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Supporting Teamwork in User-centred Product Design: The Virtual Project Room -concept

A Research Study in a Distributed Software Development Organisation

Master's Thesis

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Supervisor: Professor Marko Nieminen
Instructor: Mikael Johnson

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This master's thesis presents a guiding concept for building a shared workspace. The research process of the concept is described.

The research was part of the VIKSU -project, created by Helsinki University of Technology and the Teamware Group. It explored the work processes of the user/customer-centred product design at Teamware. The objective was to find ways to support teamwork in user-centred product design, or more specifically, support for virtual project work.

Literature related to teamwork and shared workspaces were used as the theoretical background. The previous research studies of the VIKSU -project were analysed to gain insights for the concept. The empirical part consists of six interviews, two workshops and 12 project meetings, conducted in four parallel phases: Defining the Environment, User Study, Concept Design and Concept Validation.

The concept design resulted into a conceptual model that accounts for the social realm: the Virtual Project Room -concept bridges the gap between non-computer-based and computer-based support for virtual project work. This enables more flexible shared workspaces; the extent of the software and the services provided by the shared workspace can evolve over time.

The validation was conducted by comparing the concept to the Fitzpatrick's Locales Framework. The main differences were that the Locales Framework emphasises the awareness of the events and people in the shared workspace, while Virtual Project Room emphasises informal communication.

The results of this thesis are beneficial to the Teamware Group in two ways: 1) as material for improving the teamwork in the organisation, and 2) as a model for improving the groupware products.

Keywords:

user-centred design, teamwork, support for work, product development, concept design, collaboration, groupware, shared workspace, social thinking, virtual project room

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Tämä diplomityö esittelee käsitemallin, jonka avulla voidaan rakentaa yhteinen työtila. Työssä kuvataan tutkimusprosessi, jonka kautta käsitemalli syntyi.

Tutkimus oli osa Teknillisen korkeakoulun ja Teamware -yrityksen yhteistä VIKSU -projektia. Se tutki käyttäjä-/asiakaskeskeisen tuotesuunnittelun työprosesseja Teamwarella. Tavoitteena oli löytää keinoja tiimityön, tai tarkemmin sanoen virtuaalisen projektityön, tukemiseen käyttäjäkeskeisessä tuotesuunnittelussa.

Teoreettisena taustana toimi tiimityöskentelyyn ja yhteisiin työtiloihin liittyvä kirjallisuus. Käsitemallia varten kerättiin ideoita analysoimalla aikaisempia VIKSU -projektin tutkimuksia. Empiirinen osuus koostui kuudesta haastattelusta, kahdesta työpajasta ja 12 projektitapaamisesta, jotka toteutettiin neljän rinnakkaisen vaiheen aikana: ympäristön määrittäminen, käyttäjätutkimus, konseptin suunnittelu ja konseptin arviointi.

Konseptisuunnittelun lopputuloksena syntyi käsitemalli, joka ottaa sosiaalisen ympäristön huomioon: virtuaaliprojektihuone -käsitemalli yhdistää tietokone-avusteisen ja ilman tietokoneita tapahtuvan virtuaaliprojektityön tukemisen yhdeksi kokonaisuudeksi. Malli mahdollistaa joustavammat jaetut työtilat; työtilan tarjoamia ohjelmistoja ja palveluja on mahdollista laajentaa ajan myötä.

Käsitemallia arvioitiin vertaamalla sitä Fitzpatrickin Locales Framework:iin. Huomattavaa oli, että Locales Framework pitää tärkeänä tietoisuutta yhteisen työtilan tapahtumista ja ihmisistä, kun taas virtuaaliprojektihuone painottaa vapaamuotoista viestintää.

Tästä tutkimuksesta on hyötyä Teamware Groupille kahdella tavalla: 1) diplomityön avulla voidaan kehittää tiimityötä organisaation sisällä, ja 2) virtuaaliprojektihuone -käsitemallia voidaan käyttää ryhmätyöohjelmistojen jatkokehityksessä.

Avainsanat:

käyttäjäkeskeinen suunnittelu, tiimityöskentely, työn tuki, tuotekehitys, konseptisuunnittelu, yhteistyö, ryhmätyövälineet, yhteinen työtila, sosiaalinen näkökulma, virtuaalinen projektihuone

Preface

This master's thesis (together with the Virtual Project Room -concept) has been my first scientific document of such a large scale, and it has been a huge learning experience.

First and foremost, huge thanks to Mikael Johnson, my instructor, whose relentless guidance and ass kicking has been invaluable. Thanks for the endless supply of interesting articles, I hope I can read them all some day.

It has been a privilege to be able to work with Teamware Group that has generously allowed us to conduct our research with Teamware Group employees. For their dedicated support, especially three persons at Teamware Group deserve additional thanks: Eija Suikola, Pirkko Jokela and Satu Kyröläinen. Also, thanks to all the other employees (who cannot be named for reasons of privacy) that participated to the workshops and interviews.

In addition to the Teamware Group, this project is largely possible thanks to the Information Ergonomics Research Group (IERG), the workplace of the author. The multi-disciplinary research group has been a strong supporter and activator of this research project and the many discussions and the sparring with the colleagues have enabled this document to be what it is today. So, thanks to Professor Marko Nieminen, Sakari Tamminen, Marjaana Träskbäck, Salla Hari, Toni Koskinen, Heini Korpilahti, Kalle Toiskallio, Päivi Pöyry and Elina Jormanainen.

Thanks to the researchers of LISSU, a co-project at University of Oulu, for their active commenting on the Virtual Project Room -concept and for the development of the MAPID -approach, which the concept is closely connected to. Many thanks to Tonja Molin-Juustila, Professor Samuli Saukkonen, Professor Kari Kuutti, and Marjo Tiikkaja.

Thanks to Anu Kankainen for giving me possibility to participate in the Maypole -project (EU ESPRIT i3net, 1997-1999). That research project inspired me to study user-centred design and concept design.

This thesis is part of a project aiming to support a user-centred design process in distributed software development. The thesis and the project could not have been realized without financial support from the National Technology Agency (TEKES) and Teamware Group.

Finally, big hugs to my dear Katja, who has loved me despite the ups and downs in the rollercoaster called “writing a thesis”.

Taivaskalliolla, syyskuun yhdeksäntenä 2003

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1. Introduction

This thesis presents a guiding concept for building a shared workspace. The concept has been specifically designed so that the resulting shared workspace bridges the gap between non-computer-based and computer-based[1] support for teamwork. The whole research process of the concept is described including the related theory, the design process phases, and the validation of the concept.

The objective is to research the ways to support teamwork in user-centred product design, or more specifically, support for virtual project work.

Supporting teamwork is challenging: there can be many teamwork processes that interact with each other, within a product design organisation. Moreover, in user-centred product design, the salient features are that the participants are from different disciplines (also termed as cross-functional teamwork), and that they may be geographically widespread and possibly with different native languages / cultures.

The **virtual project work** is partly planned, partly ad hoc work in a **virtual project**. The tasks, tools and resources may change during the project. Virtual project work is also flexible; it allows for both face-to-face and geographically distributed work.

The thesis was written during 2002-2003 for the VIKSU -research project[2]. The research was conducted in the Teamware Group (TWG) -company, and it explored the work processes of the user/customer-centred product design in the company. Teamware Group designs products consisting of computer software and related services aimed for the end-users. The Teamware Pl@za® -product[3] and similar shared workspaces were used as the starting point for finding out ways to provide support for virtual project work.

Through designing the Virtual Project Room (VPR) -concept, this thesis aims to find out how could workspaces provide computer-based and non-computer-based support for teamwork in a virtual project at Teamware Group.

From a scientific point of view, the research provides a solution that accounts for the social realm: the **Virtual Project Room** -concept bridges the gap between non-computer-based and computer-based support for virtual project work. This enables more flexible shared workspaces; the extent of the software support and the services provided by the shared workspace can evolve over time.

This first, introductory chapter presents the objectives, scope and structure of this work. Also, motivation for this thesis and a short description of the VIKSU -project are included.

1 Opposite to computer-based work, non-computer-based work refers to all the work not performed using computers.

2 The VIKSU -project was created by Helsinki University of Technology and Teamware. Its purpose is to develop tools and enhanced work processes in order to improve the work in Teamware Company.

3 Teamware Pl@za® is Teamware's main product; a web-based intra- / extra- / Internet solution.

1.1. Objectives of the Thesis

The goals of the research in this thesis are strongly influenced by the mission of the VIKSU -project, which is:

> "...To gain more business benefits of the user-centredness by understanding the connections needed between different development and business processes. The goals for this mission are to understand and model the process of producing right software solution for not so accurate needs. This is done by understanding how the information about users and their activities should be managed and delivered in the product development organisation and between different stakeholders throughout the whole product life cycle." (Molin-Juustila & Johnson 2002).

Within the limits set by the mission, this thesis focuses on the problem area of teamwork in user-centred product design at Teamware Group.

At Teamware Group, one of the ways to implement the user-centredness into the product design is to create multi-disciplinary teams of employees from different organisational functions (i.e. virtual project teams, discussed in *2. Teamwork in a Virtual Project* and *6. Design Phase 2: User Study*).

Through its groupware product, the Teamware Pl@za®, the Teamware Group has vested interest in developing ways to support teamwork. This thesis focuses on supporting specific teamwork, the virtual project work (see *2.3. Virtual Project Work*). Through designing the Virtual Project Room (VPR) -concept, this thesis aims to find out how could workspaces provide computer-based and non-computer-based support for teamwork in a virtual project at Teamware Group.

There are four versions of the Virtual Project Room, of which two (v2, May 2002 and v4 – final, March 2003) are official. This thesis covers the research and concept design of the Virtual Project Room from its inception to the final version.

Research Questions

The research question in this thesis is:

> How could workspaces provide computer-based and non-computer-based support for teamwork in a virtual project at Teamware Group?

The research in this thesis is conducted at Teamware Group. The target users are the teamworkers of the virtual projects in the Teamware Group. The workspaces similar to the Teamware Pl@za® -product are the starting point in finding out ways to provide support for teamwork.

The answer to the research question is provided in form of a guiding concept for building a shared workspace that bridges the gap between non-computer-based[4] and computer-based support for teamwork.

The research question has been elaborated further into three detailed questions, specific to this research:

4 Opposite to computer-based work, non-computer-based work refers to all the work not performed using computers.

RQ 1: What is teamwork in a virtual project?

By first defining what teams and teamwork mean, it is possible to form an understanding of the virtual projects and -teams. This research question is elaborated in chapter *2. Teamwork in a Virtual Project*, which results into definitions of virtual project and virtual project work.

RQ 2: How to support teamwork in workspaces?

By defining the specific forms of support, it is possible to keep the thesis within its scope. This thesis anchors to the definition of the shared workspace that describes forms of supporting teamwork in workspaces. This research question is elaborated in chapter *3. The Support for Teamwork in Workspaces*, which results into definition of virtual project room.

RQ 3: What is the structure of the Virtual Project Room?

For the Virtual Project Room -concept to be meaningful, it has to contain some sort of objects or elements and the relations between them, i.e. a structure. In the VPR -concept v2, the structure could be separated into high-level and more detailed description of the VPR[5]. This research question is elaborated in "The Structure for the Concept", chapter *7. Design Phase 3: Concept Design*.

Research Approach

The research approach of the thesis can be viewed from three different angles: case study research, constructive research and design research.

The research focuses on one case company[6]. Qualitative methods are used to gather empirical data about the organisation and employees. However, contrary to the typical case study research, there is just one case study and the case is not compared to other similar cases.

The objective of the research is to construct the Virtual Project Room -concept[7]. The theoretical background is formed[8] first, then the empirical data is gathered and analysed. This leads to designing the concept by applying processes similar to the user-centred design. Finally concept is validated and evaluated.

According to Järvinen & Järvinen (1996) this research approach could be also called design research, since the aim is to construct artefacts (which can be products, prototypes or implementable designs) and evaluate them.

5 See "Preliminary Versions of the Virtual Project Room" in *Appendix 1: Previous Research Studies in the VIKSU -project*. See also *Figure 8: The Virtual Project Room -model v2, the elements*, p. 35.

6 Case Study Research: see Eisenhardt (1989).

7 Constructive research: see The Constructive Research Approach in www.metodix.com, http://www.metodix.com/showres.dll/en/metodit/methods/metodiartikkelit/const_research_app/.

8 Theoretical background is described in chapters *2. Teamwork in a Virtual Project* and *3. Support for Teamwork in Workspaces.*

Research Methods

The results of this thesis are based on data collected through interviews (6), workshops (2) and project meetings (12). Also the results of the previous research studies of the VIKSU -project[9] were analysed from the point of view of the Virtual Project Room. The research has been conducted mostly during the year 2002. Some of the previous research studies were started already in 2001, though.

Figure 1: Research Activities for the Virtual Project Room -concept.

The interviews were conducted by asking open-ended questions. They focused on identifying important topics or problems in the teamwork of the employees. The employees were allowed to talk about the issues that they felt were important. Some of the questions that were typically asked were: 1) *What do you do in your work?* 2) *What tools do you use in your work?* 3) *What kind of documents do you use or produce?* 4) *What are your typical work practices?*, and 5) *How would you improve your work?* The findings of the interviews[10] present a sample of issues that the employees discussed.

The two **workshops** were held during the spring 2002. The agenda of the workshops consisted of organisational development sessions involving 7-15 participants across many functions in the Teamware Group. The workshops were part of the TWG Communication Network -study[11] and were formative. Rather than describing each workshop in this thesis, their implications are included in the analysis of the previous research studies[12].

Project meetings were held regularly, approximately every month. The agenda of the meetings spanned from discussing project plan to collaborative sharing of data, results and ideas between the project participants. The notes from the project meetings are not included in this thesis, but the implications are, however, included in the analysis of the previous research studies[13].

1.2. Scope of the Thesis

This thesis concentrates on teamwork in virtual projects, for which it aims to provide support. The central concepts (virtual project, virtual project work and virtual project room) define a clear focus on the type of teamwork and the forms of support that are studied in this research.

The objectives and the central concepts for the Virtual Project Room -concept (and the thesis) were jointly defined and refined by the participants of the project[14], i.e. the researchers at the Helsinki University of Technology (HUT) and Oulu University, and the project members at the Teamware Group.

The motivation of the thesis is not to form a new theory, but to describe the work at Teamware Group in such way that it can be used in the design of groupware tools

9 See *Appendix 1: Previous Research Studies in the VIKSU -project*.
10 See *Appendix 2: Research Findings*.
11 See *Appendix 1: Previous Research Studies in the VIKSU -project*.
12 See *Appendix 1: Previous Research Studies in the VIKSU -project*.
13 See *Appendix 1: Previous Research Studies in the VIKSU -project*.
14 The concept was developed in the project meetings, see *Research Methods*, above.

(e.g. Teamware Pl@za®). The main result of this research is the Virtual Project Room -concept. It structures the support (for teamwork) by defining what is important for virtual project work. The concept is strongly tied to the empirical research at Teamware Group and is thus specific to the teamwork in virtual projects in Teamware Group.

The Virtual Project Room -concept concentrates on cross-functional teamwork in Finland and less on geographically distributed work, although it is understood that the company operates in several countries. In particular, this means that although the concept offers possibilities for geographically distributed work and suggestions to overcome barriers of language, it does not have empirical research data related to those issues. The analysis of the virtual project work between the different countries is outside the scope of this concept.

This thesis does not provide an implementation of the support for teamwork, based on the Virtual Project Room -concept. Thus, validation of the Virtual Project -concept is not done with a usability test or similar method. Instead, the validation in this thesis is conducted by comparing the concept to the Locales Framework (in chapter *8. Design Phase 4: Concept Validation*).

1.3. Motivation

Why do we need social thinking in software practise? The answer is the same, whether it's about society (Fitzpatrick 2002), global virtual collaboration (Qureshi & Zigurs 2001) or evaluation of collaboration technology (Andriessen 2002): **the focus is not in technology** by itself. Although technology has significant role in enabling new ways of communication and collaboration, the use of technology does not guarantee better results. So, in order to increase efficiency of the work, Qureshi & Zigurs place emphasis in collaboration, while Fitzpatrick focuses in **communication**.

Fitzpatrick argues that the traditional requirements-gathering techniques are no longer adequate to account for the complex dynamic nature of the social world, for which the software is being designed. Although the coding of the systems is still important, the emphasis shifts to also understanding the social, organisational, and interactional contexts in which the system will be used. This moves software practice into a different problem space: into the social realm, where "the aim is not to find the truth, but to improve some characteristics of the world where people live"[15]. (Fitzpatrick 2002).

Fitzpatrick identifies three challenges for software practise: 1) It needs to take account of the intertwined problem-solution space and the iterative processes needed to learn more about the problem and come up with better solutions. 2) The software needs to be more flexible and evolvable if the problem solution iterations are to be taken seriously. 3) New concepts, methods and techniques are needed to understand and account for the social realm, the problem space. (Ibid).

This thesis aims to provide a solution that addresses these challenges. A new concept (The Virtual Project Room) is designed, which aims to account for the social realm. This concept is built iteratively using the methods and processes of user-centred design. The Virtual Project Room -concept does not make a distinction between computer-based and non-computer-based support for virtual project work. This enables the shared workspaces that are built using this concept, to be flexible and the extent of the software support can evolve over time.

15 The quote; Rittel, H., Webber, M. (1973, p. 167; Ref. Fitzpatrick 2002) Dilemmas in a General Theory of Planning. In *Policy Studies* 4(1): 155-169.

1.4. The VIKSU -Project

The purpose of the VIKSU[16] research project was to develop tools and enhanced work processes in order to improve the work in Teamware Group. The project lasted for three years (from 2000 to 2002) and continued the previous collaboration between Helsinki University of Technology, Oulu University, and Teamware Group.

VIKSU was part of the larger TEKES[17] -funded KESSU[18] joint research project, which is co-ordinated by Oulu University and involves other clients besides Teamware Group. Collaborating with the VIKSU -project was another member of the KESSU-project family, the LISSU[19] -project, whose objective was to describe and develop the market-centred design processes in the early stages of a product life cycle (see Molin-Juustila 2003).

This thesis is the result of an important research objective for the VIKSU-project: the design of the Virtual Project Room -concept.

1.5. Structure of the Thesis

This thesis has three main parts: the presentation of theoretical background (chapters 2-4), the description of the design phases of the Virtual Project Room -concept (chapters 5-8) and in the end, the summary and discussion (chapters 9-10).

The design phases have been conducted iteratively and partly in parallel. This is discussed more in *4.3. The VIKSU Design Process*.

Chapter 1. Introduction

Introduces to the reader to this thesis: to the objectives, research questions, scope and the background of this research.

Chapter 2. Teamwork in a Virtual Project

Begins the description of the theoretical background by defining teamwork in a virtual project (or virtual project work as defined by the Virtual Project Room -concept). The chapter spans from groups and teams through virtual teamwork and finally to virtual project work. This chapter is related to the research question 1, *What is teamwork in a virtual project?*

Chapter 3. The Support for Teamwork in Groupware

Continues the theoretical background by examining ways of support for teamwork in groupware. The chapter starts with defining shared workspaces and applies that to the definition of the virtual project room. This chapter is related to the research question 2, *How to support teamwork in workspaces?*

16 VIKSU is a Finnish acronym for "virtual desktop for user-centred design".
17 TEKES is the National Technology Agency of Finland.
18 KESSU is a Finnish acronym for "User-centred design processes and tools in product development".
19 LISSU is a Finnish acronym for "User-centred design with focus on business benefits".

Chapter 4. User-centred Design in the Research Process

Defines the design process of the Virtual Project Room -concept by applying user-centred design to the research process. The chapter spans from the definition of the user-centred design, usability engineering and user-centred product concept design to the definition of the process model used in the research.

Chapter 5. Design Phase 1: Defining the Environment

Describes the first phase (of four) in designing the Virtual Project Room -concept. This phase examines the environment (i.e. the Teamware Group, TWG, organisation) in which the research is conducted. The VIKSU -project research study "TWG Communication Network" is introduced as it influenced this phase of the design.

Chapter 6. Design Phase 2: User Study

The second phase describes the target users in the research, the teamworkers in virtual projects at Teamware Group. The VIKSU -project research studies "Workshop on Planning the Kick-off Event", "Requirements for Requirements Management System", "DECA", "Feature Browser" and "The Virtuaaliprojektihuone KESSU -SIG" are introduced in this chapter.

Chapter 7. Design Phase 3: Concept Design

The chapter 7 charts through the concept design phase, the creation of the Virtual Project Room. The VIKSU -project research study "Preliminary Versions of Virtual Project Room" is introduced in this chapter.

Chapter 8. Design Phase 4: Concept Validation

The fourth and last phase evaluates the final Virtual Project Room -concept by comparing it to the Locales Framework. This chapter starts with introducing the Locales Framework that is then compared to the elements and structure of the Virtual Project Room -concept.

Chapter 9. Summary

Concludes the research by giving answers to the research questions that were presented in the *1. Introduction*.

Chapter 10. Discussion

Finishes the thesis by discussing the applicability and validity of the research. Also, the success of the thesis is elaborated. Finally some topics and questions are presented for further research.

2. Teamwork in a Virtual Project

> *"If we are to support the designers, then, it is important to understand what designers do, in other words 'how they design'"*. (Preece 1994).

This chapter aims to give an answer to the research question 1, *what is teamwork in a virtual project?*[20]

Finding an appropriate definition for teamwork is difficult due to so many disciplines interested in the subject.[21] This thesis is related to workspaces (and thus groupware systems). One possibility would be to define teamwork the same way as cooperative work in the discipline of computer supported cooperative work (CSCW)[22]. For example, Schmidt and Bannon define cooperative work as:

> "**Cooperative work** is constituted by *interdependence in work*, that is, by work activities that are related as to content in the sense that they pertain to the production of a specific product or service. Thus, the boundaries of cooperative work networks are defined by actual cooperative behaviour and are not necessarily congruent with the boundaries of formal organisations." (Schmidt & Bannon 1992).

