From ER to VR:

Analysing interaction in a Collaborative Virtual Environment

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Acknowledgements

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introduction

In this chapter the goal is to:

- Introduce the context of the thesis and the case.

- Provide an outline of the thesis, to aid 'navigating'.

1.   Introduction

1.1.   To err is human

It is commonly accepted that making mistakes is part of what makes us human. When working in a team the mistakes often have different characteristics than when working alone. Clearly, a well-functioning specialised team requires individual skills, but that is only part of the picture. More importantly, when it comes to teamwork, the members must have abilities to work together. Based on the notion that it is more common to misunderstand others than oneself, communication issues often become essential where group interaction is concerned. When the interaction takes place in a hectic environment where life and death is at stake, you have the typical setting of a hospital-based trauma team. Of course, such a trauma team is not the only group that fits these criteria. Medicine can be considered on a par with aviation and nuclear power plants regarding the (high) risk level. Yet, these domains separate by the number of people at risk. As patients take risks on a personal level, not much attention is drawn to individual cases compared to the public 'dirty laundry' following an airline disaster (even when comparing the number of casualties). Population-based research in the US shows that preventable medical errors are the eight most common causes of death (referred by Sexton, Thomas, & Helmreich, 2000).

1.2.   Managing error

Acknowledging the need for error management has led the aviation industry worldwide to develop safety training focused on team management. The term Crew Resource Management (CRM[1]) was first coined subsequent to a NASA sponsored workshop in 1979. Although not an international standard, the concept of CRM has spread worldwide, and has had massive impact on the aviation community. CRM researchers point to the problem of validation criteria for positive effects through CRM training (Helmreich, Merritt, & Wilhelm, 1999). Considering accident or near-miss rates as yardsticks for validation cannot be used, as rates are too low in statistical standards. The fact that training programmes and reporting procedures differ makes the validation task even harder. Ultimately this has led to the non-scientific

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[1] Originally an acronym for Cockpit Resource Management, now Crew Resource Management.

assumption that CRM training must have some positive effect in regard to safety, based mainly on its impact and acceptance within the community.

1.2.1. Patient safety and CRM

Influenced by research and practice from the aviation industry, several researchers have made efforts to compare (Sexton et al., 2000) and apply (Brattebø et al., 2001; Helmreich, 2000; Gaba, Fish, & Howard, 1994; Uhlig et al., 2001) established concepts derived from research on CRM to medicine in the battle for improved patient safety. Examples of issues dealt with within the CRM framework are: Systematic error management, simulator training, communication skills, team training, and promoting a safety culture. As noted by Pizzi, Goldfarb, and Nash (2001): "At this time, the evidence connecting CRM approaches to improving patient safety does not exist, notwithstanding the face validity of the approach" (p. 6). Nevertheless, in an extensive report the Institute of Medicine encourages the medical community to, amongst other efforts, increase the use of realistic simulators and look to aviation and CRM to find solutions to withstand the consequences of human error (Kohn, Corrigan, & Donaldson, 2000).

1.2.2. The BEST example

In Norway, the issues mentioned above have influenced a particular group of practitioners to build a holistic training programme. The programme is labelled 'BEST[2]', and is founded in blending medical domain knowledge[3] and procedure standards, such as ATLS® (Weldon, Silberfein, Chehardy, & McSwain Jr., 2002), with the 'philosophy' from CRM. BEST is a one-day course that is carried out in a structured way. An ambulant training team, normally consisting of a surgeon, an anaesthesiologist, and a pedagogical consultant, carry out the actual programme. The BEST team travels extensively in order to offer the concept to hospitals all over the country.

The BEST programme

As to the programme, it includes both a theory and a 'hands-on' practice session, as you may see in Table 1.

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[2] Acronym for 'BEtter and Systematic Trauma care' (in Norwegian: 'BEdre og Systematisk Traumebehandling').
[3] Emergency medicine/Trauma care.

