Prerequisites and Installation

Criteria	Support/Features	Grading	Comment
integration and supported interfaces	access: web interface, REST export: Raw, HTML, XML, PDF feeds: RSS, Atom		import content from MediaWiki possible
bandwidth requirements			
basic architecture	composition of loosely coupled web services, orchestrated by MindTouch Dream[127]; distributed environment using hosted PHP applications and Mono based parts.		
collaboration model	basically asynchronous, but is able to resolve synchronous (concurrent) changes		
data backend	MySQL	low	only MySQL is supported
extensibility	list of web services extensions available[128]	high	godd extensibility due to open API[129] and modular design
scalability	distribution, replication, caching	high	well scalable due to its distributed structure
security	transport security: SSL, TLS authentication: LDAP, Active Directory, Drupal, Wordpress, Joomla	high	

Table 5.89: DekiWiki - Overall System Properties

Criteria	Support	Grading	Comment
e-mail integration			with the Outlook Connector[130] e-mails and attachements can be versioned, searched and shared in DekiWiki
synchronous discussion (chat)	no		
asynchronous discussion (forum)	yes	low	flat commenting; probably add-on available
audio conferencing	no		
video conferencing	no		
project oriented organization	yes		
task management	no		

[127]Distributed REST Application Manager - `http://wiki.opengarden.org/Dream`
[128]`http://wiki.opengarden.org/Deki_Wiki/Extensions`
[129]`http://wiki.opengarden.org/Deki_Wiki/API_Reference`
[130]`http://wiki.mindtouch.com/Deki_Wiki/Outlook_Connector`

calendar management	no		
note management			not explicitly, but wiki itself can be used for publishing notes
file management	yes	high	wikis are well versioned; Desktop Connector[131] for easy attachement management
resource planning	no		
address management	no		
collaborative editing	yes	high	synchronous editing with conflict resolution
whiteboard	no		
shared presentation	no		
shared desktop	no		

Table 5.90: DekiWiki - Application and Task Support

Criteria	**Support**	**Grading**	**Comment**
mobility	no		not explicitly, however via REST some mashups for mobile devices may be possible
semantic capabilities	yes		tagging
easy information handling for end-users	yes	high	WYSIWYG web based editor; REST based Desktop Connector for easy file management
individual customization	yes	high	via stylesheets, scripting with DekiScript (Javascript syntax) and others
multiple access types	yes	medium	via web interface and custom REST based clients
identity/user management	yes	high	user roles and groups, inheritable permissions, ACLs

Table 5.91: DekiWiki - Usage

5.8 Comparison of Evaluation Results

One of the goals of this evaluation is the direct comparison of features between products of one software category. To this end, we compare all projects belonging to the same group of CWEs. There are five groups given below:

- File Management Systems
- Groupware Systems
- Real-time Office Applications
- Real-time Audio, Video and Data Collaboration Systems
- Wiki based Systems

For each group, a comparison matrix including the results of evaluated features is created for each of the following fields