Instead of a discipline specific definition, this chapter aims for a more generic definition of teamwork (termed "conventional" teamwork), before narrowing to virtual teams and finally to virtual project work. Virtual project work is a definition by the VIKSU -project and it is a key term in the Virtual Project Room -concept.

2.1. Teamwork

In the world of today, the terms team and teamwork are often used as buzzwords to create an impression of good, close relationships between workers and managers. This section, however, concentrates on defining "real" teamwork; a description that sets teamwork apart from work that is performed by any type of group.

Groups

A team is also a group (*but not vice versa*). Before going to the specific definitions of the teams, the basics of the groups are described first. These apply to the teams as well.

The most obvious characteristics of a group is:

> **A minimum membership of two people.** Usually ranging from 2 to 30 individuals. (Huczynski & Buchanan 2001, p. 278).

20 Described in *1.1. The Objectives of the Thesis*.
21 Examples of disciplines interested in teamwork; see "Science Disciplines Related to Teamwork" in *Appendix 4: Research Notes*.
22 For a short description of CSCW, see e.g. *The Domain and Goals of CSCW* (Pfeiffer, University of Calgary), part of Electronic Meetings - CSCW & GDSS http://ksi.cpsc.ucalgary.ca/courses/547-95/pfeifer/cscw_domain.html.

In addition, the group (in this context sometimes defined as a psychological group) differs from an aggregate of people[23] by following characteristics:

> **A shared communication network.** The members of the group must be capable of communicating with every other member.
>
> **A shared sense of collective identity.** The group members must identify with the other members of the group and not see themselves as individuals acting independently. They must all believe that they are both members of and participants in the group, which itself is distinct from other groups.
>
> **Shared goals.** The shared goals are only achievable by the members working together. They must feel obliged to contribute to the attainment of the shared goal.
>
> **Group structure.** The individuals in the group have different roles. There are norms and/or rules that regulate acceptable/disliked behaviour in the group. (Huczynski & Buchanan 2001, p. 278).

Another important feature of the groups is that they are not static; the groups change over time. This is generally termed as group development. Tuckman and Jensen have created a model of group development with five stages:

> **Forming.** An orientation stage, in which group members are trying to find out about each other and what are the rules, roles and tasks of the group.
>
> **Storming.** This stage is about conflict; group members try to negotiate the common goals to as close to personal goals as possible. Lot's of bargaining etc.
>
> **Norming.** A cohesion stage; group member develop ways of working to establish close relationships. Practical details are taken care of (who, what, when). Feeling of groupiness.
>
> **Performing.** The group has developed an effective structure. The members are committed, doing the job and accomplishing the objectives. They are equally happy working alone, in sub-groupings or together. Some groups may not reach this stage at all.
>
> **Adjourning.** The group members disband (either the task is completed or members just leave). They may reflect on the time spent in the group. (Tuckman & Jensen 1977; Ref. Huczynski & Buchanan 2001)[24].

Teams

The terms 'group' and 'team' are often used interchangeably in the literature. Sometimes their use depends on the personal preferences of the writer, sometimes the term team is used, because it has more positive sound to it. Sometimes, especially by management consultants, the 'team' is used metaphorically rather than to depict an actual team. Sometimes the 'team' represents the normative goal of a collection of people working at their best and the 'group' as the actual, current, level. (Huczynski & Buchanan 2001)

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23 *Aggregate* refers to a collection of people who happen to be in close physical proximity for a short period of time.

24 Tuckman, B.C., Jensen, M.A.C. (1977) Stages of small group development revisited. *Group and Organization Studies*, Vol.2, no.4, pp.419-427.

The literature often considers teams as a successful transformation of a group; the group has reached a performing stage (see Tuckman & Jensen's five stages of group development, shown previously). As a way to make a distinction, Belbin found six differences in an inquiry about differences between group and team:

	Group	*Team*
Size	Medium or large	Limited
Selection	Immaterial	Crucial
Leadership	Solo	Shared or rotating
Perception	Focus on leader	Mutual knowledge understanding
Style	Convergence conformism	Role spread co-ordination
Spirit	Togetherness, persecution of opponents	Dynamic interaction

Table 1: Six differences between a team and a group (Belbin 2000; Ref. Huczynski & Buchanan 2001)[25]. (Adapted).

A more comprehensive analysis was performed by Katzenbach and Smith (1993) who, in their analysis of 47 teams in 37 different organisations, identified characteristics that distinguish between a work group and a real team (See *Table 2*). According to the Katzenbach and Smith, the essence of a real team is in common commitment, and that is lacking in a work group.

	Work group	*Real team*
Leadership	Strong, clearly focused leader	Shared leadership roles
Performance depends on	Individual contributions	Individual contributions and collective work products
Accountability	Individual	Individual and mutual
Accountability for outcomes rests on	Individual outcomes	Mutual outcomes
Work products	Individual	Collective
Members are interested in	Common goals	Common goals and commitment to purpose
Responsive to	Demands of management	Self-imposed demands

Table 2: Contrast between 'work group' and 'real team' (Katzenbach and Smith 1993. The summary table adapted from Huczynski & Buchanan 2001).

Focusing on the real team, Katzenbach and Smith also described six key elements that both define and prescribe the characteristics of what they call a team:

> **Small number.** In a team there is a limit to the number of people who can interact constructively.
>
> **Complementary skills.** A team possesses an appropriate mix of 1) technical or functional expertise, 2) problem-solving and decision-making skills, and 3) interpersonal skills.
>
> **Truly meaningful purpose.** Within the management-set boundary, there is sufficient flexibility to allow the team to establish common goals that are meaningful to members.

25 Belbin, R.M. (2000) *Beyond the Team*. Oxford: Butterford Heinemann.

Specific performance goal(s). A team defines clear and measurable goals so that the team can track progress. output for the organisation, which is unachievable by an individual, working alone.

Committed to a common approach. The way the members work together to achieve their purpose, e.g. allocation of tasks, scheduling deadlines.

Mutual accountability. Team members hold themselves accountable for the achievement of their goals, which underpins the commitment to and trust of one another. (Katzenbach & Smith 1993).

In summary, the term team is an elusive target. Depending on the literature that is read, it is defined differently. This thesis considers team in the same sense Katzenbach and Smith use the 'real team'. In short: a well performing group that works for common goals.

Teamwork

Teamwork is a widespread phenomenon; its use ranges from small non-governmental organisations to large multinational companies, from manufacturing to research. Sundström et al. (1990; Ref. Huczynski & Buchanan 2001)[26] categorised the different types of teamwork into four categories: advice, action, project and production (see *Table 3*).

Type *(Example)*	*Relations to other work units*	*T.S. *)*	*Work cycles/ time frame*	*Typical outputs*
Advice (Committees)	Differentiation: low, Coordination: low	Low	Brief or long; one cycle can be a team life span	Decisions Recommendations Proposals
Action (Sports)	Differentiation: high, Coordination: high	High	Brief, repeated under new conditions	Competitions Concerts
Project (Research groups)	Differentiation: high, Coordination: low (traditional units) / high (cross-functional)	High	Different in each new project	Plans Designs Reports
Production (Manufacturing teams)	Differentiation: low, Coordination: high	High	Repeated or continuous process	Food Components Customer service

*) *Technical specialisation*

Table 3: Types of teams and their outputs (Sundström et al. 1990; Ref. Huczynski & Buchanan 2001). (Adapted).

This thesis concentrates on multi-disciplinary teams of employees from different organisational functions at Teamware Group[27]. In Sundström's categories of teamwork, this refers to *cross-functional project teams*.

26 Sundström, E., De Meuse, K. Futrell, D. (1990) Work Teams. In *American Psychologist*. Vol.45, no.2, February. pp. 120-133.

27 Described in *1.1. Objectives of the Thesis*.

Project teams and cross-functional teams

A **project team** consists of individuals who have been brought together for a limited period of time, from different parts of the organisation, to contribute towards a management-specified task. When the project is finished, the team is either disbanded or the members are given new assignments. According to Huczynski & Buchanan, project teams are created when:

> Creative problem solving is required which involves the use of different types of specialised knowledge.
>
> There is a need for close co-ordination of the work on a specific project. (Huczynski & Buchanan 2001, p. 384).

When the project teams consist of members from several different functions, they are called *cross-functional (project) teams*. Huczynski & Buchanan define such teams in the following way:

Cross-functional team refers to a team composed of employees from about the same hierarchical level but from different work areas or functions in the organisation, who are brought together to complete a particular task. (Huczynski & Buchanan 2001).

The members of the cross-functional team traditionally work in different departments or work areas. Sometimes, they may also include customers, suppliers and external consultants. They are supported by their organisation's structure, systems and skills, which enable teams to operate successfully as more independent units (less bound by functional ties) towards goals that transcend the abilities of individual members. (Huczynski & Buchanan 2001, p.384).

The cross-functional teams differ from other types of team in three important respects:

> **Representative.** The individual members usually retain their position back in their 'home' functional department.
>
> **Temporary.** The teams have a finite life, even if their end is years in the future.
>
> **Innovation.** The teams are established to solve non-conventional problems and meet challenging performance standards. (Huczynski & Buchanan 2001, p385).

The demands for the successful cross-functional team are thus a lot higher than for most of the other types of teams[28]. There is inherent conflict in a cross-functional team, as each member has at least two affiliates: the cross-functional team itself and the organisational function that the member is part of. The characteristics of the real team (see *Teams*, above) are also important.[29]

28 As seen in *Table 3*.
29 For more elaboration, see "Pros and Cons of Cross-functional Teams" in *Appendix 4: Research Notes*.

Implication for this thesis
The cross-functional teamwork is the basis upon which the definition of the virtual project work is built. As discussed in this section, in addition to the special characteristics of the cross-functional teamwork, there are general characteristics of teams and groups that apply as well. All these characteristics are considered as part of the virtual project work.

2.2. Virtual Team

The previous chapter discussed teamwork in general. The teams described in that chapter are referred as conventional teams in this thesis, to separate them from the virtual teams. Of the conventional teams, the cross-functional team shares characteristics with the virtual team the most. However, in virtual teams the members can be from different organisations, and they can also be geographically separated.

Working in a virtual team is likely to be more difficult than in a conventional team. A down-to-earth way to describe this difference is:

> "Everything that goes wrong with in-the-same-place teams also plagues virtual teams – only worse.
> Egos, power plays, backstabbing, low confidence, poor self-esteem, leaderlessness, and lack of trust all harass virtual teams. When communication breaks down, people must take measures to repair it. It is just that much more difficult to communicate across distance and organisations using tenuous electronic links." (Lipnack & Stamps 2000, p. xxviii).

Virtual Team members thus need more skills in teamworking (especially communication and social skills) than the members of a conventional team. The advantages of such demanding way of work can, however, outweigh the disadvantages. It allows teams to work irrespective of the physical distance; teams can virtually collocate all the information (or references to the information) and interactions they need to work together in a context. (Lipnack & Stamps 2000).

The virtual teams typically work across organisational boundaries, use collaborative technologies and are working in flexible organisations. Lipnack and Stamps (2000) sum this as: "Virtual teams are the people-operating systems for the twenty-first century".

A virtual team is defined as:

> A virtual team is a group of people who work interdependently with a shared purpose across space, time, and organisation boundaries using technology. (Lipnack & Stamps 2000, p. 18).

Another related definition by Guss (1998) states that a virtual group/project is:

> A temporary group of trained people separated by geographic, temporal or psychological distance, who work across organisation forms, depend on face-to-face and remote communication with the intent of satisfying business requirements of sharing skills and working toward team and client goals. (Guss 1998).

The webs of technology and trust link virtual teams; it is the efficient use of modern technologies and overcoming the lack of frequent face-to-face communication that distinguishes a virtual team from its conventional counterpart. (Lipnack & Stamps 2000).

In an attempt to summarise the similarities and differences of the virtual teams and conventional teams, Lipnack and Stamps identify four essential words for virtual teams:

> **People** populate and lead small groups and teams of every kind and every level of organisations.
>
> **Purpose** holds groups together, which for teams mean a focus on tasks – work progressing from goals to results.
>
> **Links** are the channels, interactions, and relationships that weave the living fabric of a group unfolding over time. The greatest difference between in-the-same-place teams and virtual ones lies in the nature and variety of their links.
>
> **Time** is a dimension common to all life and one that dominates virtual teams – schedules, milestones, calendars, processes, and life cycles. (Lipnack & Stamps 2000, p. 24).

Virtual teamwork, as described in here, is not similar to eWork. Bates & Huws (2002), say that eWork "[...] includes [...] all work carried out [...] using a computer and a telecommunications link to deliver the work". They also state that eWork does not include work in regular offices. In this thesis virtual team is considered as a group of people that work both in ways of "conventional" teamwork and through modern technology. Virtual teamwork is thus a broader concept of work than eWork.

As a way to distinguish between different forms of how virtual teams are organised, Lipnack and Stamps present nine varieties of virtuality (see *Table 4*) that span across two dimensions: space-time and organisational distance.

Increasing degree of virtuality

Space-time	Same Org.	Cross-Internal	Cross-External
Global	Global Sites	Global Cross-functional	Global Alliance
Local	Distributed Sites	Local Cross-functional	Local Alliance
Same Place	Traditional Work Unit	Collocated Cross-functional	Joint Venture

Organisational distance

Table 4: Varieties of Virtuality (Lipnack & Stamps 2000, p. 62).

Conventional teamworkers (named as Traditional Work Unit) work in same-place (space-time axis) and same-organisation (organisational distance axis) levels. From that point, virtual teamwork can spread to two directions: 1) to global direction (space-time axis), leading to global teams, 2) to cross-external direction (organisational distance axis), leading to networks of organisations.

This thesis concentrates on virtual teams at Local Cross-functional level (located in the centre of the *Table 4*). This means focusing in local (rather than global) teamwork as well as cross-functional teamwork within one organisation (rather than cross-external; networks of organisations)[30].

Virtual Teams at Teamware Group

Internally at Teamware Group, the employees developed a notion of their own about the virtual teams.

A Virtual Team (as described by the Teamware Group employees) does not necessarily have a fixed set of members; the goals (and to some extent the tasks) are more or less stable, but some members might leave or join the team frequently. The style of a team is a kind of "evolution through working"; the work practices are not set in stone. The members of the team have many responsibilities outside the Virtual Team, which takes majority of the working time. Those responsibilities mostly concern personal or organisational function related assignments.[31]

The definition of the Virtual Team at Teamware Group was:

> A "Virtual Team" is a *cross-functional team* consisting of members from marketing, consulting, product-development, product management and production -departments of Teamware Group. Not all of the members are located in the same country and have same nationality. Majority of the members in Virtual Team are from Finland and in Finland, however.

Implication for this thesis

The discussion about the virtual teams in this section sharpens the focus of the virtual project work. It is not just cross-functional teamwork, but Local Cross-functional virtual work; "cross-internal" teamwork in an organisation and in local space-time.

The definitions of the virtual team by the literature as well as by the Teamware Group employees identify the essential issues that should be included into the virtual project work.

2.3. Virtual Project Work

The term virtual project work is used in this thesis as the definite description of the work for which the Virtual Project Room -concept is designed. The description draws from the understanding of the conventional teamwork (*2.1. Teamwork*) and virtual teams (*2.2. Virtual Team*). Instead of relying only on literature, the description has been developed with the project participants[32]. The emphasis has been on defining a description that matches closely with the actual work at Teamware Group.

30 These choices have been made in the VIKSU project meetings. See *1.2. Scope of the Thesis*.
31 This description is based on the interviews made at Teamware during spring 2002.
32 The description was developed in the project meetings (see *Research Methods* in *1.1. Objectives of the Thesis*).

The definition of the **virtual project work** is:

> The virtual project work is performed in a virtual project, which sets the structure for the work.
>
> Virtual project work is partly planned, partly ad hoc; the tasks, tools and resources may change during the project. Virtual project work is flexible; it allows for both face-to-face and geographically distributed work.

The definition of the virtual project work uses virtual project to explain its characteristics. The definition of the **virtual project** is:

> The virtual project[1)] differs from a traditional project[2)] in that the plans and resources defined at the beginning of (or before starting) the project can be changed during its lifetime. It is not as systematically managed and thus more flexible than traditional project, but it also requires more effort to keep the project from falling apart.
>
> The members of the virtual project typically form a cross-functional team; they are employees at Teamware Group, who work in one of the functions of the organisation (This is currently exemplified by teams called 'Virtual Teams').
>
> A virtual project is born from a specific need, finished when the need is not relevant any more (i.e. the need is satisfied or some other need overrides it).
>
> There is certain amount of instability (seen as need for flexibility) inherent in the virtual project as project plans, tools and resources are adjusted according to the needs of the project.
>
> 1) *The virtual project could also be called an agile project, it shares some similar features with the agile software development, especially in the way they differ from the traditions of their discipline (traditional software development vs. agile software development, see Cockburn 2001)*[33]*.*
>
> 2) *Traditional project is typically defined with an Iron Triangle*[34] *(Finnish: Tuloskolmio). The project aims to achieve its objectives on time and to the specified cost, quality and performance. The plans, goals and resources (including project members) are defined at the beginning of the project.*

Implication for this thesis

The definition of the virtual project work (and virtual project) is used in this thesis as the definite description of the work for which the Virtual Project Room -concept is designed.

33 Cockburn, A. (2001) *Agile Software Development*. Boston: Addison-Wesley.

34 see Atkinson, R. (1999) Project management: cost, time and quality, two best guesses and a phenomenon, its time to accept other success criteria. *International Journal of Project Management, Vol 17, No 6, pp. 337-342, 1999*. Great Britain: Elsevier Science Ltd.

3. Support for Teamwork in Workspaces

The previous chapter described the kind of teamwork (i.e. virtual project work) that this thesis is focused on. The next problem is to find out how to support that teamwork (i.e. the research question 2).

Preece (1994) offers a designer-oriented definition for support. It is based on the idea that design support is needed, because humans need help to complete the task of designing complex products efficiently. The design process is knowledge-intensive and there is a limit to the amount of information that human designers can process and store. (Preece 1994).

Preece's definition is applicable to computer software in general. A more specific definition of support, focusing in shared workspaces (by Farshchian 1999), is described next.

3.1. Shared Workspace

A shared workspace provides a virtual place to work, tools for performing the work, and channels for communication among its inhabitants. Since shared workspaces can be used for variety of tasks, many groupware systems use shared workspaces as one of the main basic components for supporting cooperation. (Farshchian 1999).

Farshchian calls this type of groupware system a Shared Workspace Application (SWA). Examples of SWAs are TeamRooms, Orbit, BSCW, and Teamware Pl@za.

Farshchian identifies three dimensions of services that distinguish the Shared Workspace Applications based on the type of support they provide to the collaboration: group dimension, activity dimension and product dimension (see *Table 5*). (Farshchian 1999).

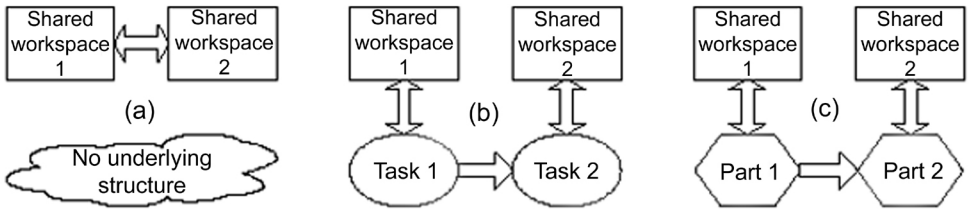
Dimension	*Research Focus*	*Typical Services Provided*
Group dimension	Identify and support different aspects of human-human interaction mediated through a shared workspace.	Navigation and orientation tools, workspace awareness, communication channels (video, audio, text), floor control.
Activity dimension	Provide flexible mechanisms for structuring a large task into smaller, interconnected activities.	Formalisms for decomposing and modelling large activities. To-do lists inside shared workspaces.
Product dimension	Provide flexible mechanisms for consistent co-editing of a large shared product.	Concurrency control, consistency preservation mechanisms, access control, change propagation, change management.

Table 5: Shared workspace applications are normally extended along three dimensions in order to support collaboration in the large (Farshchian 1999).

The services provided by the **group dimension** aim to make available advanced group-level collaboration support inside a shared workspace. Examples of such support are communication tools, gesturing tools, navigation and orientation widgets, and awareness widgets. This dimension does not have an underlying structure; the shared workspaces are connected with direct mechanisms, such as doors (see *Figure 2.a*).

The **activity dimension** covers services for dividing large task into several activities, and creating mapping between these activities and shared workspaces. By creating mappings, this dimension gives rise to activity model as the underlying structure; shared workspaces are interconnected through the tasks linked to the workspaces (see *Figure 2.b*). This dimension includes, for example, To-do lists, task lists and formalisms for modelling the flow of work from one workspace to another.

The services in **product dimension** are concerned with using a model of the product to support cooperative work of the group. The cooperative work is perceived of as an aggregation of the changes done to the product in the single workspaces (see *Figure 2.c*). The focus in this dimension has traditionally been to provide services for keeping the product consistent during the concurrent accesses, and to make the latest changes accessible to all the workers. (Farshchian 1999).



(a) **Group Dimension:** Shared workspaces are connected using workspace mechanisms, such as doors.

(b) **Activity Dimension:** Shared workspaces are connected using an activity model as underlying structure

(c) **Product Dimension:** Shared workspaces are connected using a product model as the underlying structure

Figure 2: The three dimensions of services provided by Shared Workspace Applications (SWAs). Note that the mapping from the underlying structure into the shared workspaces does not have to be 1-1. (Farshchian 1999).

While a typical shared workspace application provides a combination of these services, the emphasis of the service dimensions vary depending on the intended application area of the SWA.

Farshchian (1999) also describes **six** specific **services** that a shared workspace application could provide along the product dimension. The first four are strictly concerned with the product dimension:

Sharing objects among shared workspaces. This sharing service would also apply for sharing the awareness information, meaning that changes done to the objects in one shared workspace should be visible in all the shared workspaces containing those objects.

Awareness through a composite product. A group of workers will typically work with only a few parts of a large product, but may at the same time be interested in being aware of the changes done to other related parts.