Theory section A	A 'priming session' with emergency medicine theory and principles related to handling trauma cases.
Theory section B	Covering the particular approach and rationale of the BEST model, focusing on collaboration, communication and leadership. In this section it is pointed to the expected benefits of using simulation for training the whole team in familiar surroundings, and using familiar equipment.
Practice 1	The local trauma team goes into 'simulation-action' in a particular medical case modelled by the BEST group.
Debrief 1	A debriefing session is held where issues concerning the simulation are discussed. A specific focus is on aspects of communication, collaboration and leadership.
Practice 2	As 'Practice 1', but with a new medical case.
Debrief 2	As 'Debrief 1', discussing 'Practice 2'.

Table 1. An overview of the BEST programme.

1.2.3. The MATADOR application and rationale

This thesis is concerned with investigating prototype software that seeks to emulate the BEST concept in a computer-generated reality. The MATADOR application is a collaborative virtual environment (CVE) facilitating trauma teams to perform simulations without being co-located. This is made possible by distributing a 3D model of an emergency room (ER) and a virtual patient over the Internet. Different medical cases (scenarios) can be constructed by varying how the pre-programmed virtual patient is modelled. By letting distributed participants form a team, one may observe how they deal with the situation through communication, collaboration, and leadership. The MATADOR is a desktop-based CVE, meaning that the virtual environment does not demand special hardware and may be displayed on a typical PC. Interactions are done via the mouse, whereas the team-based interaction is made possible through real-time distribution of audio to the participants. A more detailed description of MATADOR will be presented in the following chapter.

1.3. An outline of the thesis

Chapter 2 presents the case of MATADOR, giving insights into the project and its 'product', the application.

Chapter 3 and 4 are concerned with theoretical issues based on previous related research, as well as sketching out the conceptual framework upon which the current study is positioned.

Chapter 5 mixes methodological and methodical issues. First some methodological considerations are discussed, followed by a shift towards the actual method and techniques applied in this study.

Chapter 6 is the analysis section of the thesis, and should be considered its core. The analysis describes the iterative process of the study by asking more questions and seeking to pinpoint issues of analytic interest. The findings are discussed towards the end of the chapter. Following the discussion of the findings some reflexivity on behalf of the method is presented, and the trustworthiness of the findings is considered.

In Chapter 7, general issues of the MATADOR project and application are discussed. Additionally, in chapter 8, I make some notes regarding possible application improvements. And finally, chapter 9 concludes the thesis.

2

the case

In this chapter the goal is to:

- Introduce the case by means of:
    - o looking at the MATADOR project, its technology, history, and 'philosophy'.

    - o taking a closer look at the MATADOR application and the user interface.

    - o describing the field trial setting.

    - o outlining the medical case modelled in the MATADOR application.

# 2.	Case description

In this case description I will cover the MATADOR project and application; as well the field trail setting including the medical scenario. The degree of detail in this description is coarse. However, the project is well documented, and further information may be found in the official reports (Halvorsrud, 2002; Halvorsrud, 2001), the 'Developers Notes' (Hagen, Fagernes, & Halvorsrud, 2002) and in the Appendix (A-G).

## 2.1.	The MATADOR project

The name MATADOR is an acronym for Medical Advanced Training in an Artificial Distributed Environment and refers both to the project and its application. The project started in June 2000 and came to an official end two years later, in June 2002. The MATADOR application is a software simulation prototype.

### 2.1.1.	Discovering 'BEST' practice

As a research department, Telenor Research and Development (R&D) was interested in finding particular domains where training by use of collaborative virtual environments (CVEs) could be studied. They had this kind of experience in training and assessment of emergency situations in offshore environments through the EC-project DISCOVER (2002). 'Corpus Calossum' is another example of a learning environment developed and studied by the same group. The latter system is a CVE that is part of the EduAction project (Fjuk & Krange, 1999; Larsen & Krange, 2001), where collaborative learning processes among pupils in secondary school are studied. While searching for a setting in which to apply their technology the team came across a small group of medical practitioners who had developed a training programme for hospital based trauma teams in handling acutely traumatised patients. Their project was labelled BEST[4] (Brattebø et al., 2001). However, the main ideas of BEST were not merely drawn from the medical field. Being concerned with issues such as communication, cooperation and leadership, the BEST team was clearly influenced by CRM issues pursued by the aviation community. After the initial contact with BEST it was determined that their ideas of training and communication fitted well with the capabilities of a CVE. At this point the MATADOR was 'born', with the BEST model providing a pedagogical and practical foundation.