- Software Development and Organization
- System Prerequisites and Installation

[131] `http://wiki.mindtouch.com/Deki_Wiki/Desktop_Connector`

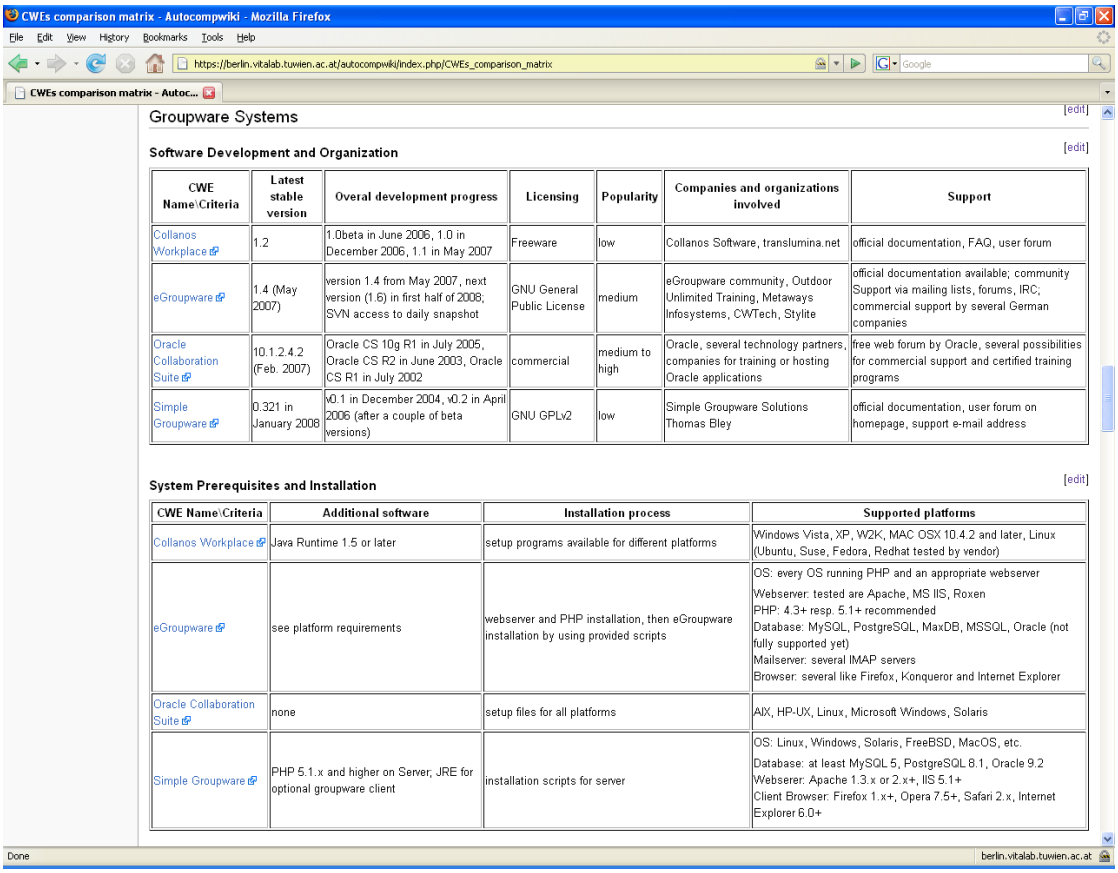

Figure 5.1: Example of a comparison among CWEs

- Overall System Properties
- Application and Task Supports
- Usage

The comparison matrix consists of products and criteria with additional information in the fields. For these direct comparisons we extracted the information about supported features from the above evaluations and put them into own tables, whereas one line is used per CWE product and their feature information is aligned in columns. Figure 5.1 describes a snapshot of the comparison from the Web page of this study.

For a quick view on evaluation results, the reader should refer to the Webpage of this study, available at
`https://www.vitalab.tuwien.ac.at/autocompwiki/index.php/CWEs_comparison_matrix`.

Chapter 6

Findings and Future Trends

Particularly for ESA, the analysis of their requirements show that the main interests are sharing information on the one side and communication on the other side, while collaborative work in the sense of corporate task management or collaborative editing are only of medium importance or optional (see Figure 2.2).

From the evaluation and comparison of CWEs products, we have found that existing CWEs provide many features required by large-scale and multinational organizations but those features are not well-integrated into a single CWE. Due to the complexity of collaborative work within those organizations, often many CWEs are used and it is not easy to integrate those CWEs together. In particular, we found that:

- *enterprises with centralized IT structure are the main focus*: most CWEs focus on enterprise use with centralized IT structure. Many products incorporate into existing IT structure using central LDAP server for contacts; external authentication server, and supporting single sign-on.
- *security is well supported*: most products focus security needs. This means overall transport security (SSL, TLS), several authentication methods, file encryption in repository.
- *open standards are widely employed*: use of open standards is slightly increasing for data exchange, like iCal, vCard, WebDAV, RSS instead of proprietary file formats (which are often still used too), even in commercial products.
- *open source software targets to enterprise*: many open source CWEs are suitable for enterprises, such as Mindtouch DekiWiki or Alfresco, though some adaption might be required. Although open source projects generally have only limited development resources, they highly reuse well-known and well-approved frameworks/software like Apache Web server, Postgres database, PHP and Python.
- *support of synchronous real-time editing is increasing*: The support and use of synchronous real-time editing is increasing (MS Groove is available only since beginning of 2007) because fast, reliable and cheap Internet connections are available now.
- *Commodity/utility of CWE services is in increasing use*: CWEs tend to utilize commodity/utility components, such as third party utilities for VoIP and instant messaging. This trend is also shown in the widely integration of Google tools into existing CWEs or the use of Skype in collaborative work.