Easy product manipulation mechanisms. This includes not only manipulating the single objects constituting the product, but also changing the structure of the product. Structure can be an important factor for how awareness information is mediated.

Navigating and querying the product model. The workers will need navigation and querying mechanisms for selecting objects into their workspaces. For instance, a shared workspace may need to have an updated set of all the objects of a certain type created as part of the product.

The last two services are concerned with combining the product dimension with the group dimension:

Presentation of mediated awareness information inside shared workspaces. This product awareness information should be easily distinguishable from workspace awareness information. For example, the product awareness could be related to the parts of the product residing in the workspace. It should also be possible to adjust the level of mediated awareness that a shared workspace wishes to receive.

Support for informal group-level activities. In addition to presenting awareness information, there is a need for supporting the informal, direct communication, and the interplay between the formal and the informal levels. What is needed is a transfer mechanism for transferring informal objects created inside a shared workspace to the product, after the informal objects are finalised as product objects. (Farshchian 1999).

Implication for this thesis
The concept of a shared workspace is the starting point for providing support to virtual project work. The support in the Virtual Project Room -concept should cover the three dimensions of services in the shared workspaces (group, activity, product) and make it possible to include the six services (mentioned above) in the implementations of the Virtual Project Room.

3.2. Virtual Project Room

Similarly to the shared workspaces, the Virtual Project Room -concept identifies services or service-like *elements.* The elements are spread along all the three dimensions (group, activity and product) of services found in shared workspace applications.

This section describes the definition of the Virtual Project Room -concept. The design of the concept as well as the structure and the contents are described later, in chapter *7. Design Phase 3: Concept Design*.

The Virtual Project Room -concept is not a shared workspace application itself; it is a guiding concept for building one that provides both non-computer-based and computer-based support for teamwork.

The participants of the VIKSU -project jointly developed the definition of the Virtual Project Room -concept[35]. First, a semantic analysis of the term Virtual Project Work was made[36], which was used as a starting point for joint discussion. The final definition consists of several parts; the Virtual Project Room is described using terms virtual project work and virtual project, which were described in *2.3. Virtual Project Work*.

The definition of the **virtual project room** is:

> Virtual project room is a model for tools supporting the virtual project work. It structures the support by defining what is important for virtual project work. By taking care of the issues mentioned in the virtual project room, the participants of virtual project work are able to reach their goals better. The content of the virtual project room deals with plans, goals and processes of the project, (limited) time and resources, and various artefacts created or processed by the project.
>
> The virtual project room has been created for teams that are typically cross-functional; for employees, who work in one of the functions of the organisation.
>
> The implementation of the virtual project room is a shared workspace, for each virtual project. The events, objects and people related to one virtual project are within the context of one virtual project room.

Although the Virtual Project Room -term includes the word "**room**", the concept is not intended to strictly represent a real room in a virtual space; the emphasis is rather on the notion of a **space** or a **situated context**. The problem with the idea of a "room" is discussed further in e.g. Farshchian (1999) and Fitzpatrick (2002).

Similarly to the Virtual Project Room -concept, the implementations of the concept should cover all the three dimensions of the shared workspace services. The underlying structure of the implementation (a shared workspace) should be a combination of service dimensions; the shared workspaces should not be connected using only "doors", but a combination of activity and product -based networks of connections.

Implication for this thesis
The definition of the virtual project room (see above) is used in this thesis as the definition of the Virtual Project Room -concept.

35 The definition was developed in the project meetings (see *Research Methods* in *1.1. Objectives of the Thesis*).
36 Described in *Appendix 3: A Semantic Analysis of the VPR.*

4. User-centred Design in the Research Process

The *research environment* in this thesis is the teamwork at Teamware Group. The environment ties the thesis to the user-centred design.

More importantly, however, also the *research activities* in this thesis are based on the principles of the user-centred design (UCD). Through four phases of a user-centred design process, the organisational environment and the users are studied, and the concept is designed and validated.

This chapter starts with defining the user-centred design and the related terms. After the definitions, the user-centred process model is presented, resulting finally to the description of the design process used in the research of the thesis.

4.1. User-centred Design

The user-centred design emphasises that the product is created for an actual user. Those users should be involved to the design process. The best-known reference for the user-centred design is the ISO 13407 standard (1999)[37]. The standard complements the existing standard design methods and processes with a user-centred perspective that enables the design effort to be focused on a particular appropriate context.

Although there are other definitions of the user-centred design (for descriptions, see e.g. Mäki 2003), this thesis uses the definition of the ISO 13407 standard.

The user-centred design is based on the following four principles:

> **The active involvement of users and a clear understanding of user and task requirements**. By involving users to the design process, valuable information can be collected about the context of use, the tasks and how the users are likely to work with the future product or system. When users are directly involved in the development process, it is possible for them to evaluate the developing product or system and influence the design as it evolves.
>
> **An appropriate allocation of function between users and technology**. The design decisions should not be only technology driven. The decisions should depend on many factors such as relative capabilities and limitations of human versus technology in terms of reliability, speed, accuracy, flexibility of response, financial cost etc.
>
> **The iteration of design solutions**. The repeated evaluation of the design solutions with the users provides an effective means of minimizing the risk that a system does not meet user and organisational requirements (including those requirements that are hidden or difficult to specify explicitly).

37 Note: ISO 13407 standard (1999) uses the term "Human-centred design". However, as the terms have evolved during the years, the "user-centred design" is used as a synonym for it in this thesis.

> **Multi-disciplinary design**. In order to address the human aspects of the design, the user-centred design needs many skills and thus multi-disciplinary teams should be involved in the design process. The team roles can include, for example: end-user, purchaser, business analyst, systems engineer, marketer, user-interface designer, industrial designer etc. Individual team members can cover several skills and roles; the team should be diverse, but it is not necessary for it to be large. (ISO, 1990)

The user-centred design process and the related activities are described in the next section *4.2. The User-centred Design Process Model*.

Implication for this thesis

In accordance with the principles of the user-centred design;

1. The research activities in this thesis involve the users (i.e. Teamware Group employees) in the design process,
2. The result of the research is not a technological solution, but a concept covering both technological and social aspects of teamwork,
3. The work has been iterated through workshops and frequent project meetings at Teamware Group, and
4. The design team is multi-disciplinary consisting of researchers from Helsinki University of Technology and Oulu university as well as project members from Teamware Group.

The practical application of the user-centred design into the real world research and design has resulted into various methodological approaches in scientific literature. Two specific design methodologies are examined next, *Usability Engineering* and *User-centred Product Concept Design*.

Usability Engineering

In simple terms, usability engineering can be described a process by which the usability[38] of a product could be attested and perhaps guaranteed. Faulkner (2000) states: Usability engineering is "*an approach to the development of software and systems which involves user participation from the outset and guarantees the efficacy of the product through the use of a usability specification and metrics*." The process also includes the notion of the design-evaluate-redesign cycle and influences all the parts of development "*from requirements gathering to installation*". (Faulkner 2000, pp. 10-13).

The usability engineering, similarly to the product development, has a life cycle. The life cycle (see *Table 6*) summarises the main tasks and produced information in the process.

38 Usability is defined in ISO 9241-11 (1998) as "The extent to which a product can be used by specific users to achieve specified goals with effectiveness, efficiency and ease of use".

Task	*Information produced*
Know the user	User characteristics, User background
Know the task	User's current task, Task analysis
User requirements capture	User requirements
Setting usability goals	Usability specification
Design process	Design
Apply guidelines, heuristics	Feedback for design
Prototyping	Prototype for user testing
Evaluation with users	Feedback for redesign
Redesign and evaluate with users	Finished product
Evaluate with users and report	Feedback on product for future systems

Table 6: The usability engineering life cycle model (adapted from Faulkner 2000, p. 15).

Implication for this thesis

The usability engineering focuses on development of the products and systems, in which the users and tasks are well defined. This thesis, however, has focused on creating a concept that describes the tasks (and the work) themselves; it is not possible to "know" them (see *Table 6*) as a pre-phase to the design work.

Usability engineering process is thus not used in favour of methodology with more emphasis in the concept design.

User-centred Product Concept Design

The *User-centred Product Concept Design* (UCPCD) focuses on experimental, discontinuous new product development. Its aim is to discover user needs that are not yet clearly defined (Kankainen 2002).

The UCPCD concentrates in the pre-product phases of the product development; designing the product idea and the validation of that idea. The typical product development processes assume that the idea for the product already exists and thus start from defining requirements for the product and then continue onwards to specification, prototyping and implementing the product.

The User-centred Product Concept Design utilises methods and techniques that are widely known and used: They are described in for example the *Field Methods* (Wixon & Ramey 1996), the *Contextual Inquiry* (Beyer & Holtzblatt 2002) and the Doctoral Thesis of Anu Kankainen (Kankainen 2002). However, there is no known authoritative source for the process of the User-centred Product Concept Design[39]. The following definition is adapted from a UCPCD course material.[40]

39 The basic elements in the UCPCD process can be found in the article Leyonard, D. and Rayport, J.F. (1997) Spark Innovation through Emphatic Design. Harward Business Review, November-December, 102-113.

40 The course, called T-121.700 User-centred product concept design, has been taught in Helsinki University of Technology. It is aimed for the students who study Usability and User-centred Design. The course focuses on the design and validation of product ideas based on customer requirements from a specific user group. http://usability.hut.fi/Opinnot/T-121.700/.

The UCPCD process is divided into four phases: *Defining the environment*, *User Study*, *Concept Design* and *Concept Validation*. The following *Table 7* summarises the UCPCD process similarly to the usability engineering life cycle model, presented previously.

Task	*Information produced*
Defining the Environment	Target users (e.g. a market segment) Design themes
User Study (planning, executing, analysing)	User group, User needs Discovered phenomena
Concept Design (e.g. brainstorming)	Product concept definition
Concept Validation	Representations of the product concept (e.g. storyboards, scenarios, mock-ups or prototypes)

Table 7: The UCPCD life cycle model.

The phases of the user-centred product concept design are elaborated further in the next section, *4.2. The User-centred Design Process Model*.

Implication for this thesis

The user-centred product concept design (UCPCD) offers better methodological support for this thesis (than the usability engineering), because the emphasis is on the phenomena, user needs and concept definition rather than on the user requirements and defined tasks.

The UCPCD life cycle model is used as the guideline for the research process of the thesis.

4.2. The User-centred Design Process Model

The research process in this thesis is based on the phases and methodology of the user-centred product concept design (UCPCD)[41]. The UCPCD phases are similar to the ISO 13407[42] (1999) user-centred design activities and the process model (see *Figure 3*).

The ISO 13407 process model consists of four stages of user-centred activity (ISO, 1999):

1. Understand and specify the context of use;
2. Specify the user and organisational requirements;
3. Produce design solutions;
4. Evaluate designs against requirements.

Additionally there are start and end points of the iterative cycle:
- "Identify need for user-centred design" and
- "System meets specified functional user & organisational requirements",

which are outside the primary user-centred activities.

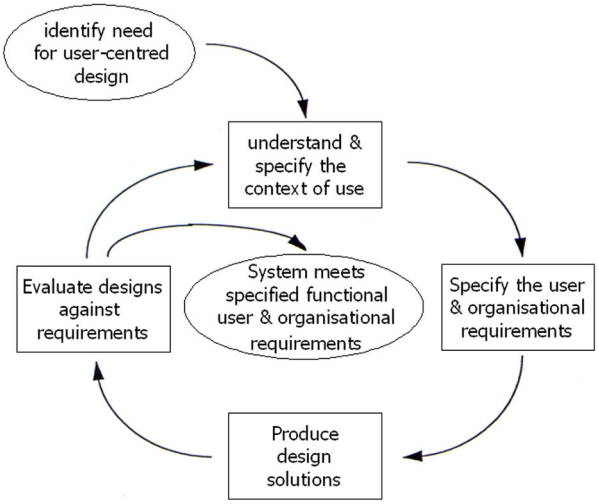


Figure 3: ISO 13407 human-centred design process model (ISO, 1999).

The phases of the user-centred product concept design develops on the user-centred activities by applying them in the context of concept design (see *Table 8*); the ISO 13407 standard describes the activities in a very generic way, while the UCPCD phases focuses on the concept design and describes the activities and resulting information in more detail.

UCD activities	UCPCD phases
Understand and specify the context of use	Defining the Environment
Specify the user and organisational requirements	User Study (planning, executing, analysing)
Produce design solutions	Concept Design (including e.g. brainstorming)
Evaluate designs against requirements	Concept Validation

Table 8: A comparison between UCD activities (ISO 1999) and UCPCD phases.

41 The phases of the user-centred product concept design originate from the Helsinki University of Technology course called T-121.700 User-centred product concept design. The course focuses on the design and validation of product ideas based on customer requirements from a specific user group. http://usability.hut.fi/Opinnot/T-121.700/.

42 Note: ISO 13407 standard (1999) uses the term "Human-centred design". The "user-centred design" is used as a synonym for it in this thesis.

The phases of the user-centred product concept design (UCPCD) are:

Defining the environment
In this phase, the focus is in defining the environment and the general direction towards which the process starts. This includes finding out the resources available for the process and selecting design themes. When these have been defined, the approximate category of target users is chosen (e.g. a certain market segment).

User Study
During the user study phase the study is executed with chosen techniques (e.g. Diary, shadowing, story group, contextual inquiry). The choice depends on the chosen focus of the study (i.e. What do we want to know about the users?). After collecting the data, it is analysed and summarised into *Description of the user group*, *Discovered Phenomena* and *User Needs* (with priorities, derived from phenomena).

Concept Design
During this phase, using the various brainstorming techniques, the product concepts are innovated, relying on the phenomena and user needs found in the user study. This phase results into a few *Product Concept Definitions* including market segment, user needs, and rough descriptions of *user interface and design*, *used technology* and *possible content* (for the product).

Concept Validation
Finally, the Product Concept Definitions are evaluated with the target user group. In the validation study, the concept definitions are formed in to *representations* so that the users can relate to the product. The representations can be storyboards, scenarios, mock-ups or prototypes, for example. The validation is executed preferably in a situation encouraging activity, so that it is easier for the user to experience the concept. The data from the validation study is then evaluated against chosen requirements/criteria.

Implication for this thesis

This thesis uses the four UCPCD phases as well as the information items mentioned above (e.g. *Discovered Phenomena* and *User Needs*) as a way to structure the research, analyse the gathered data, and design the concept.

4.3. The VIKSU Design Process

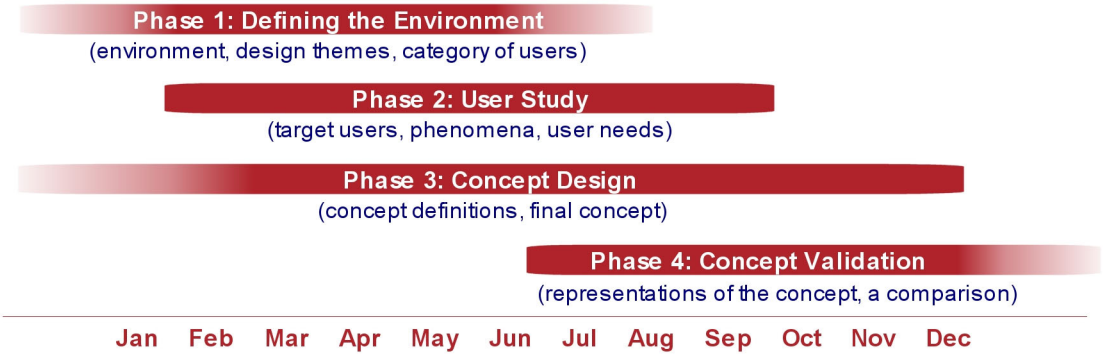


Figure 4: phases in parallel processes.

The Virtual Project Room -research started in the beginning of the year 2002[43]. Although a lot of material about the Teamware Group organisation had been collected in the past, additional research was necessary, because the organisation was changing continuously[44]. The additional research helped in understanding the virtual project work at Teamware Group.

The VIKSU design process follows the phases of the user-centred product concept design. The process model has been already described in *4.2 The User-centred Design Process Model*. The design phases were conducted in parallel (see *Figure 4*).

The phases 1. Defining the Environment and 3. Concept Design had already started before January 2002 (the time when the author joined the VIKSU -project). They were, however, given strong priority only after the start of year 2002. The phase 2. User Study lasted for most of the year 2002 and was started with six interviews[45]. The phase 4. Concept Validation began mid-2002 and lasted until early 2003.

The following chapters (5–8) describe the four VIKSU design phases in detail.

43 The author joined the VIKSU -project at that time; in January 2002.
44 The continuous change in the organisation was also confirmed by the project members from Teamware Group.
45 See *Research Methods* in *1.1. Objectives of the Thesis.*

5. Design Phase 1: Defining the Environment

Earlier in the VIKSU -project, there had already been research studies on the organisational environment of the Teamware Group. For Virtual Project Room -concept, going through the material from those studies resulted into the initial description of the overall environment at Teamware Group.

The description was then improved frequently through discussions in the project meetings. As the organisation kept changing during the research project, there were often details that needed updating.

RESULTS IN PHASE 1

Category of Target Users
The cross-functionally working employees

Design Themes
1. Support for the user-centred design at Teamware

2. An umbrella concept (containing previous research studies) of collaborative group work

3. Merging ideas from scientific literature to the concept

Organisation Structure and Communication Networks

In addition to the overall description, it was important to get to the level of individual employees (i.e. the user-centred design perspective). Since no normal organisational map or chart would describe the organisation in such detail, a research study was conducted. The study resulted into a map of communication network specific to the cross-functionally working employees.

The "TWG Communication Network" -study[46] benefited greatly from the interviews[47]. Based on the descriptions of the organisation by the employees[48], it was possible to draw a map of stakeholders (organisational functions, people and artefacts that were considered being parts of communication networks).

The map (a picture on a A3 paper sheet; see *Figure 5*) was further enhanced by comments of the employees to the preliminary versions.

Figure 5: TWG Communication Network.

46 More details in "TWG Communication Network" in *Appendix 1: Previous Research Studies in the VIKSU -project*.
47 See *Appendix 2: Research Findings*.
48 The interviews aimed to get a general picture about the organisation structures and the tools used in employee's own work.

To find out more about communication networks in the organisation, a workshop inspired by sociometry (see e.g. Wasserman & Faust, 1994[49]) was organised with ten employees. They drew their own conceptions of the communication network, both in respects to current situation and their desired goal (two separate maps). The instructions were to draw lines between objects in the tool, possibly with labels or descriptions, which would demonstrate the communication with respects to one's own work in the organisation. It was encouraged to add any new objects to the paper, if such were felt missing. The drawings were then used as a basis for discussion of the communication in the organisation and also as material for next iteration of the map.

The iterated map provided very good view to the organisation and its environment from the point of view of the employees working in cross-functional teams[50]. The analysis of the communication lines drawn to the maps allowed identifying the shapes of the communication flow and possible bottlenecks in the communication.

Results: Category of Target Users and Design Themes

As already described in the *1.1. The Objectives of the Thesis*, this thesis focuses on supporting virtual project work. Initially, however, the focus of the Virtual Project Room -concept was not that specific: The first design theme that was decided in a project meeting was that the concept would support user-centred design at Teamware Group. It did not specify in detail what kind of work the concept would focus on. The first design theme implied that as the category of users, the targets of the research would be the cross-functionally working employees at Teamware Group.

Later, as the concept design and the research studies[51] progressed, two design themes were added to the Virtual Project Room -concept.

First, as the VIKSU -project was nearing the end, it was decided that the Virtual Project Room -concept would be an 'umbrella' that contains aspects of all the previous research studies and integrates them to the concept.

Second, when the Virtual Project Room -concept had reached its second version (in may 2002), it was realised that the concept lacked strong links to the related scientific literature. Consequently, also the assertions made in the concept were missing the justifications based on theoretical background. The last design theme was thus: to find inspiring or supporting ideas from the literature to strengthen the concept.

49 Wasserman, S., Faust, K. (1994) Social network analysis. Methods and applications. Cambridge: Cambridge university press.
Also: Scott, J. (1991) Social network analysis. A handbook. London: Sage Publications.

50 The Teamware environment is described in more detail in section "1.3. The Environment" of the Virtual Project Room Concept -document (Huuhtanen 2003).

51 The research studies are presented in the *Appendix 1: Previous Research Studies in the VIKSU -project*.

6. Design Phase 2: User Study

The previous research studies[52] had focused on quite varying groups of users: participants to the requirements management process, a Kick-off project team, vision group & product definition group, Teamware Group employees (in general), and cross-functional teams.

The phase 1 of the concept design identified cross-functionally working employees at Teamware Group as the approximate category of target users.

RESULTS IN PHASE 2

Target Users
The virtual project teams

Discovered Phenomena
(listed in the chapter)

User Needs
(listed in the chapter)

Results: Target Users

For the Virtual Project Room -concept, it was necessary to narrow down the definition of the target users from the approximation made in design phase 1. The definition was clarified two times during the research:

First, the target users were defined as "Virtual Teams" meaning the specific groups of people working on "Virtual Team" projects at Teamware Group. The term "Virtual Team" and its definition were in internal use at Teamware Group.[53]

Later, the definition of the target users was extended to "virtual project teams". It is a term specified by the VIKSU -project, and is related to the terms "virtual project" and "virtual project work".[54]

Results: Discovered Phenomena

The interaction with the employees at Teamware Group through the interviews and the TWG Communication Network" -study allowed to discover phenomena related to the employees and the organisation.

Another research study that substantially contributed to the discovering of the phenomena was the *Workshop on Planning the Kick-off Event*[55]. The study aimed to get an understanding of the typical project at Teamware Group. The focus was in the events, tasks and the stakeholders.