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[4] Covered in chapter 1, 'introduction'.

2.1.2. The partners and their roles

The MATADOR project involved a handful of partners, each with special assignments and responsibilities. Table 2 lists the different partners and gives a short description of their involvement based on the final report from the project (Halvorsrud, 2002, p. 12).

Partner	Nature of involvement
Telenor R&D	The main driving force throughout the project. They have been handling the overall project management, as well as being directly involved in all aspects concerning MATADOR, including the system development of the application.
Faculty of Medicine at the University of Oslo (UiO)	Involved in the content description and the field trial.
University of Umeå	Involved in the content description, user requirements, system evaluation, evaluation of the pedagogy and the field trial.
Norwegian Medical Association	Involved in system description, user requirements, system evaluation and the field trial.
InterMedia at UiO	Involved in the identification of user requirements, the field trial, the evaluation of pedagogical aspects and system evaluation.
Multimedic AS	Played a major role in the system- and content description, user requirements, as well as system evaluation.
Boxer technologies	Supported computer equipment, and have in other respects remained passive in the process.

Table 2. MATADOR partners and their involvement.

2.1.3. Funding

In comprehensive research projects such as MATADOR, an important part of the process is to provide financial support. In this case the financial sources were the partners themselves together with a grant form Nordunet2, a research programme financed by an official Nordic collaborative effort. Amongst the requirements to receive a grant is that at least two Nordic countries are involved in the research activities. "The overriding aim of this programme is to help secure the position of Nordic countries at the forefront of Internet development. Its focus is on network utilisation and network-based applications" (Nordunet2, 2002). The total budget of

MATADOR was 8 million NOK, of which 2.6 million stemmed from Nordunet2, and the rest from the partners (mainly Telenor AS).

2.1.4. The project work and system development process

It should come as no surprise that the efforts to coordinate such a diverse group of scientists and developers involve quite a bit of administration. In order to cope with these issues the MATADOR team, in a quite early stage, divided the work amongst them by sharing responsibility for completing different tasks. Figure 1 shows the ten different tasks apart from the task of project management, which is held outside the model.
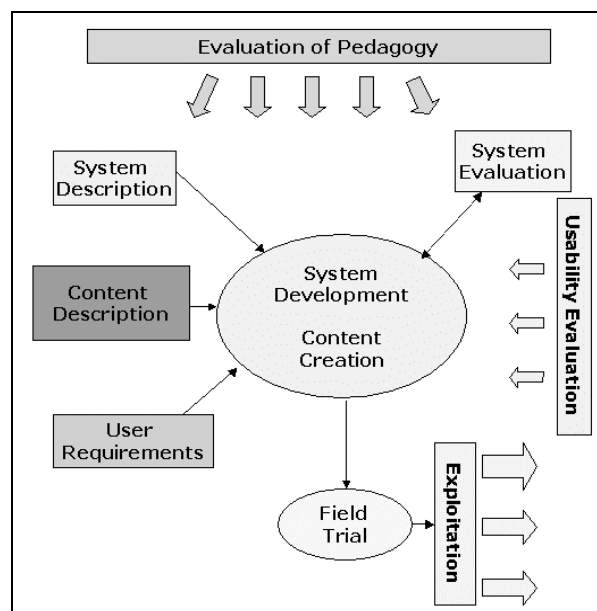
Figure 1. Model of project tasks (from Halvorsrud, 2001).