On the other hand, still there are many remaining issues for CWEs to support the current highly dynamic working environment:

- *lack of mobility support*: the current trend is to work from everywhere using many types of devices. However, most CWEs lack mobility support, e.g., interfaces and security for performing collaborative work from mobile devices.

- *lack of a well-integrated CWEs which cover different aspects*: the complexity of collaboration in multinational, large-scale organizations require different features, ranging from file management to VoIP to email, into an integrated system. However, most CWEs support only a particular type of feature. Therefore, the user normally employs multiple CWEs in the collaboration.

- *semantics support is limited*: the employment of semantics, such as ontology and collaborative tagging, is limited. Using semantic annotation will help improving the search and interoperability in collaboration tasks.

- *existing CWEs do not support large-scale/multinational organizations well*: as most CWEs focus to organizations with centralized IT structure, many open issues remain when employing those CWEs for collaborative work spanning various ESA sites (or countries) having different IT structures and being connected through the Internet.

- *context management is not well supported*: context information is important source for performing collaborative work. However, most CWEs provide very limited information about context of the users and their activities.

- *lack of extensibility to allow CWEs being integrated into SOA environments:* still many CWEs provide Web interfaces and GUI for the end user. Many popular CWEs lack Web services support so it is difficult to integrate them into SOA-based environments.

Furthermore, there is also a question about how CWEs support the user to comply with business and legal issues when performing collaboration across the boundary of a single department/organization within a single country. We observed that currently there are many projects[1] addressing some of the above-mentioned issues. The SaaS model has strongly impacted on the design and implementation of CWEs as more and more CWEs provide Web services to support composition. Supporting the collaborative work for e-workers on the move is also increased. For example, the inContext project[2] tackles the context- and interaction-based collaborative work by focusing on context management and collaboration services, while the ECOSPACE project[3] focuses on collaboration services and tools integration into CWEs for e-professionals. Another aspect is to support the collaborative work spanning different departments/sites of the same organization or different organizations/SMEs has recently attracted much attention. For instance, the ECOLEAD project[4] and the COIN project[5] work on various aspects in Enterprise Collaboration for networked SMEs that require CWEs for multiple/virtual organizations.

Note that various studies of a particular type or different types of CWEs are available. For example, as mentioned before, [19] and the WikiMatrix discuss the advantages and disadvantages of wikis and compare wiki systems. An overview about open source document management products in 2006 are presented in [20]. Those studies are further valuable sources that can be used to evaluate some CWEs.

[1] see some projects at `http://www.ami-communities.eu/wiki/Projects`
[2] `http://www.in-context.eu`
[3] `http://www.ip-ecospace.org/`
[4] `http://ecolead.vtt.fi/`
[5] `http://www.coin-ip.eu`

Chapter 7

Conclusion

This study on current and future technology trends of collaborative working environments has been performed within two months. In this report, we have discussed how we approached the objectives of the study by (i) studying the structure of large-scale organizations in general and ESA in particular and the impact of the structure on the needs of CWEs, (ii) conducting requirement analysis for CWEs suitable for large-scale organizations and ESA, (iii) defining an extensive list of criteria used for evaluating CWEs, together with a list of state-of-the-art CWEs representing different software types, and (iiii) evaluating and comparing the list of selected CWEs based on the extensive list of criteria. Overall, we have selected 15 CWEs (see section 5.2) falling into five main categories named *File Management*, *Groupware*, *Real-time Office*, *Real-time Audio, Video and Data Collaboration*, and *Wiki* systems.

From the conclusion of the study, we think that it is worth to further conduct the evaluation of the composition and integration of commodity CWEs for large-scale and multinational organizations. We also need to evaluate some particular criteria by experimental work, such as scalability and usability, as analyzing documents is not enough. Further analysis on current and future trends of CWE technologies and tools for networks of enterprises would also be strongly related to this study. The detailed results of this study are available at `https://www.vitalab.tuwien.ac.at/autocompwiki/index.php/Main_Page`.

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