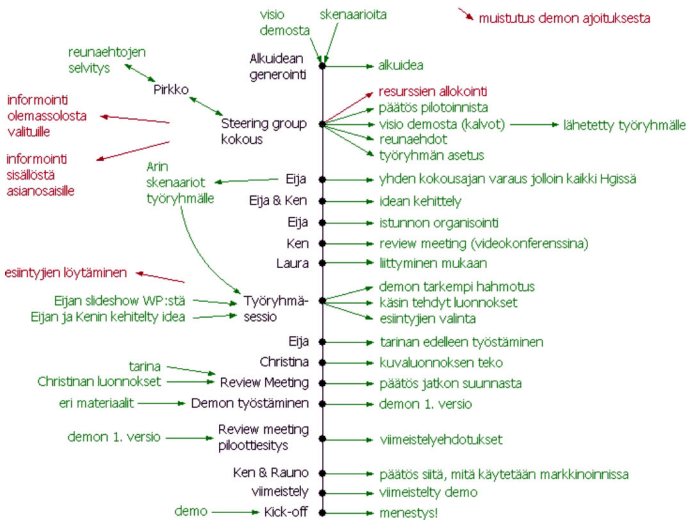


Figure 6: Timeline of the Kick-off project.

52 See *Appendix 1: Previous Research Studies in the VIKSU -project*.
53 The definition for the "Virtual Team", as used at Teamware, is described in "Virtual Teams at Teamware", in *2.2. Virtual Team*.
54 See *2.3. Virtual Project Work*.
55 More details in "The Workshop on Planning the Kick-off Event", *Appendix 1: Previous Research Studies in the VIKSU -project*.

The study resulted into a timeline of the Kick-off project (see *Figure 6*), which highlighted the ad hoc nature of the project; only part of the project is planned well beforehand, some decisions are made "on-the-fly".

Altogether, the discovered phenomena related to the Virtual Project Room -concept resulted into the following list:

- Project is a partly ad hoc process
- Work styles include: formal and informal meetings, independent work
- The users have varying levels of comfort towards computers
- Many computer systems and tools. The systems do not always communicate with each other.
- Details outside the formal organisation structures change quickly and often
- Large parts of cross-functional communication is conducted informally
- Some prefer to communicate with computer, others face-to-face
- Social relations have a significant role in the work

These phenomena were then used to formulate the user needs, in addition to the needs expressed directly during the interviews, the workshops and the project meetings.

Results: User Needs

Motivated by direct user needs, there were three research studies focused on creating a computer tool as the solution. The first one concentrated on creating a better *requirements management* system that would also relate to use contexts and user tasks. That study expanded into a Master's Thesis by Johnson (2002).[56]

The second study focused on creating a tool that would allow commenting, editing and analysing of the documents in the system. The tool was called *DECA* (distributed editing and commenting)[57]. The DECA study contributed to the Virtual Project Room -concept by emphasising the importance of the communication and interoperation of the tools; the tools should be designed as part of a network, not as individual systems.

The aim of the third study was to find ways to visually connect product features, user needs and segment scenarios to each other. The *Feature Browser* tool[58] raised two important issues in respects to Virtual Project Room -concept: 1) in cross-functional work, the ontologies (e.g. terminology, semantics, language, relations between terms) used by the employees can be very divergent. It is very difficult for a computer tool to efficiently overcome that kind of gap. 2) Sometimes simple and conventional methods are more powerful and flexible than computers, such as using the Post-It notes to categorise and sort user needs.

56 More details in "Requirements for Requirements Management System", *Appendix 1: Previous Research Studies in the VIKSU -project*.
57 More details in "DECA", *Appendix 1: Previous Research Studies in the VIKSU -project*.
58 More details in "Feature Browser", *Appendix 1: Previous Research Studies in the VIKSU -project*.

In addition to the direct user needs, more needs were found during the interviews and the TWG Communication Network" -study, in which the Teamware Group employees also discussed about issues with the work and ideas how to solve the issues. Most of the ideas (among the other research data) were recorded into a group of web pages called the *"Virtuaaliprojektihuone KESSU" -SIG*.[59] The web pages were another research study in the VIKSU -project that allowed the project to test an implementation of the shared workspace[60].

The web pages had a section for *Idea Forge*, a mock-up of a system to collect and categorise ideas from employees (see *Figure 7*). The ideas contained meta information related to e.g. the purpose of the idea, who originated the idea, what was the target of the idea and what kind of effect the implementation of the idea would have. The ideas in the Idea Forge ranged from small issues with computer programs to suggestions for large-scale organisational changes.

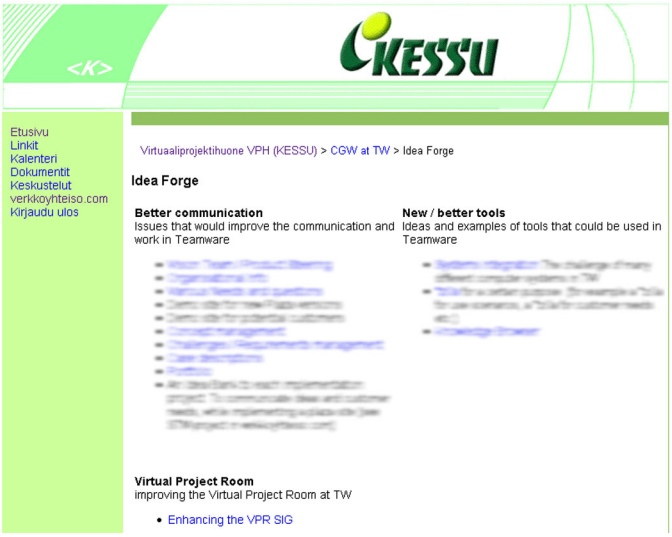


Figure 7: "Virtuaaliprojektihuone" -SIG.

The direct and indirect user needs mentioned above were analysed and combined with the needs derived from the discovered phenomena. These needs were then summarised into seven main user needs that were used in the later phases of the concept design.

The seven user needs for the Virtual Project Room -concept are:

No Strictly Defined Work Process. Adhering to strictly defined processes cannot efficiently support the virtual project work in Teamware Group. The organisational culture in the Teamware Group seems to encourage employees to develop their work practices rather than force a certain work process to everyone. This emphasises the need for the tools to be flexible and not to restrict the work in one way only. The work process is partly planned, partly ad hoc.

Flexible Shared Decision-making. The decision-making is especially difficult in the Teamware Group environment, because all the members have their own responsibilities to their peers and other stakeholders, and because the terminology and language between them is not the same. The shared decision-making is probably achieved well by using tools that allow flexible construction and reconstruction of information structures or by using more ordinary methods such as drawing boards and Post-It notes.

59 More details in "The Virtuaaliprojektihuone KESSU -SIG", *Appendix 1: Previous Research Studies in the VIKSU -project*.

60 The concept of a shared workspace is described in *3.1. Shared Workspace*.

Encouraging Organisational Development. The organisational culture at Teamware Group encourages organisational development. More specifically, the organisational development is taking place in various forms from organisation wide to individual development. It is thus not only a process that flows from the top of the organisation to the bottom.

The strength in this approach is in plurality: allowing the employees / teams to find their best work practices. Organisation wide development can support that goal, although great care has to be taken that the different efforts do not have adverse effects on each other in the long run.

Differences in Terminology and Language. The different organisational functions use different terminology and language to deal with the daily work they have. When employees from these different functions co-operate, it is necessary to communicate also the differences in terminology to one another.

The communication is not only "data"; it is full of meanings and terms that cannot be directly translated. For shared understanding, it is necessary to, for example, to jointly create the shared definitions for terminology and language, or use person(s) as "translators" between different domains of terminology.

Cross-functional Virtual Project Work. Characteristical to this type of work is that the members of the team are not restricted to those defined at the start of the project. Rather, employees are invited to join and leave based on the current needs of the project. This puts the communication and sharing information into a vital position as there are members in the periphery of the project that most likely also need the information shared inside the project.

In practice this is most viable when the communication culture in general emphasises open sharing of information and that tries to remove any barriers to accessing the information; in principle, it should be possible for everyone to access all information.

Project Life Cycle Based on Need. The project is more volatile than in traditional sense. The typical cross-functional projects at Teamware Group are started based on a specific need and they end when that need is not current anymore. This allows for great flexibility and enables the use of broad level of expertise. It also puts high demands on forming shared understanding and making the information available to everybody concerned.

Computer-based environment is not a closed system. The work practices at Teamware Group are not restricted only to the computer-based tools; much of the work is done also without direct use of computers. Currently the computer-based environment is largely closed; it does not directly support, for example, keeping a catalogue of books or other material available in people's rooms. It is, however, used for reserving rooms for meetings.

7. Design Phase 3: Concept Design

Early ideas for the Virtual Project Room were already discussed during the years 2000 and 2001. However, only after the beginning of 2002, the Virtual Project Room concept design was given high priority.

The background for the concept design has been already described in this document: the objectives[61], the environment and the design themes[62], as well as target users, discovered phenomena and user needs[63].

RESULTS IN PHASE 3

Concept
The Virtual Project Room – An abstract concept for virtual project work

Results: Concept

What is a concept? The term concept was analysed to get a starting point for the concept design of the Virtual Project Room.

According to Oxford English Dictionary[64] the term concept is defined as:

> A thought/idea, a disposition/frame of mind or an opinion.

In the fields of logic and philosophy, the dictionary defines concept as:

> The product of the faculty of conception; an idea of a class of objects, a general notion or idea.

Ulrich & Eppinger (1995) describe a product concept as a rough description of the technology, functionality and form of a product or a service, which is created during very first phase of the product design process.

Although the resulting Virtual Project Room -concept in this thesis does not aim to be a concrete product, the definition of product concept can be adapted for it: the Virtual Project Room -concept is an abstract concept containing suggestions for a next version of a concrete product.

Following the recommendations of Ulrich & Eppinger, the design of the Virtual Project Room -concept (the first phase of product design) was conducted by multidisciplinary team. The team identified customer needs, generated alternative product concepts in response to the needs, and selected one concept for future development. The selection was conducted by evaluating and comparing the concepts with respect to customer needs and other criteria emerging from developer organisation, development process and marketplace.

61 See *1.1. The Objectives of the Thesis.*
62 See *5. Design Phase 1: Defining the Environment*..
63 See *6. Design Phase 2: User Study*,
64 Oxford English Dictionary (http://dictionary.oed.com/) gives many (sometimes up to 30) definitions for single words. There are, however, limited set of definitions that are applicable to this document. (The word 'Concept' sampled on 10.10.2002).

Preliminary versions of the Virtual Project Room

The first versions of the Virtual Project Room -concept were brainstormed based on the interviews at Teamware Group and the documentation of the VIKSU -project from the years 2000-2001. Several project meetings were held at Teamware Group, where the preliminary versions of the concept were analysed and commented by the project participants.

After the version v1 of the Virtual Project Room -concept, the efforts in the concept design were directed towards analysing and incorporating the information from the previous research studies[65] into the concept. Consequently, the Virtual Project Room version v2 (published on 1.5.2002) had a strong emphasis on the empirical data collected during the research studies.

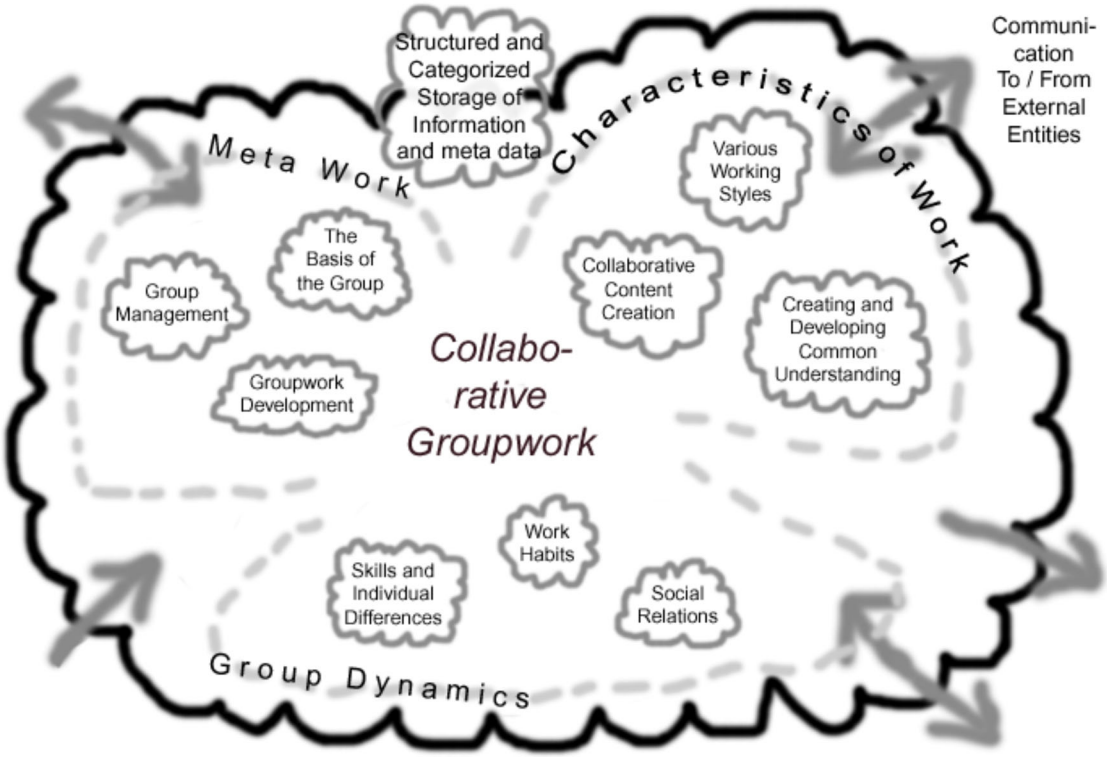


Figure 8: The Virtual Project Room -model v2, the elements.

At the centre of the Virtual Project Room version v2 (see *Figure 8*) is collaborative group work (the focus of the concept at the time). The concept is structured into three areas and two additional viewpoints that are in the "periphery" of the collaborative group work:

> **Areas of the Virtual Project Room v2:**
> Meta Work
> Work
> Group Dynamics
>
> **The viewpoints of the Virtual Project Room v2:**
> Structured and Categorised storage of Information and Meta Data
> Communication To / From External Entities

65 See *Appendix 1: Previous Research Studies in the VIKSU -project*.

At the more detailed level, the three areas were further divided into nine elements:

> **Meta Work:** Group Management, Basic Purpose of the Group, and Groupwork Development
>
> **Work:** Collaborative Content Creation, Various Working Styles, and Creating and Developing Common Understanding
>
> **Group Dynamics:** Skills and Individual Differences, Work Habits, and Social Relations

From the Virtual Project Room -concept v2, the concept design continued by seeking to restructure the elements of the concept in a more logical way, as was requested by the project participants.

The Structure for the Concept

The Virtual Project Room -concept version v3 was work-in-a-progress version of the v4, and is not discussed here any further. The design of the structure for the new Virtual Project Room -concept (versions v3 & v4) was conducted by combining the structure of the Virtual Project Room v2, the previous research projects and a teamwork literature review.

The preliminary structure for the Virtual Project Room -concept version v4 was inspired by thorough examination of the issues discussed in the Huczynski & Buchanan (2001). The preliminary structure was then discussed and refined in project meetings of early autumn 2002.

The actual literature review consisted of 10 books related to teamwork (in alphabetical order):

> **Brown** (1988) Group Processes: Dynamics within and between Groups
>
> **Duarte & Snyder** (2000) Mastering Virtual Teams: Strategies, Tools, and Techniques That Succeed
>
> **Huczynski & Buchanan** (2001) Organizational Behaviour – An introductory Text
>
> **Katzenbach & Smith** (1994) The Wisdom of Teams: Creating the High-Performance Organization.
>
> **Katzenbach & Smith** (2001) The discipline of teams: a mind-book-workbook for delivering small group performance.
>
> **Lipnack & Stamps** (2000) Virtual Teams – People Working Across Boundaries with Technology. 2nd Edition
>
> **Parker** (1994) Cross-functional teams: working with allies, enemies and other strangers.
>
> **Procter & Mueller** (2000) Teamworking
>
> **Senge** (1994) The Fifth Discipline.
>
> **Senge et al.** (1994) The Fifth Discipline Fieldbook: Strategies and Tools for Building a Learning Organization

Table 9: The 10 books related to teamwork, used in the literature review

The contents of the books were summarised into topics and then combined in to 19 *Derived General Topics*[66] that were typically shared between the books. These derived general topics were: *Learning, Facilitation, Work Experience, Expertise, Team Structure, Goals and Purpose, Team Life Cycle, Status and Power, Leadership, Decision-making, Teamwork Management, Organisational Requirements, Communication, Roles, Performance, Team Development, Evaluation, Motivation, and Tools*.

The derived general topics were then matched with the elements in the preliminary structure. The elements were adjusted so that the important issues raised in the literature were included into the Virtual Project Room -concept.

All the 19 derived general topics were fitted into at least one element of the Virtual Project Room. However, as can be seen from the *Table 10*, the Virtual Project Room emphasises issues differently from the literature. For example Communication topic has an element of its own in the Virtual Project Room -concept, while Leadership is included in an element with many other derived general topics.

Derived General Topic(s)	***The Elements of the Virtual Project Room***
Communication	**Generic Infrastructure** (*Active Storage, Discussion, Conferencing, Library)*
Team Structure, Goals and Purpose, Roles, Status and Power, Leadership, Decision-making	**About the project** (*Project Description, Roles and Responsibilities, Resources*)
Team Life Cycle, Teamwork Management	**Planning** (*Process Chart, Plans, Milestones, Open Issues, Action Points)*
Performance, Evaluation	**Results** (*Results and Artefacts, History and Timeline*)
Learning, Facilitation, Work Experience, Expertise, Team Development	**Need to Know** (*Contacts and People Who Can Help, Documentation, Learning More, Tips & Tricks*)
Learning, Work Experience, Team Development, Evaluation, Motivation	**Coffee Break (Ideas)** (*Best Practices, Our SWOT)*
Tools	**The Toolbox**
Organisational Requirements	**Requirements for the Organisation**

Table 10: The relation between Derived General Topics and the (adjusted) elements of the Virtual Project Room.

66 See the details of the literature review in *Appendix 5: The Review of the Teamwork Literature*.

In addition to the Derived General Topics, similar matching was conducted with the structure of the Virtual Project Room -concept v2[67] and the previous research studies[68]. The following *Table 11* summarises the relations between previous research studies and the elements of the Virtual Project Room.

	Generic Infra-structure	About the Project	Planning	Results	Need to Know	Coffee Break (Ideas)	The Toolbox	Req. for Org.[69]
Requirements Management -study		X	X					X
Kick-off Event	X	X	X	X	X	X	X	X
"Virtuaali-projektihuone KESSU" -SIG	X	X	X	X	X	X	X	X
DECA							X	
TWG Communication Network	X	X	X	X	X	X	X	X
Feature Browser							X	X
Virtual Project Room v2	X	X	X	X	X	X	X	X
The interviews	X	X	X	X	X	X	X	X

Table 11: Research studies that have motivated the elements of the Virtual Project Room -concept.

The evolved concept was discussed and modified in several project meetings during autumn and winter 2002.

The Final Virtual Project Room -Concept

The Virtual Project Room is divided into seven elements describing aspects of teamwork (see *Table 10* and *Figure 9*). These elements aim to capture the different viewpoints in to teamwork. The viewpoints cover literature from different disciplines, and both practical and theoretical research. The seven elements are further divided into 17 (sub-) elements that discuss specific issues of the main elements.

In the following, the main seven elements are described shortly.

Generic Infrastructure, as the name implies, forms the basis of communication and sharing the information in the Virtual Project Room. Its essence is in providing as generic practices and tools as possible to maximise their flexibility and suitability for different needs.

67 The structure is described in the *Preliminary versions of the Virtual Project Room*, earlier in this chapter.
68 The previous research studies are introduced in *Appendix 1: Previous Research Studies in the VIKSU -project*.
69 Requirements for the Organisation.

The downside is that the infrastructure does not give support to any process specifically, thus it's up to the users to figure out how to use the infrastructure for a chosen task. As an opposite of generic infrastructure, the element *Toolbox*, concentrates on specific tools aimed at supporting specific needs and specific processes (or process types).

About the Project -element serves at least two purposes; it is the information centre for the people outside the project and also the description of the foundation that the project builds on.

The most important items for the people outside the project are the description of the project and its goals, the members and their expertise or responsibility areas, and other resources that the project has.

For the project team, the most important items are the jointly defined and agreed goals of the project, roles and responsibilities of the team members and the other resources of that the project has.

Figure 9: The elements of the Virtual Project Room v4.

Planning -element could, in a simplified sense, be called "the team management related issues" of the Virtual Project Room. In essence, this element is about directing the project; i.e. planning, control and follow-up.

Directing a Virtual Project is especially challenging, because tasks, tools and resources may change during the project much more than in traditional project. It is then, the task of the project team to be flexible to change and at the same time define clear goals and plans to keep the project in control.

Results -element gathers all the outcomes of the Virtual Project in one specific place. The outcomes can be, for example, written decisions made during the project, products that the project produces or a descriptive history of the project; all the outcomes are results of what the project has done and what it has accomplished.

The importance of this element is in the gathering and summarising; time is not wasted on searching when all the made decisions, specifications and other artefacts are viewable from a single place.

Need to Know -element gives ideas how to improve the knowledge sharing processes. Virtual Project members are always building their knowledge and skills on top of their current abilities.

There are concrete advantages in collecting and sharing the experiences (and, if possible, knowledge) in order to have a "collective memory" of the successes,

failures, good practices et cetera in the teamwork of the past. That information (and, possibly, knowledge) can be used to improve and give guidance to the teamwork in the future.

Coffee Break (Ideas). Because also informal situations are used in getting work done, this element aims to support also the "informal work" so that good ideas don't get lost. In order to avoid the informal time becoming formal work time also, this element aims to support the informal work in a non-intrusive way.

Participation should be voluntary, although encouraged. Employees could discuss issues concerning the work and suggest ideas to others during a time or in a place that is considered a break (e.g. coffee break). Should any important issues or ideas arise, they should be recorded somewhere (e.g. a room with whiteboards).

The Toolbox -element is basically a place to store and reference to various tools available to the employees.