As we can see in Figure 1 the thin lines drawn between the boxes indicate processes involved in the application development. Input processes are the content description, the system description and the user requirements. The line connecting to the system evaluation has arrows in both ends representing the idea of an iterative system development process. As an output of the field trial there is a box called 'exploitation', proposing a potential commercial evolution[5]. As loosely connected entities we find the evaluation tasks, intended to describe different aspects, such as the user interactions and learning processes mediated by the application.

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[5] Such plans are continuously evaluated. Currently no such plans exist.

2.2. The MATADOR application

2.2.1. DOVRE – the technology platform

DOVRE is an acronym for 'Distributed Object-oriented Virtual Reality Environment', and is a software platform for CVEs. The development of the platform started in 1993 in the research group Applied Media Technology (AMT) in Telenor R&D. As with any technology platform, the idea is to construct elements that provide core functionality commonly required in a specific domain. In the case of a CVE, network connections, object distribution, and security issues are examples of such elements. In computer software terms this kind of platform is referred to as an application-programming interface (API). It constitutes a concept that paves the way for using components of the API in a variety of specialized applications. Further it supports the idea of software reuse, thus enabling developers to rapidly deploy applications and refine the platform software independently of other application parts.

In the course of the development of MATADOR the main group of developers left Telenor and founded their own spin-off company (Octaga AS) in June 2001. Even though the new company has commercialised the API under the name of Octagon, MATADOR still makes use of the 'original' DOVRE API.

2.2.2. Basic network design and specification

MATADOR is an application prototype built on the server/client model and distributed via the TCP/IP protocol. All graphical models in the application are compliant with the VRML97 (Virtual Reality Modelling Language) specifications (Carey, Bell, & Marrin, 1997).

The prototype supports four clients connecting to one server (Figure 2), and the server's task is two-fold. One is to maintain a 'shared audio space', enabling the participants to talk to each other at any time (more in section 2.2.5.). The second task is to distribute, in real-time, the objects modelled in the virtual emergency room. To do so, the server must not only keep track of the changing state of the patient, but also monitor each client's interactions, which then are 'fed back' to the server and continuously broadcasted to the connected computers.

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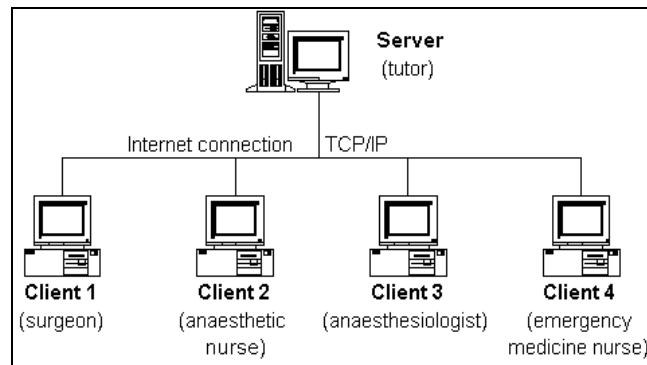
Figure 2. Network layout view (from Halvorsrud, 2001).

In any case, the server's labour-intensive work is not reflected in its user interface. As depicted in Figure 3, a tutor typically controls the server. And the graphical user interface provides much of the same features as the clients, differing mainly in the capability to start and stop a simulation (more on the user interface in section 2.2.4.).

Figure 3. Tutor at work.

2.2.3. The patient model

Saving the patient's life is the main objective in the course of the medical simulation. As to the modelling of the patient, one could expect that MATADOR would include a rather complex algorithm, or maybe even a touch of 'Artificial Intelligence'. However, this is not the case. The physiological condition of the patient has a deterministic development, which to a certain degree depends on the participants' interventions. The parameters, such as heart rate, blood pressure, respiration rate etc. are parsed into the server application via a text file during start-up. As mentioned, the values follow a pre-programmed change during the simulation, in an attempt to portray a pathophysiological realistic scenario. Currently the MATADOR prototype

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only incorporates one complete scenario, developed by chief consultant in surgery, Johan Pillgram-Larsen. It is based on a real incident, and adjusted to suit a CVE-based simulation (more details in the 2.3. 'field trial' section).