The tools can be of any type. In general, the tools in the *Toolbox* should try to serve some particular task or a certain style of work. If the tool is very generic, it could be included into the *Generic Infrastructure*, instead.

Requirements for the Organisation. This last element differs greatly from the others in the sense that it is not about virtual project work, *per se*. It is, however, very important to acknowledge that virtual project work is not performed in a vacuum; especially in business environment, it is the organisation (such as a company), which provides the resources and possibilities as well as the overall boundaries and restrictions to the projects.

This element discusses issues such as organisational culture, organisation structure and organisational communication.

-- A more detailed description of the elements is available in Appendix 7: The Elements of the Virtual Project Room. --

All in all, The Virtual Project Room is a concept that aims to cover lots of issues without being too shallow on the details. It approaches work at both generic and specific level: The concept aims to provide guidance based on the general solutions, and also provide some examples of the very specific tools that can be used in the work.

The following list summarises the characteristics of the Virtual Project Room. The concept:

> Acknowledges that all work is not performed with computers and gives design suggestions based on that view.
>
> Offers a structure of elements that categorises different aspects of work and gives suggestions on how to design work and systems based on those elements.
>
> Advices the project member on where to put and where to find different types of information related to the project.
>
> Gives ideas for tools that could be used in a project

Bridging the Gap

So how does the Virtual Project Room -concept bridge the gap between computer-based and non-computer-based support for virtual project work?

The Virtual Project Room -concept does not explicitly define which elements should be implemented in computer software and which not. Instead, examples of both computer-based and non-computer-based[70] ways to perform the work has been given in the description of the Virtual Project Room -concept. The following examples enlight this approach.

For example, some Teamware Group employees prefer video- and telephone conferencing, while others prefer discussion forums and chat-tools. The employees have also remarked they use handwritten post-it notes during the product design, while others are comfortable with computer-based diagram-tools. In addition, the roles and responsibilities are sometimes decided e.g. with simple spoken agreement, sometimes with a formal written agreement or with a computer-based system. The way how this information is communicated to third parties is often decided depending on the situation.

The Virtual Project Room –concept offers all these choices and thus allows the employees to work in the style they prefer. This *flexibility* has been one of the main motivators in this thesis. Building on the ideas of Fitzpatrick (2002)[71], who emphasises the need for more flexible and evolvable software, the concept emphasises flexible support for teamwork, where software and also more traditional tools are used in complementary ways.

Also the scenario created for the Virtual Project Room -concept[72] has been written to allow both computer-based and non-computer-based ways to perform the work. Even though the scenario in general emphasises the computer-based ways to perform the work, it should be understood that it is not necessary to use computer-approach in the elements of the Virtual Project Room -concept. The following excerpt from the scenario shows how a complementary approach could be possible:

> The InfoShare project has prepared the first candidates for the marketing material of the new product version. The material is placed under the "Outcomes and Artefacts" -topic in the "Results" -section. Next to the links of the marketing material is a short description, and guidance how to find the material in paper form.

70 Opposite to computer-based work, non-computer-based work refers to all the work not performed using computers.
71 See *1.3. Motivation*
72 The scenario is described in *8.1. Results: Representations of the Concept.*

8. Design Phase 4: Concept Validation

This chapter finishes the description of the phases in the design process. The design phase four describes how the Virtual Project Room -concept was validated.

The validation has been done in two different ways. First, two representations were made of the concept, to concretise the concept. Second, a comparison with the Locales Framework was conducted to examine the merits and weaknesses of the Virtual Project Room -concept.

RESULTS IN PHASE 4

Representations of the Concept
Use Scenarios,
Pl@za Migration Plan

Comparison with Locales Framework

8.1. Results: Representations of the Concept

To concretise the Virtual Project Room -concept, two representations of the concept were created: a use scenario and a Teamware Group internal document called Pl@za Migration Plan.

The Pl@za Migration Plan contains suggestions for the Teamware Group on ways to integrate the elements of the Virtual Project Room -concept into their product, the Teamware Pl@za. That document will not be discussed in this thesis. The use scenario is, however, presented next.

The Scenario

The scenario was created to give an idea what the Virtual Project Room -concept could mean in practise. It was originally included, per chapter, to the description of the elements in the Virtual Project Room -concept document. A shorter version of the scenario was also included to the beginning of the same document.

> A Virtual Project named InfoShare, consisting of members (one each) from Sales, Marketing, Production and Product Development, has been given a task to define the needs for the information distribution, since the company is going to launch a new product version.
>
> A virtual workspace (i.e. The Virtual Project Room) is created for the InfoShare group. This allows for the group to immediately start active work on the project. The *Generic Infrastructure* is available for sharing documents (*Active Storage*), *Discussion, Conferencing* and for looking more related information (*Library*).
>
> In the preliminary meeting, the InfoShare team defines the initial roles and responsibilities for the members. In addition to the roles and responsibilities, the general project information is described to the project web pages (Under *About the Project – Project Description* and *Roles and Responsibilities*), so that also other employees become aware of the project. Later on, as the project plans develop further, the *Resources* information is updated to visualise what are the project's economical possibilities and how much time each member has for the project.
>
> Decisions and plans are stored to the computer system and are announced to general marketing etc. forums, so that employees are aware of the progress. As the progress of the tasks and the process plans are kept up-to-date, it is relatively easy to get an idea of how well the project is going. Much of the overlap of work between co-workers and other projects can thus be avoided.

The most difficult problems are discussed in the public discussion forums of the project and also an employee from consulting is asked to comment on the discussion.

The InfoShare project has prepared the first candidates for the marketing material of the new product version. The material is placed under the "Outcomes and Artefacts" -topic in the "Results" -section. Next to the links of the marketing material is a short description, and guidance how to find the material in paper form.

During the project, the several rounds of candidates are evaluated and the reasons for approval or rejection are written next to each candidate.

The time for extensive, company-wide commenting and approval for the new marketing material has come. Thanks to the extensive contact information about all the employees of the company, it is easy to find the main responsibles of the different functions in the different countries (so that those employees can be informed personally, in addition to publishing the information in marketing forums).

During the international discussion, it is noted that new guidelines for the company logo has been just published. Consequently, the new guidelines are added to the documentation section of the InfoShare project.

Near the end of the project, an idea comes up (during "Coffee Break" discussions) that there could be a self-teaching interactive demo about the new version and how it differs from previous products.

After all participants have seen the idea in the whiteboard and commented on it, it is decided to approach management and ask whether another Virtual Project should be created to design that demo.

8.2. Results: Comparison with the Locales Framework

As mentioned in *1.3. Scope of the Thesis*, the Virtual Project Room -concept has not been implemented as a shared workspace in this thesis. Thus, it is not possible to validate it in the similar fashion as groupware tools could be validated[73]. Instead, the validation of the Virtual Project Room -concept is conducted as a comparison with the Locales Framework, a toolkit for social-oriented design of collaboration software.

In the following the Locales Framework is introduced, then the Virtual Project Room -concept is validated using the framework.

The Locales Framework

The Locales Framework is motivated by the need to incorporate social thinking in to the software practices for collaborative systems design. (Fitzpatrick 2002).

The definition of the Locales Framework starts with the "*locale*". It is the primary unit of analysis and design in the framework. A locale does not exist a priori as does a space or room. "...A locale is the place constituted in the ongoing *relationship* between people in a particular social world..." The framework is based on a metaphor of *place* as the lived interaction with space and resources. (Fitzpatrick 2002).

The metaphor of place embodies principle of *centres* giving rise to relationships. The shared purpose of the social world, for example, provides a centre around which the people, spaces and resources make sense. (Ibid).

73 This issue is discussed in *10.1. Applicability and Validity*.

The Locales Framework consists of five aspects. Each of these aspects characterises the nature of work from a different perspective:

> **Locale Foundations.** Identifying the group or social world (Is there a shared goal? How membership is defined? Is there internal structures in the group?). Identifying their *locale* (the spaces, objects, tools and resources they use to support their interactions).
>
> **Civic Structures.** The broader environment of the locales. Could be physical, spatial, organisational, informational, legislative, etc., depending on what is relevant. Also relates to external influences, locale life cycle etc.
>
> **Individual Views.** Groups are made up of individuals belonging to many social worlds. They have differing views of the locales, which they negotiate with each other. The intensity of the participation varies dynamically over the locales.
>
> **Interaction Trajectory.** The locale "in action" over time: past, present, and future; cycles, rhythms, and phases; the performance of the work, the articulation of the work etc.
>
> **Mutuality.** The glue of collaborative activity – how *presence* is enabled in a locale and how *awareness* of that presence is supported. Mutuality enables the "w" questions to be answered: who, what, when, where, why, and (almost "w") how. (Fitzpatrick 2002).

The aspects are not orthogonal; they are in fact highly interdependent and overlapping. Their purpose is to highlight different perspectives to the same phenomenon. The intent of the framework is to serve as a set of heuristics or a sensitising checklist for design. It cannot be used mechanistically in a cookbook fashion (Ibid).

The Locales Framework describes also a two-phased process that can be used in design:

> **Phase 1: Understanding the Current Locales.** The aim is to understand the current situation in the locales of interest through using the framework.
>
> **Phase 2: Evolving New Locales.** The aim is to explore possibilities to enhance support for activities in the locales by either improving existing locales or evolving new ones. Questions in this phase could be: What weaknesses in the current locales could be improved? How locales could be enhanced to better support mutuality, individual views etc.? (Fitzpatrick 2002).

The Comparison

This comparison will examine the elements of the Virtual Project Room -concept by going through the five aspects of the Locales Framework, one by one. The comparison is summarised in *Table 12*.

The features of the group, such as shared goals and membership, discussed in the **Locale Foundations** -aspect, can be found in the *About the Project* -element of the Virtual Project Room -concept: The element covers topics such as *Project Description* and *Roles and Responsibilities*.

The locale foundations emphasises also the building blocks of the locale: the spaces, objects, tools and resources. These issues are discussed in the elements *Generic Infrastructure*, *About the Project* and *The Toolbox*.

The **Civic Structures** -aspect, first and foremost, is about the surrounding environment of the locale. In the case of the Virtual Project Room, the organisation has a lot of influence to the virtual project work. These issues are covered in the *Requirements for the Organisation* -element.

This aspect also considers external influences on a locale, such as life cycle processes and interaction between locales. The Virtual Project Room has a strong emphasis in the project structure and its life cycle (e.g. *Planning* and *Results* -elements). Interaction issues are discussed in e.g. *About the Project* -element.

Individual Views -aspect reflects very similar issues that are discussed in the definition of the Virtual Project Room and virtual project work. Thus there is no explicit element about this aspect. Some features of individuality (e.g. skills and learning) are discussed in the *Need to Know* -element.

The temporal views and the different flows of the **Interaction Trajectory** -aspect are central in the *Planning* and *Results* -elements. The *Process Charts*, *Plans* and *Milestones* -elements on one hand and *History & Timeline* on the other guide the action of the "locale" over time.

One of the most important aspects, that is out of the scope in the Virtual Project Room, is **Mutuality**; the *presence* of participants and objects as well as *awareness* of that presence. The Virtual Project Room -concept limits itself to describing different aspects of work. However, when an implementation using the concept is built, it is very important to consider how presence and awareness are represented in the implementation. This issue is discussed further in *The Support for Awareness* (this chapter).

Aspects of the Locales Framework	***The Elements of the Virtual Project Room***
Locales Foundations (group; locale)	**Generic Infrastructure**, **About the Project**, **The Toolbox**
Civic Structures (environment, external influences, locale life cycle and structure, interaction between locales)	**Requirements for the Organisation**, **Planning**, **Results**, **About the Project**
Individual Views (individuality, many memberships)	*In the definition of the virtual project work*, **Need to Know**
Interaction Trajectory (past, present, future; flow)	**Planning**, **Results**
Mutuality (presence, awareness)	*Not considered an element of work, an implementation issue*
Not included into the aspects:	**Coffee Break (Ideas)**

Table 12: A comparison between the Locales Framework and the Virtual Project Room -concept.

There is one element that does not directly belong to any of the aspects defined in the Locales Framework. The *Coffee Break (Ideas)* concentrates on informal communication. Using the Locales Framework, informality issues could most likely be addressed, if they are emphasised. The Virtual Project Room -concept, however,

considers informal communication such an important element of work that it has been mentioned separately.

Support for Awareness

As discussed in *The Comparison*, the elements of the Virtual Project Room do not directly describe how awareness and presence could be supported in virtual project work. It is, however, a very important aspect of a shared workspace.

The product development projects are typically divided into parts based on the information system that is being developed. That division, however, is not enough. As Farshchian (2001a) remarks, no matter how rational the division is, each development group will still need a lot of information from outside the group in order to coordinate its work. Access to this ad hoc information becomes especially difficult when the developers are geographically distributed. (Farshchian 2001a).

Awareness can be maintained simply with **close physical distance**. Kraut & Egido (1988 Ref. Farshchian 2001a)[74] found that in a study of 70 research labs, physical proximity increases the *frequency* and the *quality* of communication and decreases the *cost of initiating* communication. Using social abilities, the researchers within close proximity could "look over shoulder" and "keep in touch" to be aware of the status of the product being developed. (Kraut & Egido 1988 Ref. Farshchian 2001a).

In distributed cooperation, where distances are long, both the amount and quality of the information decreases. In addition, providing and consuming the *awareness information* becomes explicit burden to the co-workers. (Ibid).

Farshchian (2001a) argues that **generic tools for simulating long-term physical proximity** of the distributed project members are needed. This would enable an easier and cheaper way for developers to initiate collaboration, when needed.

Without going into more details of this issue in this thesis, the following *Table 13* presents a suggestion for awareness elements that could be included to a shared workspace.

Elements of workspace awareness	
Presence	Who is in the workspace?
Location	Where are they working?
Activity Level	How active are they in the workspace?
Actions	What are they doing? What are their current activities and tasks?
Intentions	What will they do next? Where will they be?
Changes	What changes are they making, and where?
Objects	What objects are they using?
Extents	What can they see? How far can they reach?
Abilities	What can they do?
Influence	Where can they make changes?
Expectations	What am I to do next?

Table 13: The elements of workspace awareness (Farshchian 2001b).

74 Kraut, R., Egido, C. (1988) Patterns of contact and communication in scientific research collaboration. In *CSCW'88, Proceedings of the Conference on Computer Supported Cooperative Work*. pp. 1-12. New York: ACM Press.

9. Summary

The research question in this thesis has been:

> **How could workspaces provide computer-based and non-computer-based support for teamwork in a virtual project at Teamware Group?**

The three detailed research questions have been[75]:

> RQ 1: What is teamwork in a virtual project?
>
> RQ 2: How to support teamwork in workspaces?
>
> RQ 3: What is the structure of the Virtual Project Room?

Each of the following answers (A 1 – A 3) provides a solution to the detailed research question of the same number (RQ 1 – RQ 3). These solutions have already been discussed in chapters *2. Teamwork in a Virtual Project*, *3. Support for Teamwork in Workspaces* and *7. Design Phase 3: Concept Design*.

A 1: Virtual Project Work

The answer provided here is a Teamware Group specific solution to the question: "*What is teamwork in a virtual project?*"

Through defining teamwork and virtual teams[76] it has been possible to form a definition of **virtual project work**:

> The Virtual Project Work is performed in a Virtual Project, which sets the structure for the work.
>
> Virtual project work is partly planned, partly ad hoc; the tasks, tools and resources may change during the project. Virtual project work is flexible; it allows for both face-to-face and geographically distributed work.

This definition sets requirements and limits to the Virtual Project Room -concept.

A 2: Virtual Project Room

The answer to the question "*How to support teamwork in workspaces?*" has been approached by examining the concept of Share Workspace[77]. It has been possible to anchor the form of support to the definition of Virtual Project Room:

> Virtual Project Room is a model for tools supporting the virtual project work. It structures the support by defining what is important for virtual project work. By taking care of the issues mentioned in the Virtual Project Room, the participants of virtual project work are able to reach their goals better. The content of the Virtual Project Room deals with plans, goals and processes of the project, (limited) time and resources,

75 Descriptions of the research questions are in *1.1. Objectives of the Thesis*.
76 See chapter *2. Teamwork in a Virtual Project*.
77 For more details, see *3. Support for Teamwork in Workspaces*.

> and various artefacts created or processed by the project.
>
> The Virtual Project Room has been created for teams that are typically cross-functional; for employees, who work in one of the functions of the organisation.
>
> The implementation of the Virtual Project Room is a shared workspace, for each virtual project. The events, objects and people related to one virtual project are within the context of one Virtual Project Room.

A 3: The Elements of the Virtual Project Room

To find out, *what is the structure of the Virtual Project Room*, this thesis has combined the empirical data collected at Teamware Group with a literature review[78].

First, the elements of the Virtual Project Room were brainstormed based on the implications of the previous research studies and the elements of the Virtual Project Room -concept version v2[79]. The results of the literature review (19 Derived General Topics[80]) were then compared with the elements that were modified to cover all the derived general topics. Parallel to all this research, the elements were discussed and refined in the project meetings.

The final elements of the Virtual Project Room are[81]:

> **Generic Infrastructure** (Active Storage, Discussion, Conferencing, Library)
>
> **About the project** (Project Description, Roles and Responsibilities, Resources)
>
> **Planning** (Process Chart, Plans, Milestones, Open Issues, Action Points)
>
> **Results** (Results and Artefacts, History and Timeline)
>
> **Need to Know** (Contacts and People Who Can Help, Documentation, Learning More, Tips & Tricks)
>
> **Coffee Break (Ideas)** (Best Practices, Our SWOT)
>
> **The Toolbox**
>
> **Requirements for the Organisation**

A: Virtual Project Room -concept

So, now that the detailed research questions have been answered, *how could workspaces provide computer-based and non-computer-based support for teamwork in a virtual project at Teamware Group?*

This thesis provides the answer in the form of the Virtual Project Room -concept.

The Virtual Project Room -concept is a guiding concept for building a shared workspace that bridges the gap between non-computer-based and computer-based support for teamwork. The concept provides examples how to perform work, such

78 For details, see The Structure for the Concept in *7. Design Phase 3: Concept Design*.
79 See "Preliminary Versions of Virtual Project Room" in *Appendix 1: Previous Research Studies in the VIKSU -project*.
80 See *Appendix 5: The Review of the Teamwork Literature*.
81 For details, see *Appendix 7: The Elements of the Virtual Project Room*.

as design, communication and team management, with and without computers[82].

The Virtual Project Room -concept shares many of the ideas of the shared workspaces, as described by Farshchian (1999). More specifically, the Virtual Project Room -concept identifies *services* or service-like *elements* that are spread along all the three dimensions (group, activity and product) of services found in shared workspace applications.

The Virtual Project Room -concept is not a shared workspace application itself; it is a guiding concept for building such application.

The concept is already presented in the "The Final Virtual Project Room -concept", chapter *7. Design Phase 3: Concept Design*, and won't be repeated here. However, the following characteristics describe the Virtual Project Room -concept:

> Acknowledges that all work is not performed with computers and gives design suggestions based on that view.
>
> Offers a structure of elements that categorises different aspects of work and gives suggestions on how to design work and systems based on those elements.
>
> Advices the project member on where to put and where to find different types of information related to the project.
>
> Gives ideas for tools that could be used in a project

82 See *Bridging the Gap* in *8. Design Phase 3: Concept Design*.

10. Discussion

It has been important, in this thesis, to find ways to support also human-human interaction (as well as human-computer interaction) and the social activities that are part of the teamwork. This echoes the thoughts of Arnison & Miller (2002), who argue that conventional teams and virtual teams should not be considered separate entities. They consider those teams as the ends of a continuum and suggest to adopt teams that are somewhere in between the ends.

The research process has resulted into the guiding concept for building a shared workspace. The Virtual Project Room -concept, accounts for the social realm. It bridges the gap between non-computer-based and computer-based support for virtual project work. The concept provides examples how to perform work, such as design, communication and team management, with and without computers. This enables more flexible shared workspaces; the extent of the software and the services provided by the shared workspace can evolve over time.

The validation with the Fitzpatrick's Locales Framework has pointed out that the Virtual Project Room does not consider the awareness of the events and people in the shared workspaces. Although this is more of an implementation issue (i.e. to be addressed in the shared workspace application itself), some guidelines have been provided at the end of the validation.

The Virtual Project Room -concept has a special characteristic in that it emphasises informal communication. The informal aspects have emerged from the empirical data to the concept. It remains to be seen whether this is a significant aspect in future shared workspace applications.

This chapter discusses further the applicability of the Virtual Project Room -concept, benefits to the Teamware Group, lessons learned and directions for further research.

10.1. Applicability of the Results

As described in *1.2. Scope of the Thesis*, the thesis has concentrated on teamwork in virtual projects, for which it provides support. The central concepts (virtual project, virtual project work and virtual project room) define a clear focus on the type of teamwork and the forms of support that have been studied.

The empirical research conducted during the VIKSU -project has been the main source for information. The Virtual Project Room -concept is strongly tied to Teamware Group. The concept does not aim to be a new theory. Rather, it should be thought as a conceptual model that provides structured description of the virtual project work at Teamware Group. That description can be used to build shared workspace applications. Because the concept has specific focus, it is not directly generalisable; further studies in other organisations would be needed.

The theoretical background (chapters 2-4) and the phases of the concept design (chapters 5-6) illustrate the reasoning that formed the decisions made in the Virtual Project Room -concept.

Concept design in general inherently involves innovation. The design process does not follow a purely logical path that leads to a singular result. It is thus not possible to reach the level of validity prevalent in e.g. mathematics. However, the concept has been developed in close cooperation with the project participants, and the active feedback from the participants has ensured that the design decisions do reflect the empirical data.

A shared workspace application, based on the Virtual Project Room -concept, has not been created yet. Thus, validation of the Virtual Project -concept has not been done with a usability test or similar method. Instead, the validation in this thesis has been conducted by comparing the concept to the Fitzpatrick's Locales Framework. Once such shared workspace applications are created, the concept can be evaluated in more depth. The evaluation should include appropriate testing frameworks (e.g. DGIn model[83] or a cautious use of the Media Richness Theory[84]).

10.2. Benefits to the Teamware Group

Teamware Group can benefit from this thesis in two ways: 1) as material for improving the teamwork in the organisation, and 2) as a model for improving the groupware products.

The description of the virtual project work and the elements in the Virtual Project Room -concept can be used to improve the teamwork in the organisation. The combination of empirical data from Teamware Group and the teamwork literature has resulted into an effective summary of what virtual project work could mean at Teamware Group. This summary provides suggestions for better facilitation of teamwork practices and processes within the organisation.

The Virtual Project Room -concept can also be used as a model, when designing future groupware tools and the related services. The structure of the Virtual Project Room (see *Figure 9: The elements of the Virtual Project Room v4.*, p. 39) can be used as a new, alternative suggestion for the logical structure of a shared workspace application. This suggestion, alongside with current Teamware Group products, supports the iterative design of groupware tools. Also, the elements described in the Virtual Project Room could serve as a source of inspiration and as a comparative list, when brainstorming for features in a new version of the shared workspace application. The Pl@za Migration Plan, a Teamware Group internal document[85], was created for this purpose.

Additionally, some ideas (such as elaboration on systems integration) have been written to *Idea Forge* in the "Virtuaaliprojektihuone KESSU" -SIG[86].

10.3. Lessons Learned

The Teamware Group has actively participated to the design of the concept (12 meetings in Teamware Group during the year 2002 as well as the interviews and workshops). The active communication has made it possible to get invaluable feedback during the concept design.

The Virtual Project Room -concept has expanded its view also into non-computer-based aspects of tools and communication. Although the human- and organisation behavioural issues are outside the central expertise of the participating researchers, the lack of expertise has been compensated with close communication with Teamware Group and with the application of the teamwork related theories.

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83 See Andriessen, J.H.Erik (2003) *Working with Groupware – Understanding and Evaluating Collaboration Technology*. London: Springer-Verlag. http://www.springer.de/cgi/svcat/search_book.pl?isbn=1-85233-603-X
See also: *Appendix 6: Evaluation Criteria (according to DGIn model)*.

84 See Dennis, A. R., Kinney, S. T. (1998) Testing Media Richness Theory in the New Media: The Effects of Cues, Feedback, and Task Equivocality. In *Information Systems Research*. Volume 9. Number 3. pp. 256-274. http://pubsonline.informs.org/main/pdfstore/TestingMediaRichness_article.pdf.

85 Short description in *8.1. Results: Representations of the Concept*.

86 More details in "The Virtuaaliprojektihuone KESSU -SIG", *Appendix 1: Previous Research Studies in the VIKSU -project*.

The collaboration between the project participants has also been a testbed and inspiration for ideas in the Virtual Project Room -concept. The participants have worked together in a way very similar to a virtual team (that consists of researchers). A wide selection of working styles, from post-it notes to teleconferencing and groupware tools have been experimented and actively used during the research.

The concept has been created for a specific organisation, and it has good possibilities to be useful in the work at Teamware Group. Unfortunately, the concept has not been implemented, put into use and evaluated in practice at Teamware Group. One of the big challenges for supporting a virtual team, is to find the proper balance between computer-based and non-computer-based environment for that specific team. The evaluation of the Virtual Project Room -concept would also require either strong investment in efforts or long time span to realise all of the different elements. It would be interesting to investigate the long-term impact of the use of the concept.

10.4. Further Research

As discussed in the *10.1. Applicability*, the concept lacks the power of generalisation since the concept has been developed with the empirical data of just one organisation. It would be interesting to conduct more **case studies in other similar organisations**, to see whether the elements represented here could be applied to those organisations. It is quite possible that the results of this research could be generalised, beyond Teamware Group, to some category of organisations or to certain style of work. This was, unfortunately, outside of the scope.

As pointed out by the validation with the Fitzpatrick's Locales Framework, the **guidelines for the awareness support** could be improved further in the Virtual Project Room -concept. The elements of workspace awareness, by Farshchian (2001b), provide a good starting point for further research.

Third possible direction for research would be to develop **process support for the virtual project work** at Teamware Group. This could be similar to Fisher & Fisher (2001, p. 120)[87], who describe "The Xerox model for developing virtual teams":

> 1.Form the team
> 2.Communicate the vision
> 3.Develop a mission statement
> 4.Define goals
> 5.Develop norms
> 6.Develop roles
> 7.Develop meeting processes
> 8.Develop communication processes
> 9.Develop work processes

The development of the process support could clarify the tasks of the virtual project work and strengthen the Virtual Project Room -concept further.

It is questionable, however, whether that kind of process support, as such, would work if it were implemented (as software) in a shared workspace[88]. It could cause more hindrance than help in virtual project work.

87 Fisher, K., Fisher, M.D. (2001) *The distance manager*. New York: McGraw-Hill.
88 See *3.1. Shared Workspace*..

Finally, the fourth research direction (and possibly the most interesting one) could be to study the **similarities and differences between virtual project work and Communities of Practice** (e.g. Wenger et al., 2002[89]). The Communities of Practise is also a way of working virtually. The Communities of Practice do not acknowledge a strict membership as in virtual project, but define many levels of participation (e.g. levels such as Leader, Core Group, Active, Lurker). The research would provide insight into how the work styles of large scale loosely-tied groups of people (such as Communities of Practise) could enrich the virtual project work.

89 Wenger, E., McDermott, R. & Synder, W. (2002) Cultivating communities of practice. In *Training & Development*, Volume 56, Number 2, pp. 83-85. Also:
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The earlier version (v2) of the VPR document (1.5.2002) is available to Teamware Group employees and research affiliates at akseli.tekes.fi. File: vpr_concept_v2.doc

The LISSU -Project

The MAPID -approach (v3):
Molin-Juustila, T. (2003) *Model on Market-centred Approach to Product Innovation Development*.
The document is available to Teamware Group employees and research affiliates at akseli.tekes.fi. File: MAPID_03_final.doc

Appendix 1: Previous Research Studies in the VIKSU -project

The development process in the VIKSU-project has been a collaborative one with LISSU -project and Teamware Group employees giving feedback and suggestions on the directions of the process. For example, by defining the organisation-level product design processes and communication between stakeholders, the MAPID -approach[90] has clearly influenced the directions chosen in the VIKSU-research and the focus of this VPR concept.

The VIKSU -project has developed tools for the needs in Teamware Group and now the VPR -concept collects those tools, 'under one umbrella', to view the whole picture.

There have been several parallel tracks in the project. In the following seven sections, the research efforts are presented sequentially, although in reality some were done in parallel.

The iterative development process has included interviews, workshops, commenting on draft versions, building prototypes and testing them. The following sections describe development of the tools and this concept building on these tools.

Requirements for Requirements Management System

Target Users: The designated Requirements Management (RM) team and other participants to the RM process
Design theme(s): Distributed web-based requirements management
Discovered phenomena: Distributed updating of the Excel-spreadsheet (the RM tool) is difficult
User needs: Collaborative, distributed requirements management
Concept(s): A suggestion for process: needs and solutions
Representations of the concept: Web prototype and a new spreadsheet structure (see *Figure 10*)

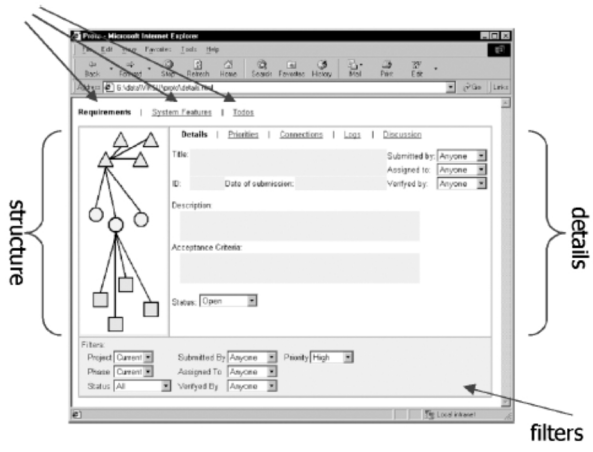


Figure 10: A prototype for requirements management tool.

The research for requirements management (RM) systems and their requirements was conducted by Mikael Johnson as his Master's Thesis. The research was initiated from the need for better management of the requirements at Teamware Group. Although at the time (Autumn 2000), it was possible to group the requirements according to stakeholders or functionality, it was not possible to order them according to use context or user tasks. Also, the used computer-based tool made the distributed modification of the data difficult. (Johnson 2002).

The research produced three artefacts: a set of use cases, a

90 MAPID – Market-centred Approach to Product Innovation Development, see Huuhtanen (2003); *1.8.1. The MAPID -approach*.

prototype and a new information model. The analysis of these artefacts contributed to the conclusions of the Master's thesis, which were:

1) (Existing RM tools): no tool had all the desired capabilities, requirements were limited to a scope of a project and emphasis was in functional requirements grouped by the concept of a program.
2) (The RM process): The requirements process in Teamware Group was wider in scope than what the RM literature assumed. Thus the RM -research domain was not sufficient.
3) (The Information model): A new version of the spreadsheet template for Requirements Register was made, incorporating data fields for user requirements and context of use.
4) (Web based RM component): Based on the research a shift in focus from RM to studying pretraceability of the requirements; a solution focusing only to RM would not satisfy the needs in the requirements process. (Ibid).

As the *Conclusions* -chapter of the Johnson's Master's thesis describes, the product design process in Teamware Group is distributed. This means that several projects work together, to build a large system. Also, in addition to the functional requirements, there is a lot of information about the customer and user that, while not always strictly requirements, are strongly related.

The Master's thesis concluded that the process that was termed as Requirements engineering in literature actually had much wider scope and included also strategic business decisions and product vision issues. The more appropriate concepts in literature would be Systems Engineering or Product Family Engineering. (Ibid).

Implication for the VPR
The MAPID -approach (Molin-Juustila 2002) of the LISSU -project aims to include several functions of the organisation (such as marketing and product development) also to the very early phases of the product design, including areas that relate to strategic and product visioning. One of the concrete issues that could be included in the process defined by the model is the requirements management process; as indicated in the above text the wider scope of cross-functional work is needed also there. This essentially forms one core activity for the Virtual Team.

The Workshop on Planning the Kick-off Event

Target Users: Kick-off project team
Design theme(s): What happens during a typical project in Teamware Group?
Discovered phenomena: Partly ad hoc process; formal meetings, informal meetings and independent work
User Needs: Flexibility, face-2-face possibility, awareness of others and coordination
Concept(s): Description of the process
Representations of the concept: A timeline of the project

The need for the workshop came from wanting to get an understanding of the typical project in Teamware Group, i.e. *"What happens during a project?".* An actual project, "preparation for Kick-off Event" was documented and analysed (during summer 2001). The focus of the analysis was in the events, tasks and the stakeholders.

The analysis resulted to a timeline describing the different tasks, phases and the stakeholders preparing the Kick-off project. From the timeline it was possible to

identify main working practices (formal meetings, informal meetings and independent work) and the add-hoc nature of the process[91].

Implication for the VPR

There is an ideal in the IT industry that the project plan, created in the beginning of the project, dictates the whole life cycle of the project. In reality at Teamware Group, however, this is rarely true; the initiation and direction of the process is characteristically partly ad hoc. Planning and defining goals are necessary for the project, but they are somewhat changing targets, subject to revision. In practice the project plan is changing even during the project; it is refined iteratively by re-evaluating regularly the priorities for the sub-goals and -tasks in the project.

For the Kick-off research study, the virtual project work is defined as:
1) partly planned, partly ad hoc
2) born from a certain need, ends when not needed any more

Additionally, support for virtual project work has to be flexible, because the people, resources, processes and plans often change during the lifetime of the project.

Feature Browser

Target Users: Vision group and the product definition group[92]
Design theme(s): Visualising information
Discovered phenomena: The relation between customer segment scenarios (as defined in MAPID -approach) and product features is not clear
User Needs: What features depend on this scenario and vice versa?
Concept(s): A tool for defining categories and relations
Representations of the concept: A software UI prototype (see *Figure 11)*

The Feature Browser (FB), a research effort during autumn 2001, explored the direction of visualising important information during product design. The goal for developing the Feature Browser was to build a user interface for browsing and navigating between product features, user needs, and segment scenarios. The primary stakeholders were the vision group and the product definition group.

When the Feature Browser was specified, the idea was to concentrate on the "day before, day after" -scenarios of the SD-document[93], defined in the MAPID -approach and the Product Definition. The feature browser would visualise the

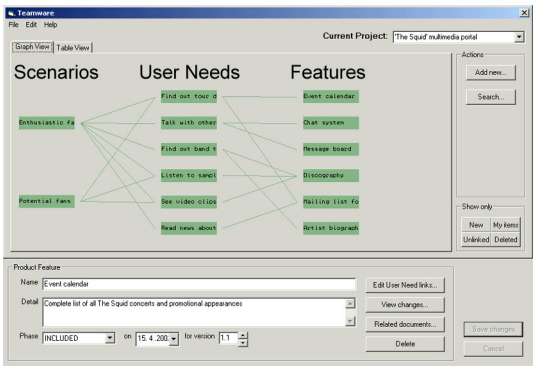


Figure 11: The Feature Browser tool.

91 These results are derived from the documents of the research on planning the Kick-off Event.

92 Vision Group and Product Definition Group are teams at Teamware which plan and define the future of the Teamware Products.

93 The SD-document, also called the Segment Description -document, is a collaboratively contributed document that describes information about a segment. The information is derived from different functions. The SD-document is part of the MAPID-approach (see Huuhtanen (2003); *1.8.1. The MAPID -approach*).

relations between Scenarios, User Needs and Features, relating to a developed product.

The Feature Browser produced successfully a semi-functioning prototype with which it was possible to analyze the use cases and requirements for similar full-featured tool. The analysis identified two areas as most challenging: 1) What terms and concepts are required for the visualisation (i.e. the ontology) and 2) How to visually present large amounts of data? The relations between the terms and their amount partly define also the requirements for the tool and thus should be prerequisite for building it.

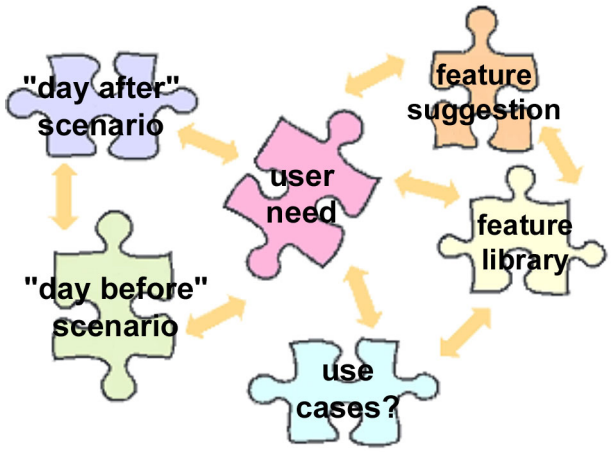


Figure 12: Examples of the concept dependencies.

The feature Browser was made from the viewpoint of two stakeholders (vision- and product definition groups). The visualisation tool would be particularly useful, if different stakeholders at Teamware Group could view the information with varying interfaces and views. It is, however, difficult to explicitly define what the differences between stakeholders actually are; language (native tongue and/or professional terminology) and forms of information (text, pictures, audio) are examples of possible domains for differences.

Before developing a tool, considerable effort should be invested into the definition work. Such work can be carried out with relatively small effort, for example by using Post-It notes in a workshop or process simulation.

One obstacle for effectively using a visualisation tool is that often the information is currently collected and stored in such formats that automatic "translation" across the differences is not possible.

Implication for the VPR

Visualisation is very important in the definition work and aids in understanding complex relations. There is a freeware tool called Protégé that is designed for this kind of work. However, the three categories mentioned in the above text are not enough for creating the relations.

Developing specific tools for cross-functional work is not simple due to the differences in ontology (terminology, used language, attributes and their relations). It is important to find solutions to ontological issues by, for example, defining common ontologies or by using some sort of translation. Because of their simplicity and easiness to use, Post-It notes or similar work practices are very good tools to start the ontological charting and definition work.

In this aspect, the VPR -concept aims to be method-agnostic, that is, it aims at supporting work independent of the approach taken. For computer-based tools, see *Toolbox* -element of the Virtual Project Room[94]. For more human-centric approach, the VPR suggests training and sharing ideas (formally or informally).

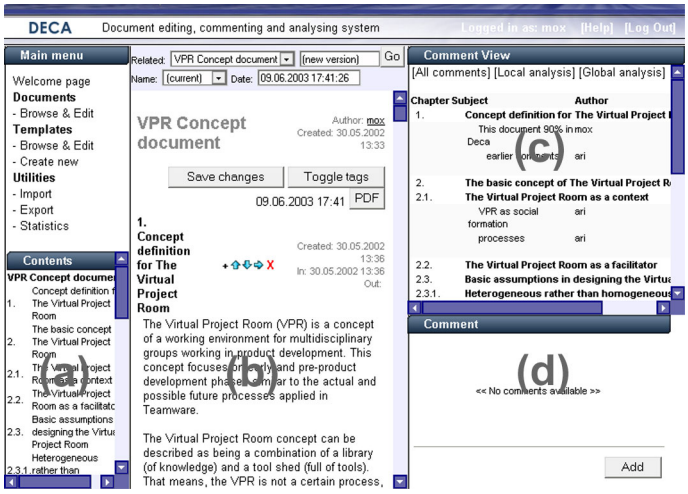
94 The *Toolbox* is described in the *Appendix 7: The Elements of the Virtual Project Room*.

DECA

Target Users: Cross-functional teams (based on MAPID -approach)
Design theme(s): Distributed document editing and commenting
Discovered phenomena: Documents separate from comments, no defined processes
User Needs: Effective work
Concept(s): A tool combining documents, comments and their analysis
Representations of the concept: Software prototype (see *Figure 13)*

The research for the DECA (Document Editing, Commenting and Analysing) -tool was developed during autumn 2001 - spring 2002. The need for DECA emerged from the MAPID -research, related to the SD -document[95] and defining the work processes for editing, commenting and producing next versions of the document based on the comments. A brief search into related software did not produce good results for a multi-user, distributed tool, especially since web was the preferred choice of media and thus it was decided to build own construction.

The DECA was built in a university course at HUT and the aim was to do a functioning prototype. The development approach used in the course was not user-centred and thus the outsourcing unfortunately resulted into a prototype that did not meet all the detailed needs of the users (the tool did not interoperate with current work practices; i.e. the MS Word-documents). The functionality of the prototype was, however, satisfactory for testing and evaluating the tool's approach to documenting and commenting.



(a) Table of contents
(b) The document
(c) The comments
(d) Add a comment

Figure 13: DECA-tool with an open document.

During the evaluation it was noted that the tool is most beneficial when new structures (for documents) are being created, evaluated and refined. It is thus the cross-functional decision-making and decision sharing that gains most from this tool. Because changing the structure is relatively easy, it is not a lot of work to make quite radical changes as well.

Combining documenting and commenting has potential for making the processes more effective and organised. However, since the tool also includes new practices for the documenting and commenting, the effective use requires change in practices, preferably for all the participants and is thus not a simple issue to implement and evaluate.

Currently (winter 2002) there are more and more tools with properties similar to DECA, although they are not necessarily useful in every situation *(e.g. Acrobat 5.0 features in document commenting focus on work style of "one person at a time").*

95 SD-document; see previous footnote.

Implication for the VPR
When choosing the recommended work practices (for a certain group), equal consideration should be placed on: 1) current practices (e.g. using word documents & email), 2) non-technical methods (e.g. printed-paper and red pen) and 3) technical tools. The process of change in work practices can negatively affect efficiency also in the long run. Also, technical merits of a tool do not guarantee increased efficiency.

The tools are most useful when they are integrated as part of the whole infrastructure; for example computer-based tools could be modular services. Preferably the tools would allow for employees to use current work practices or something similar to those in addition to the more "optimised" work practices.

The use of DECA is recommended for shared decision-making and for defining structures for information (e.g. about users) especially in cross-functional environment, rather than strictly as document editor. At its current form, the value in DECA is in iterative, joint forming and evaluation of information structures, it is less useful for stylised, visually rich document editing.

TWG Communication Network

Target Users: Teamware Group employees
Design theme(s): Visualising unofficial organisation structure, tools and communication networks
Discovered phenomena: Many systems/many tools, details outside formal organisation structures change quickly and often. Large parts of cross-functional communication is conducted informally
User Needs: Finding all the necessary information
Concept(s): A tool for finding out issues with communication and visualising the communication
Representations of the concept: An unofficial organisation map with descriptions of tools used in the organisation

The research for TWG Communication Network -tool took place in spring 2002. The initial purpose for the pictures was to get an understanding of the organisational structure in Teamware Group, but it then evolved into a sociometrical tool for visualising and developing communication networks.

The first part of the research concentrated on creating and developing a map of stakeholders (organisational functions, people and artefacts that were considered being parts of communication networks). The map building was needed, since up-to-date information about the communication structure of the organisation was not readily available (due to frequent changes in the organisation).

The second part concerned with the employees creating their own social networks on the map. This part was conducted in a workshop and was motivated by the often-expressed issues with communication, especially with lack of needed information. This resulted into a collection of maps (two per person, "the current" and "the ideal" states), which were used as basis for discussion on communication.

Implication for the VPR
The perceived communication networks differ from individual to individual. To solve the issues in communication, it is useful to visualise and share the current and "ideal state" understanding of the communication. Once the current situation is anchored, development can take place.

Consequently, it is important to have up-to-date information on organisation structures. However, too heavy or long updating procedures should be avoided, as they are at risk of being always out-dated due to continuous organisational change.

Communication is not only "data"; it is full of meanings and terms that cannot be directly translated. For shared understanding, it is necessary to, for example, jointly create the shared definitions for terminology and language, or use person (s) as "translators" between different domains of terminology.

The "Virtuaaliprojektihuone KESSU" -SIG

[SIG = Special Interest Group. In the context of Pl@za, it refers to a (restricted) work area (and tools) designated to the members of certain group]

Target Users: Teamware Group employees
Design theme(s): Improving the communication between different organisational functions, testing and improving current groupware tools
Discovered phenomena: The use activity of computer-based tools depends on the person; for some, using computers is natural, some prefer face-to-face communication
User Needs: Getting work done efficiently, even when not working at the same time or at same location
Concept(s): Suggestions for improvements on existing tools
Representations of the concept: Descriptions of the improvements (stored in the SIG)

The need for creating the SIG "Virtuaaliprojektihuone KESSU" (in March, spring 2002) was at first to use Pl@za for sharing the work and results of the research projects and as a place for discussion. It was quickly noticed, though, that since the SIG was very similar to the ones that the Virtual Teams were using, it would be very useful to analyze the suitability of the SIG as a teamwork tool. It also allowed the researchers to explore the Pl@za Product and to experiment with additions to Pl@za.

The research with SIG resulted in creation of the section called "Idea Forge" which is a melting pot for the different issues in teamwork at TWG and ideas for improvement, collected from employees during interviews and workshops. The ideas were not strictly limited to "extending Pl@za", but rather highlighted some issues that could be solved also with social or organisational changes, not only with technical tools. Although the ideas were deemed interesting and valid, they were considered (at the end of spring 2002) too large for the scope of VIKSU -project and were thus handed over to Teamware Group's internal organisational development processes.

Implication for the VPR
The SIG has been found very useful as a place for sharing information. For researchers, equivalent forums have since then been available (starting in autumn 2002) at http://akseli.tekes.fi which contains SIGs for all the research projects of TEKES. For Teamware Group, the Pl@za has been in internal use for many years.

For this kind of infrastructural tool, the crucial point is not whether the tools are "available for use", but whether the tools are "in widespread use allowing to share the information to all stakeholders". The organisational culture[96] is one of

96 There has been at least two studies related to organisational culture within Teamware. One of them is a research project inside KESSU by Iivari, N. (2002) Presentation on the results of organisation culture study, Kessu Areena -meeting, 4.12.2002.

the major factors influencing the choice for direction of organisational development; whether people are forced to conform to a standard work practice or people are allowed to more freely find their optimal work practices.

The more distributed the work becomes (e.g. in geographical sense), the more compensation is needed to share information that is not available to all the interested stakeholders.

Preliminary Versions of Virtual Project Room

Target Users: Cross-functional teams (based on MAPID -approach)
Design theme(s): An umbrella concept (containing previous research studies) of collaborative group work
Discovered phenomena: Social relations play significant role in the work, the cross-functional work has not yet established as a form of work.
User Needs: Getting information, working efficiently, developing work, shared understanding
Concept(s): An abstract concept for collaborative group work
Representations of the concept: The VPR -models v1 and v2

The concepting for the Virtual Project Room started already in the beginning of the VIKSU -project (in 2000). However, focused research effort for the Virtual Project Room -concept started in January 2002. The tools mentioned in the previous sections have already influenced the earlier VPR version. Also, the LISSU -project (especially the organisational processes defined in the MAPID -approach) and the Teamware Group employees have given valuable insights and suggestions to the concept.

At the end of spring 2002 the VPR -concept v2 was published. It was rather direct mapping of the different research efforts into a common concept. It concentrated in examining the collaborative group work from the perspective of one work group.

In the high-level model of the concept, the collaborative group work (the focus of the concept) was divided into three areas (i.e. *Meta Work*, *Work* and *Group Dynamics*). Additionally, there were two other viewpoints that were in the "periphery" of the collaborative group work, namely "*Structured and Categorised storage of Information and Meta Data*" and "*Communication To / From External Entities*".

At the more detailed level, the three areas were further divided into:

1) (Meta Work): Group Management, Basic Purpose of the Group and Group work Development
2) (Work): Collaborative Content Creation, Various Working Styles and Creating and Developing Common Understanding
3) (Group Dynamics): Skills and Individual Differences, Work Habits and Social Relations

Implication for the VPR
The VPR v2 -concept is the basis that the new VPR -concept (v4) builds on. The VPR v2 is a concept based on empirical results that describes collaborative work at abstract level. The VPR v4 elaborates further by taking more practical work oriented approach with structure derived from analysis of teamwork theories. It is important retain the connection to the real life while developing the new VPR -concept; the "essence" of the elements (see *Figure 8*, p. 35) in the VPR v2 should be found in the VPR v4 as well.

Appendix 2: Research Findings

The interviews were conducted by asking open-ended questions. They focused on identifying important topics or problems in the teamwork of the employees. The employees were allowed to talk about the issues that they felt were important. Some of the questions that were typically asked were: 1) *What do you do in your work?* 2) *What tools do you use in your work?* 3) *What kind of documents do you use or produce?* 4) *What are your typical work practices?*, and 5) *How would you improve your work?* The findings of the interviews (below) present a sample of issues that the employees discussed.

Findings from the Interviews

The following list shows the main findings from the interviews of six Teamware Group employees and one workshop that were conducted in spring 2002.

Employee 1

- Communication between sales, marketing and product development; What can be offered? (Asked by sales&marketing from product development), What is needed? (Asked by product development from others)
- Various meetings are used to make important decisions related to product's future
- Good experiences from an active and supportive boss
- Sometimes meetings are arranged ad hoc, when issues arise
- Problems with using Finnish and English as work languages in the organisation
- Problems with employees not disclosing relevant information to others
- No defined rules on what communication method to use for a given situation
- Need for sharing information more between functions
- Tools in use: many different tools; own (personal) tools, word-documents, web pages, two Pl@za systems, discussion forums etc.
- Problems with "issues" register; the issues are not well categorised and prioritised. How to allow access (to add issues) to as many as possible without overcrowding the system?
- Idea: references to interesting information/documents
- Idea: A place in Pl@za that would offer meta-information about information available elsewhere

Employee 2

- Information about the customer is not being distributed efficiently to the product development
- Not having access (passwords etc.) to different tools and systems used in different functions hinder the sharing of information
- Information is located in many different places in many different tools
- There is active communication between Sales and Marketing and also Consulting
- Communication is not easy when discussing to other countries; sometimes face-to-face meeting is necessary
- The organisation (structures) change often
- It is not always clear where certain information should be stored.
- Sometimes sharing information is restricted by individuals on purpose, to safe-guard own interests
- Sometimes access restrictions hinder efficient communication and work

Ideas:
- Some time should be allocated for improving one's work
- The education for employees to use tools and systems needs to be improved
- The rules and typical practices of work need to be visible; the rules has to be defined together (per team)
- Each bit of information should have someone that is responsible for that information (keeping up-to-date etc.)
- The information sharing should be as open as possible
- The recipient of the information should decide, what information to receive, not the sender.

Employee 3

- Good experiences with getting feedback from users by allowing them to test the product while it is being developed
- Idea: More information items to personal contact registry; about work, experience etc.
- Idea: should have unofficial meetings to discuss comments, feedback from colleagues, new ideas...
- Employees should be integrated more to the organisation; education about the work practices, introduction to the various parts of the organisation.

Employee 4

- Need for educating employees more to use the tools of the organisation
- Need for more information about the future of the products / current development versions
- Creating new SIGs in Pl@za is too bureaucratic
- Organisational communication could be improved by allocating resources on content development for Pl@za (e.g. a content editor that would make sure the structure and content is up-to-date and continuously improved)

Employee 5

- Success in work through large contact network; necessary to know people and what they do
- Contact information is needed including employees responsibilities and job descriptions
- Problems with withholding information / people not being informed enough; duplicate work
- It is not clear where announcements should be made
- Organisation changes quickly
- The organisational atmosphere does not encourage open discussion
- Not only using computer data, also physical materials (leaflets, posters etc.)
- Need for "rautalanka"[97] when communicating between organisational functions
- Discussion areas need responsible persons that moderate discussions and activate people
- Seeing people face-2-face makes the communication easier (you "know" the people when you have met them at least once)

97 "rautalanka" (directly: iron wire) means that one has to explain the issue at hand with very simple explanations; using terminology of one profession makes the issue incomprehensible to people outside that profession.

Employee 6

- Good experiences with communicating with the users of the customer by allowing them to test their implementation of the product while it is being developed
- Systems used by the other functions are not familiar / are structured in weird ways
- "Visits" to (attending meetings of) other functions are necessary in order to know all the important information for work
- Lots of information is in one's head, not in computer systems

Findings from the Workshop (TWG Communications Network), 13.3.2002

Two workshops were held during the spring 2002. The agenda of the workshops consisted of organisational development sessions involving 7-15 participants across many functions in the Teamware Group. The workshops were part of the TWG Communication Network -study[98] and were formative. Rather than describing each workshop in this thesis, their implications are included in the analysis of the previous research studies[99].

- Need for "rautalanka"[100] when communicating between different organisational functions
- Different functions have different work practices. Also between countries there are differences
- Need to evaluate the successes and failures of the cases (/projects) that have been done
- Need for more information about the products and their future
- Need to have all the information about the customer in one place [at least in referenced form]

98 See *Appendix 1: Previous Research Studies in the VIKSU -project*.
99 See *Appendix 1: Previous Research Studies in the VIKSU -project*.
100 See previous footnote.

Appendix 3: A Semantic Analysis of the VPR

The following semantic analysis of Virtual Project Room is based on the descriptions of the terms from Oxford English Dictionary[101]. The Virtual Project Room -term is examined by first going through each word separately and then those definitions are incorporated into one meaning.

Virtual

For the word *Virtual,* the following definitions were relevant: [4. a.]: "That is so in essence or effect, although not formally or actually; admitting of being called by the name so far as the effect or result is concerned." and [4. g. Computers]: "Not physically existing as such but made by software to appear to do so from the point of view of the program or the user; spec. applied to memory that appears to be internal although most of it is external, transfer between the two being made automatically as required."

Virtual is the most complicated word in the term *Virtual project room,* because it has many different meanings. The computer-related meaning for *Virtual* applies mostly to computer programs. Since VPR-concept is more about teamwork than it is about computer software, the definition of the term *Virtual* is defined as:

> Relates to events and objects that are not (necessarily) concrete or directly perceivable. For example in teamwork, the members (although working together in a team) might not work physically together or on physically perceivable products. The members could work at different hours and possibly in geographically distant buildings.

Project

For the word *Project,* the following definitions were relevant: [5. a.]: "Something projected or proposed for execution; a plan, scheme, purpose; a proposal." and [5. d.]: "A co-operative enterprise, often with a social or scientific purpose, but also in industry, etc.".

Combining the definitions above, the term *project* is defined for the VPR-concept as:

> A co-operative, joint work involving e.g. plan(s) and purpose(s). By its nature, an evolving process; not totally predetermined outcomes. More specifically, a structure involving planned work and certain group of people (a project team).

101 Oxford English Dictionary (http://dictionary.oed.com/) gives many (sometimes up to 30) definitions for single words. There are, however, limited set of definitions that are applicable to this document. (sampled on 19.09.2002).

Room

For the word Project, the following definitions were relevant: [1. a.]: "Space; dimensional extent.", [2. a.]:"Sufficient space; accommodation." (Also with addition of ample, enough, etc.) and [5. a.]:
"A particular portion of space; a certain space or area.".

For the VPR-concept, the term *room* has the same meaning as defined above, hence:

> A space. As a certain space/area for a set of elements, the "room" represents the boundaries of the VPR-concept. Can be also thought as the context of the events and objects.

Virtual Project Room

Combining the above definitions for *Virtual, Project* and *Room,* A definition for the term *Virtual Project Room* is now construed as the following:

> A concept with boundaries, describing work (context, structure etc.) in teams, with focus on teamwork that is not temporally or spatially restricted.

Appendix 4: Research Notes

These notes are written during the research by the author of the thesis. The purpose of the notes is to give more depth to the arguments presented in the thesis.

Science Disciplines Related to Teamwork

The different disciplines of science have many overlapping regions of interest. However, the different disciplines often approach the same areas of interest from a different point of view. This means that while some of the theories may not be compatible with each other, some other theories may be very similar or complementary to each other.

In the following I'll give some examples of areas in teamwork that some different science disciplines are interested in.

Social Psychology is primarily interested in social aspects, especially in groups. The research has developed many conceptual tools to understand the social environment in which the teamwork is happening. Social psychology also explores human resources and -management as well as groupwork and group development from the social point of view.

Work and Organisational Psychology has more economical and company -oriented view on work. Human resources and -management is a strong research field in this discipline. Also managing organisational change and organisational development belong to the primary study areas. This discipline has structural models and managerial tools that can be used in teamwork.

Science of Adult Education is also interested in organisational development, but with a stronger emphasis on learning and the self-development. In the large-scale, also society has on influence on how teamwork is done in the world of today. For example, nowadays it is seen important to stay updated, with lots of information flowing here and there. This discipline has explored the boundaries and possibilities of personal and organisational learning and development.

In some ways **technology** (in general) **and Computer Science** (especially) have made possible to create vast infrastructures and networks of communication. This has and is seen to be changing the nature and style of teamwork, for example through the emergence of virtual teams.

Pros and Cons of Cross-functional Teams

Cross-functional teams are very challenging work environment. At best, it has many benefits:
For customers: more attractive and customised products; have their needs met more rapidly.
For team members: more challenging and rewarding jobs with broader responsibilities; greater opportunities for gaining visibility in front of senior management; increased understanding of entire process across the organisation; a 'fun' working environment; and closer relationships with colleagues.
For organisation: increased productivity; improved co-ordination and integration; significantly reduced processing times; improving market and customer focus; reducing the time needed to develop new products; improving communications across the functional boundaries. (Huczynski & Buchanan 2001, p385).

However, it is especially likely for cross-functional teams to encounter following problems:
Problem of allegiance: Since a team member is a representative of a certain functional department, he has to solve the conflicts regarding the best interest of the group versus that of the department.
Stress: The likelihood of pressure and conflict are higher than in other teams
Temporal nature: Since the project is likely to be fast-paced and short-lived, it puts strain on member who have to quickly develop stable and effective working group process.
High demands for organisational support system: Effective communication, adequate amount of time for work, finding out appropriate balance in leadership
Conflicts on boundaries: internal battles over intra-company boundaries; restriction of information, unwillingness to work as a team. (Huczynski & Buchanan 2001, p. 386).

Appendix 5: The Review of the Teamwork Literature

The literature review related to teamworking to identified 19 general topics that were typically shared between the books. These derived general topics were: *Learning, Facilitation, Work Experience, Expertise, Team Structure, Goals and Purpose, Team Life Cycle, Status and Power, Leadership, Decision-making, Teamwork Management, Organisational Requirements, Communication, Roles, Performance, Team Development, Evaluation, Motivation*, and *Tools*.

The derived general themes were identified by analysing the topics in the books and finding general themes that could be associated with several books.

The relations between individual books and the derived general themes can be seen below.

The name of the book and its topics (adapted)	*Derived general themes*
Brown (1988): The Reality of Groups (e.g. individual-group relationship), Elementary Processes in Groups (e.g. Becoming member, interdependence and group process, tasks and goals, relationships, group norms), Structural Aspects of Groups (e.g. roles, status, leadership, communication networks), Social Influence in Groups (e.g. majority-minority), Individual versus Groups (productivity, decision-making), Prejudice and Discontent, Intergroup Conflict and Cooperation (e.g. superordinate goals), Social Categorisation, Social Identification and Intergroup Relations	Learning, Work Experience, Team Structure, Goals and Purpose, Team Life Cycle, Status and Power, Leadership, Decision-making, Teamwork Management, Communication, Roles, Performance, Team Development
Duarte & Snyder (2000): Understanding Virtual Teams (Critical success factors, Crossing Technical boundaries, crossing cultural boundaries), Team Member Roles and Competencies, Building Trust in Virtual Teams, Virtual Team Meetings, Virtual Team Dynamics, Working Adaptively	Expertise, Team Structure, Status and Power, Leadership, Communication, Roles, Performance, Tools
Huczynski & Buchanan (2001): Learning, Personality, Communication, Motivation, Group Formation, Group Structure, Teamworking, Organisational Development, Organisational Change, Organisation Culture, Leadership, Decision-making, Power and Politics	Learning, Facilitation, Work Experience, Expertise, Team Structure, Goals and Purpose, Team Life Cycle, Status and Power, Leadership, Decision-making, Teamwork Management, Organisational Requirements, Communication, Roles, Performance, Team Development, Evaluation, Motivation, Tools
Katzenbach & Smith (1994): Understanding Teams (Performance, A Working Definition and Discipline), High-Performance Teams, The Team Performance Curve, Team Leaders, Teams, Obstacles and Endings, Teams and Performance: The Reinforcing Cycle, Teams and Major Change, Top Management's Role: Leading to the High-Performance Organisation	Work Experience, Expertise, Team Structure, Team Life Cycle, Status and Power, Leadership, Decision-making, Teamwork Management, Organisational Requirements, Roles, Performance, Team Development

The name of the book and its topics (adapted)	*Derived general themes*
Katzenbach & Smith (2001): Virtual Teaming, Outcomes – Not Activities – Shape Your Choice, Number [of Team Members] and skill, common purpose, goals and working approach, mutual and individual accountability, Obstacles and Opportunities for Virtual Teaming, Teams and Change	Expertise, Team Structure, Goals and Purpose, Decision-making, Teamwork Management, Roles, Performance, Team Development
Lipnack & Stamps (2000): Why the Way to Work, Networks (e.g. The Networked Community, Managing), Teams (e.g. Crossing Boundaries, The people Boundary), Trust – Virtual Relationships (e.g. Capital Across the Ages, Creating Social Capital), Place, Time (e.g. Dimensions, Life Cycle, Together and Apart), Purpose – Why We Work (e.g. Turning Hierarchy on its side, Authority, Why Cooperate?), People (e.g. Stress, Members, Leaders, Levels), Links – Being in Touch (e.g. Four ages of Media, Communicating), Navigate (e.g. The Virtual Team Room, Holding the Whole), Theory – A system science of Virtual Teams, Think – reaching for possibilities together (e.g. Mind, How Groups Think, Learning), Future (e.g. Islands of Trust)	Learning, Work Experience, Expertise, Team Structure, Team Life Cycle, Status and Power, Leadership, Decision-making, Teamwork Management, Organisational Requirements, Communication, Roles, Performance, Team Development, Tools
Parker (1994): Strategy of teams, Barriers and Obstacles to Teamwork, Leading Cross-functional Teams, Empowering Teams, Setting goals for shared Commitments, Building Bridges Outside the Team, Appraising Teamwork and Team Members, Team pay for Team Play, Learning as Team Event, Techniques for Working Together as a Team, Management's role in Building Team-Based Organisation, Tools for Developing Cross-functional Teams	Learning, Facilitation, Goals and Purpose, Status and Power, Leadership, Decision-making, Teamwork Management, Organisational Requirements, Communication, Roles, Performance, Team Development, Evaluation, Motivation, Tools
Procter & Mueller (2000): Teamworking: (Strategy, Structure, Systems and Culture), teamwork and management, teamworking and employee involvement: (terminology, evaluation, context), managing teams: changing roles and responsibilities, team leaders and members, teamworking and the management of flexibility: (local and social-structural tensions in high performance work design initiatives), working in teams: (employee attitudes and experiences), flexible when it suits them': (the use and abuse of teamwork skills)	Work Experience, Team Structure, Goals and Purpose, Status and Power, Leadership, Decision-making, Teamwork Management, Organisational Requirements, Communication, Roles, Performance, Team Development, Evaluation, Motivation
Senge (1994): The laws of the fifth discipline, Personal mastery, Mental models, Shared vision, Team learning, Prototypes (Openness, Localness, A manager's time, Ending the war between work and family, Microworlds: The Technology of the Learning Organisation, The Leader's New Work)	Learning, Work Experience, Expertise, Goals and Purpose, Status and Power, Leadership, Decision-making, Teamwork Management, Organisational Requirements, Communication, Team Development

The name of the book and its topics (adapted)	*Derived general themes*
Senge et al. (1994): The Wheel of Learning, Leadership Fields, Reinventing Relationships, Systems Thinking, Personal Mastery, Mental Models (e.g. Creating scenarios, double-loop accounting), Shared Vision, Team Learning (e.g. Building on Organisation that Recognises Everyone's Uniqueness, Tools for Discovering Learning Styles, Bringing Diverse People to Common Purpose, Executive Team Leadership), Arenas of Practice (e.g. Training as Learning), Frontiers (e.g. Organisations as Communities, Free Agency, Employment Stability, and Community Boundaries, Creating a Learning Lab).	Learning, Facilitation, Work Experience, Expertise, Team Structure, Goals and Purpose, Team Life Cycle, Status and Power, Leadership, Decision-making, Teamwork Management, Organisational Requirements, Communication, Roles, Performance, Team Development, Evaluation, Motivation, Tools

Appendix 6: Evaluation Criteria (according to DGIn model)

J.H.Erik Andriessen, 2003 (from lecture notes of a Groupware course held in collaboration with Helsinki University of Technology – Finland, Delft University of Technology – Netherlands, and Ankara University of Technology – Turkey)

(DGIn model = Dynamic Group Interaction model)

Try to compare the two systems with the following set of criteria. Some of these comparisons can be made on the basis of what is in the descriptions of the systems. For other criteria you need to work with the system yourself.

This is quite an exhaustive and general list. Not all criteria may be relevant or applicable in your case. Make an adequate choice.

1. Technical efficacy

1. *Reliability / robustness*: degree of vulnerability against crashes, errors made etc.
2. *Portability (technical compatibility)*: degree to which the tool fits to other technical systems, to different platforms; is system web based and available from everywhere.
3. *Maintainability*: degree to which a tool can be maintained despite new versions.
4. *Network performance*: adequate speed of information exchange and communication, adequate bandwidth, good audio quality.
5. *Adaptability*: degree to which tool can be adapted to task requirements or user's preferences
6. *Costs*: of purchase, of maintenance, of infrastructure, of implementation, including training of users.
7. *Security and Privacy*.

2. Usability: The extent to which the interface of the tool is easy to use and attractive.

1. *Simple way of operation, easy to use*.
2. *Control*: degree to which the user feels he/she is in control of what happens (and not the application)
3. *Affect / Excitement*: degree to which using the application is exciting and fun for the user.
4. *Support*: degree to which the application provides assistance to the user (Help function).

3. Fit to the context

1. *Adaptability to group structure*: role division, meeting characteristics
2. *Other context issues*

4. Interaction support: Degree to which the tool in practice supports or hinders individual task performance and group processes

1. *Individual task performance*:
2. *Communication*:
   - Support of synchronous and asynchronous communication within the group.
   - Support of communication with environment.
   - Providing awareness of member availability, activities, work processes, etc.
3. *Co-operation, i.e. task oriented interaction*:
4. *Sharing information and knowledge*:
   - Adequate support for shared storing and retrieving information (including sufficient storage capacity).
   - Providing adequate information: accurate, reliable information, being up-to-date.
5. *Co-ordination*:
   - Support for assigning roles and tasks.
   - Support for planning, scheduling, tracing tasks and products.
   - Support for other co-ordination mechanism
6. *Social interaction*:
   - Ease of informal interaction.

5. Outcome effects

Product outcomes:
Degree to which usage of the tool contributes (or may contribute) to intended products or services or to the development of new practices.

User outcomes:
- Satisfaction
- Quality of the work situation of the users (more/less easy work, more/less interesting, more/less stress etc

6. Your general judgment as to usefulness, costs (in general, not only financial) and relative advantage: the extent to which the tools are perceived as useful for the tasks and better than (existing) alternatives.

Appendix 7: The Elements of the Virtual Project Room

Generic Infrastructure

The *generic infrastructure*, as the name implies, forms the basis of communication and sharing the information in the Virtual Project Room. Its essence is in providing as generic practices and tools as possible to maximise their flexibility and suitability for different needs.

The downside is that the infrastructure does not give support to any process specifically, thus it's up to the users to figure out structures, practices and processes for a chosen task. As an opposite of generic infrastructure, section *Toolbox*, concentrates in specific tools aimed at supporting specific needs and specific processes (or process types).

The specific four elements of generic infrastructure (*Active Storage*, *Discussion*, *Conferencing* and *Library*) are described below. The elements are explored from the viewpoints of both non-computer-based and computer-based environment.

Active Storage

Note: The concepts of Active Storage and Library are not easily defined and the two might be perceived as overlapping each other. This document, however, argues that the two concepts allow to view the issues related to storing information from different angles and thus both are important.

There is always need to record and retrieve information in some way; it just isn't practical to keep everything inside people's heads. There is also need to store objects of the non-computer-based environment, such as tools, books and equipment. Storage can come in many shapes and sizes. Conventional storages can take a lot of space in the non-computer-based environment, while huge computer-based storages do not usually require a lot of space in the non-computer-based environment.

The Active Storage can be thought as the actively used storage where employees store their work, whenever needed. Employees can have their personal storage areas as well as shared ones (shared within a group, shared within the whole organisation).

As opposed to a library (*see Library*), the storage does not make any restrictions on the content that it holds. For a more rigorous effort to store categorised and sorted information, the library is more suitable. More elaboration on this in the *Library*.

One characteristics that applies to both non-computer-based and computer-based storages is that the larger the space, the more structure and work is needed to cope with it[102]; in order to find the stored items, the item has to be located (and searched for). Some sort of hierarchy or classification is needed to have the related items close to each other and to know where to place new items.

The structure can be defined during the construction time of the storage or incrementally, during the use of the storage. The latter, however, does place demands for the users to plan well the structure in order to maintain good

102 These arguments are based on the knowledge management literature. See e.g. Nonaka, I. & Takeuchi, H. (1995) *Knowledge Creating Company: How Japanese companies create the dynamics of innovation* and the research study "Virtuaaliprojektihuone KESSU" -SIG.

efficiency, especially since the items are shared with other users (as in virtual project work).

Discussion

Discussion can be supported, for example, by providing space (e.g. a room) or tools, listing topics, or making introductions (to the subject). This element, however, examines the *mediators* of discussion; answering to what tools or methods can be used for supporting discussion.

This discussion -element focuses on support for non-simultaneous communication (i.e. asynchronous or disconnected communication). The simultaneous aspects of communication are discussed in the following section, *Conferencing*.

Conferencing

The conferencing -element differs from discussion -element in that it focuses on real-time communication, specifically on situations where multiple people are communicating with each other at the same time. In the non-computer-based environment this typically means meetings in a room or with a telephone, in computer-based environment the meetings are held via text-based chats or video-based tools.

People, who are not eager to use computer-based tools (such as text-based chat), and who need to communicate across geographical distances, the audio or video conferencing methods are recommended as they allow for communicating also tone of the voice, eye-movement, facial expressions and gestures, i.e. non-verbal cues[103]. This way, the misunderstandings can be avoided and the interaction is more similar to communicating face-to-face.

In addition to support for different methods of conferencing, also the process can be supported in the preparation for conferencing session by: 1) defining roles; a chairman, a secretary etc., 2) defining agenda, and 3) reserving resources (e.g. reserving time from peoples' calendars, reserving a room/space for the conferencing).

Library

The library is not just a jungle of information (*see Active Storage*), but a result of a rigorous effort to collect, categorise and utilise meta tags to manage the information that is considered important. A library doesn't necessarily contain all that information directly; the information can be also found through a reference.

One way of combining Library and Active Storage would be to think the Library as an additional way to access the information in the Active Storage; The objects in the Active Storage, that are considered important to find easily, are added to Library by describing information about them (categories, meta information etc). Employees have, then, the possibility to search for those objects using the capabilities of the library (search, keywords etc).

A conventional library is a good example to compare with when building computer-based libraries, it should be noted, however, that a good library needs a librarian (in some way or another), otherwise the information becomes outdated and difficult to find.

The library -element builds on the need for finding all the necessary information (*see* the research study *TWG Communication Network*) and aims to serve at least two types of information: general information similar to that in a conventional

103 Non-verbal: See e.g. Huczynski & Buchanan, 2001, p189.

library and specific information related to the organisation. The specific information can be, for example, information about a product, written by one function, but needed by other functions also.

About the Project

The need for the *About the Project* -element rises from the fact that there are employees who are not aware of all the project that are going in the organisation and do not know how to find information about them[104]. When employees become aware of the projects in the organisation, by viewing the project introductions, the likelihood of duplicate or conflicting work decreases. Also, employees are able to find the sources of information by knowing and being able to contact the members of the project.

The "*About the Project*"-element serves at least two purposes; it is the information centre for the people outside the project and also the description of the foundation that the project builds on.

The most important items for the people outside the project are the description of the project and its goals, the members and their expertise/responsibility areas, and other resources that the project has.

For the project team, the most important items are the jointly defined and agreed goals of the project, roles and responsibilities of the team members and the other resources of that the project has.

This element is divided into three (sub-) elements: *Project Description*, *Roles and Responsibilities* and *Resources*. These elements are discussed in the following sections.

Project Description

The content of the *Project Description* is quite self-explanatory. It contains a brief introduction to the project. A background -chapter describes why the project was created, for example the needs that motivated the project. The project description also includes the project goals and describes the ways those goals are planned to accomplish (related to e.g. Brown 1988, p30)[105].

Within the project, the Project Description is the most helpful when its contents are jointly created and agreed on, by the project members. The members could even sign their agreement to strengthen their commitment to the project.

Roles and Responsibilities

Similarly to the *Project Description*, the *Roles and Responsibilities* -element is quite obvious. However, it is not an easy task to define and describe the roles and responsibilities in a project beyond the official organisation charts. The purpose of this element is to describe as closely as possible the **actual state of the roles and responsibilities**, not the official/formal titles or organisational positions. This would lessen the uncertainty about who is responsible for what task and what other project members should be doing in the project. It could also increase the commitment of the members as they become clearly aware of their roles.

104 This argument is based on the interviews of Teamware employees.
105 Brown, R. (1988) *Group Processes*.

It is quite possible that there are existing processes, definitions and systems related to this type of group- / organisational management. Such relations could be taken advantage of, if they exist.

It is important to notice that there can be more than one assignment for one person within a project and between different projects.

Leadership and decision-making
One of the most challenging aspects of virtual project work (and teamwork in general) is the distribution of the leadership and decision-making in the team. There isn't any silver bullets to this subject; even the scientific literature hasn't come to an agreement about it. Some emphasise the role of management in controlling the team, others argue that effective teamwork is attained through self-guidance of the team.

In the more detailed level there are arguments for assigning leadership to single individual(s) and on the other hand for distributing the leadership in "small packages" to the whole team. These issues together with general notions of status and power are discussed in the following sections.

Resources

The Resources -element can simply be a list of resources that the project has. A more sophisticated solution would exchange information with other sources that deal with resources, for example with resource management systems, calendars and reservation systems. This would ensure that the resources of the project are not over- (or under-) allocated.

One special type of a resource is the employees; their work time is an important resource.

In relation to *Roles and Responsibilities*, also in the case of resources there has to be some rules on who are allowed to change the allocated resources, for example who can reserve time on employees calendar and for what reasons.

Planning

The *Planning* -element could, in a simplified sense, be called "the team management related issues" of the Virtual Project Room[106]. In essence, this element is about directing the project; i.e. planning, control and follow-up.

Directing a Virtual Project[107] is especially challenging, because tasks, tools and resources may change during the project much more than in traditional project. It is then, the task of the project team to be flexible to change and at the same time define clear goals and plans to keep the project in control.

Since a Virtual Project is typically cross-functional[108], co-ordination[109] and communication[110] are especially important; because of project members' differing expertise and terminology, one has to make sure the communication has been and will be understood correctly.

The following two (sub-) elements point out the typical tools and artefacts that can be used when planning the Virtual Project Work.

106 See Huuhtanen (2003); table 3, *4.2. Structure* in *VPR*.
107 See Huuhtanen (2003); *2.2. The Meaning of the Virtual Project Room*.
108 See Huuhtanen (2003); *2.2. The Meaning of the Virtual Project Room*.
109 See research study *The Workshop on Planning the Kick-off Event*.
110 See research study *TWG Communication Network*.

Mapping the Process

This element deals with visualising the progress of the Virtual Project. Typical ways of visualisation are, for example, process charts, plan -documents and milestones.

The mapping (i.e. visualisation of the process) allows for project members, and also for employees outside the project, to see the current state of the project, what has been done, what is being currently worked on and what is the project's future. Although the plans might change due to the nature of the Virtual Project (see *Planning*), it is more useful to have the plan rather than no plan. And the past does not change, so that part of the mapping is the same as in traditional project.

Managing the Tasks

Related to the *Mapping the Process*, this element deals also with planning and visualising the work. However, now the focus is in the individual tasks, not in the whole processes. Typically tasks are managed, for example, through (open/closed) issues, action points, and/or bugs database.

There can be tasks of many types (e.g. writing a piece of code, making a documentation, making a specification or arranging a meeting) and with varying complexity. It is thus necessary to agree and define the categories in which the different tasks are put, so that the managing of the tasks does not become overwhelming[111].

Results

The *Results* -element gathers all the outcomes of the Virtual Project in one specific place. The outcomes can be, for example, written decisions made during the project, products that the project produces or a descriptive history of the project; all the outcomes are results of what the project has done and what it has accomplished.

The importance of this element is in the gathering effect; time is not wasted on searching when all the made decisions, specifications and other artefacts are viewable from a single place.

The following two (sub-) elements describe two example types of results that a Virtual Project can have.

Outcomes and Artefacts

This element describes the more ordinary type of results, namely the *Outcomes and Artefacts* that the Virtual Project produces. These can be, for example, specifications, other design documents, mock-ups, concepts or products that the project has produced. This element should also contain descriptions (documents or in some other form) of the decisions that the project has made or that has been made about the project.

Having the current information of the outcomes of the project, combined with visible *process* and *tasks* (see *Planning*), allows for project members, and employees outside the project, to know the status of the project and adjust their work accordingly.

The documents that are used in the project, but are not produced by the project, should be found in the element *Documentation*.

111 See research studies *DECA* and *Feature Browser*.

Evaluation

This element differs from *Mapping the Process* -element in that the past events in this element are not descriptions of the plans that were once made, but descriptions of the evaluations that have been made.

It is the analysis aspect of this element that makes it important; reflecting on the plans that have been made (*Planning*) and the results that have been accomplished (*Results*) makes it possible to describe the insights of the reflection and re-adjust and improve the project or future projects.

There are many ways to do evaluation, most typical probably being some sort of questionnaire. Whatever the used methods are, they should be chosen carefully so that they are felt to be useful for the project as well as for the other projects and employees.

One particular case of evaluation that is not so obvious is evaluations of projects past as a whole. The two examples of such evaluations are a summary of the project's history and a timeline of the project's past. It should be noted that in the context of evaluation, these are not simply straightforward mentions of the past event, but products of reflection that include also descriptions of projects successes and failures.

These "feedback" -aspects of the *Evaluation* element are central in the literature of the learning organisations (see Senge 1994)[112]. The employees are encouraged to learn in their work through evaluating the past work; a rigorous effort is made to learn through previous successes and failures.

Need to Know

The research studies have pointed out that one of the big challenges is to communicate between organisational functions and to share information in a Virtual Project[113].

The *Need to Know* -element gives ideas how to improve the knowledge sharing processes. Virtual Project members are always building their knowledge and skills on top of their current abilities. With the emergence of the knowledge management[114] and learning organisation[115] – paradigms, many efforts to explicate the experience and knowledge of the employees have become under heavy discussion also in teamwork literature.

Although these paradigms are relatively new, the phenomena itself is not; there are concrete advantages in collecting and sharing the experiences (and, if possible, knowledge) in order to have a "collective memory" of the successes, failures, good practices et cetera in the teamwork of the past. That information (and, possibly, knowledge) can be used to improve and give guidance to the teamwork in the future.

The following four sections describe four different approaches to the distribution information.

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112 Senge, P.M. (1994) The Fifth Discipline: The art and practice of the learning organization.

113 See research studies *TWG Communication Network*, *Requirements for Requirements Management System* and *The "Virtuaaliprojektihuone KESSU" -SIG*.

114 See, for example Nonaka, I. & Takeuchi, H. (1995) *Knowledge Creating Company: How Japanese companies create the dynamics of innovation*. Oxford: Oxford University Press.

115 See, for example Senge, P.M. (1994) *The Fifth Discipline: The art and practice of the learning organization.* London: Century Press.

Contacts and People Who Can Help

This element emphasises the importance of social networking and formal ways of encouraging that networking. In addition to the basic contact information of all the employees in an organisation, this element should also include team-specific information, such as position of the member in the team, his/her role in the work, descriptions of areas of expertise. An employee could perhaps also annotate the contacts and categories according to the people that he/she considers important.

With this kind of extensive contact information, it would be relatively easy, in addition to the *About the Project*, to find employees that could help with a certain problem.

Documentation

The management of documentation, although generally considered the 'necessary evil', is an important aspect in Virtual Project work. This is because in the cross-functional work, there is a lot of communication and shared information[116]. To avoid information overload, some of the information must be shared passively, i.e. by making it available as searchable documentation.

As a distinction to the *Library*, the documentation -element contains project -specific information; documentation that the project has collected or is deemed relevant in the specific context of that project.

Learning More

The *Learning More* -element is related to **all kinds of learning needed in order to accomplish the project goals**. While learning isn't likely to be a goal by itself, it can be a secondary objective, when an optimal solution is sought for; in some situations it is useful to educate oneself, to learn more about specific topics that are relevant to the task at hand.

Since the gains from learning are often indirect, the decisions on investing time and effort in learning are typically made by the project or other decision-makers. In a cross-functional environment that relies on expertise of the individuals, some resources should be reserved for individual development, as a means of foundation for future ideas and innovation.

One of the particular aspects of Virtual Project work is the demands it places on communication[117] and decision-making[118]. In this kind of work, social skills have a more prominent position and thus it is recommended that members of the Virtual Project have good social skills in teamwork or are actively learning to improve their skills. This VPR argues that many of the difficulties can be overcome or even avoided when the members are conscious (or, aware) of the issues in cross-functional teamwork and have good skills in teamworking.

For practical purposes, learning is divided roughly to three styles: *self-learning*, *courses/workshops* and *facilitation*. Also, the following styles are applicable to learning both individually and in teams. While the styles described below are not dependent on each other, it is recommended to use them all as a complementary approach as that is likely to be more effective.

Self-learning
Self-learning can take many forms. Most typical approach is to read books (such as

116 See research study *TWG Communication Network*.
117 See *4.3.4. Differences in Terminology and Language* in VPR
118 See *4.3.2. Flexible Shared Decision-making* in VPR.

reference guides, practical guides or theoretic literature) on a specific subject. One can also learn through following an example, through experimenting or using prepared self-teaching material.

Courses and Workshops
Probably the most typical form of improving teamwork skills are the many courses and course-like workshops of teamwork. The courses have many different objectives, methodologies and because of the large variety, they are largely outside the scope of this document.

To give some idea of the variety of the courses, the following are mentioned: 1) traditional class-room type teaching where teachers teach and people more-or-less passively listen, 2) courses focused on individual development, 3) courses or workshops that encourage co-operation and joint problem solving. All of these different types of courses have their own strengths and it should be considered carefully, which is the best for the given situation.

Facilitation
As a distinction from *courses and workshops,* the facilitation deals with the supportive coaching, usually by an external specialist, integrated into the actual work performed in the daily working life.

Tips & Tricks

This element is about collecting and sharing cumulated experience. It takes time to learn to the "ways of the organisation"; there are thousands of small details and practices that employees familiarise themselves with during the years they are employed by the organisation. While it wouldn't be worth the effort to write down all the details of daily work, there are some repeating issues that need not to be solved again every time.

For those special issues, the *Tips & Tricks* -element offers a place to write them down and encourages to share the wisdom of the daily work with others.

Coffee Break (Ideas)

Because also informal situations are used in getting work done[119], this element aims to support also the "informal work" so that good ideas don't get lost. In order to avoid the informal time becoming formal work time also, this element supports the informal work in non-intrusive way.

It should be voluntary, although encouraged, to discuss issues concerning the work and suggest ideas to others during a time or in a place that is considered a break (e.g. coffee break). Should any important issues or ideas arise, they should be recorded somewhere; there could be a room available to all that would contain free space to make notes (which would stay there until they are not valid anymore). A full scale version of this would be the change laboratory[120]. No matter whether the place is in non-computer-based environment or in computer-based environment, it should be well known to employees and close to the daily activities and especially break areas.

The following sections describe two examples of approaches that could be used to encourage discussion (although they are a bit heavy methods for informal communication).

119 See research study *TWG Communication Network* and *Appendix 2: Research Findings*.
120 Change Laboratory, Muutoslaboratorio, see Senge, P.M. (1994) The Fifth Discipline: The art and practice of the learning organization.

Best Practices

Best Practices is the typical term used when investing effort in improving the work. It calls for going through the work practices, for the chosen task, that are being performed currently and then evaluating them and finding out the best ones of those practices.

By putting effort into development of the work, the actual work can be enhanced with potentially reducing the time and resources needed to do the same tasks, and also it is possible to find entirely new ways of reaching the goals of the project, with significant improvements to the quality and/or applicability of the outcomes.

Our SWOT

SWOT is another work improvement effort, which approaches the subject from four different angles, namely: Strengths, Weaknesses, Opportunities and Threats. By listing and evaluating these, it is possible to create an understanding of the current situation and consider the alternatives to go forward.

The Toolbox

The Toolbox -element is basically a place to store and reference to various tools available to the employees.

The tools can be of any type, such as software[121], social maps[122], or whole systems like the Teamware Pl@za.

In general, the tools in the Toolbox should try to serve some particular task or a certain style of work. If the tool is very generic, it could be included into the *Generic Infrastructure*, instead.

Requirements for the Organisation

This last element differs greatly from the others in the sense that it is not about Virtual Project work, *per se*. It is, however, very important to acknowledge that Virtual Project work is not performed in a vacuum; especially in business environment, it is the organisation (such as a company), which provides the resources and possibilities as well as the overall boundaries and restrictions to the projects.

Since Virtual Project work (meaning cross-functional teamwork) is not a natural fit[123] to the conventional hierarchical organisation (which is typically structured along its functions), it is important to describe the additional requirements to the organisation for it to sufficiently support the Virtual Project work.

As the organisational aspects of the work are not in the focus of the Virtual Project Room -concept, the following issues are only mentioned, not discussed in detail.

In addition to the requirements, some comparisons are made to the forms of the organisations that approach teamwork as the main type of work.

121 See e.g. research study *DECA*.
122 See research study *TWG Communication Network*.
123 For more discussion about the subject, see "cross-functional teams" in "Teamworking"-chapter in Huczynski, A.; Buchanan, D., 4th edition (2001) Organizational Behaviour – An introductory Text.

Organisational culture
As already researched by Netta Iivari[124], the organisational culture influences the way how work is performed and how employees communicate with each other. If organisational culture can be changed, it can have strong implications to the work practices and organisational atmosphere. (For additional information, see e.g. Huczynski & Buchanan 2001, p. 622).

Organisation structure
The organisation structure is one of the main supporters or hindrances to Virtual Project work; how does the organisation support cross-functional teamwork; who are the decision-makers, who are the superiors? (For additional information, see e.g. Huczynski & Buchanan 2001, p. 408). Some "newer" forms of organisations are, for example, virtual organisation (Ibid, p. 545) and learning organisation (Ibid, p. 129). Also, included in the organisation structure is also the organisation *infrastructure*, meaning computers, rooms and other facilities and services offered to employees.

Organisational communication
In addition to the communication between individuals and teams, also the organisation as a whole has an important role in communication. Its role as official communications channel as well as the centre for distributing information between organisational functions can be essential for effective operation. (for additional information, see e.g. p200, Huczynski & Buchanan, 2001).

Keepers of the past, oracles of the future
In terms of the whole organisation, the individual employees and teams are only temporary entities; it is up to the organisation to record and remember the past and set course for the years to come. Having good facilities to record the events and decisions that have been made during the work allows the organisation to analyse its moments of success and failure and learn from them.

124 Iivari, N. (2002) Presentation on the results of organisation culture study, Kessu Areena -meeting, 4.12.2002.