2.2.4. The user interface

From the perspective of a user, or rather participant, I turn to a description of the user interface. English is the language used in the application for menu-options and feedback. The application screen is divided into four areas, or windows. These areas have been 'hardcoded', i.e. they do not give users opportunity to resize the areas to suit their own preferences. Hence the user interface remains similar for all the clients.

The menu bar

The main window

The text window
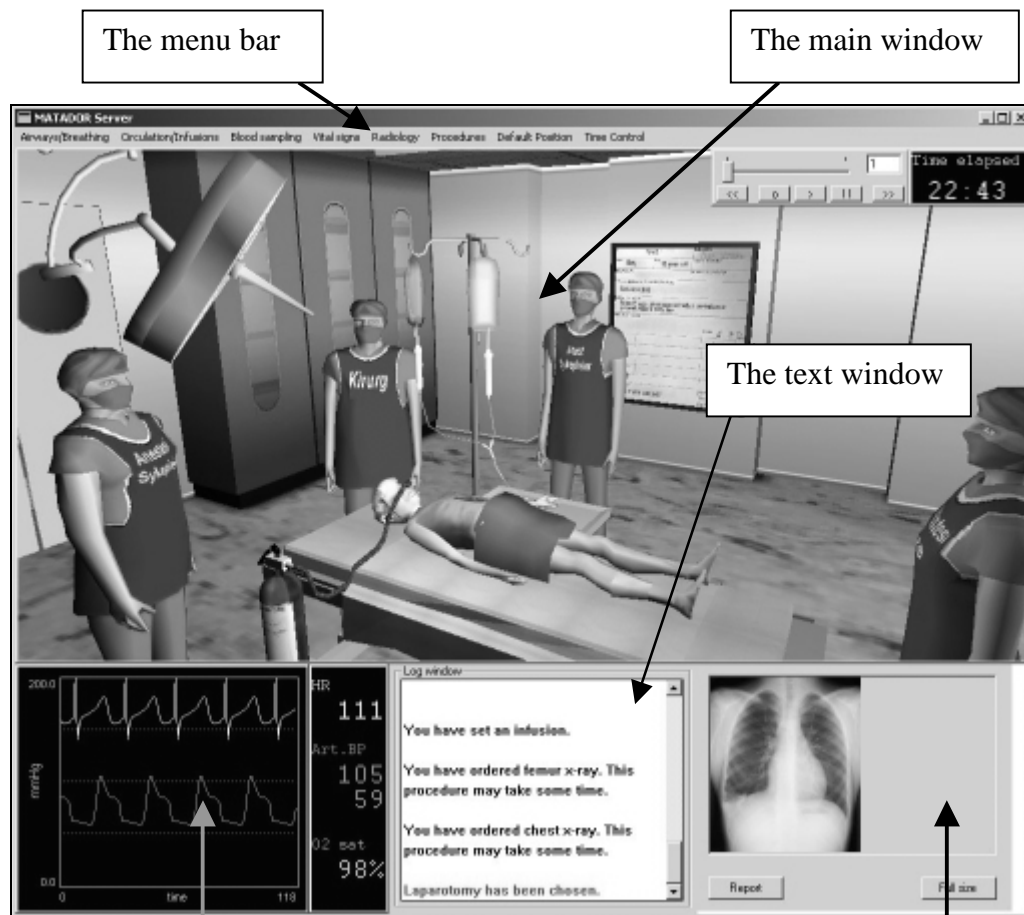
Figure 4. Screenshot illustrating the graphical user interface.

ECG window

The result window

Main window

The main window shows the 3D scene of the virtual environment (Figure 4). The viewpoint is of the first person, and the users cannot see their own avatar on any

occasion. They can see the patient, and the rest of the team members whenever their avatars are within the field of view. The window is dynamic in the sense that when other participants move their avatars in the space of the virtual trauma room it is more or less instantly perceivable by the others. During most of the simulation the virtual room rendered in the main window includes a patient on a table in the centre, as is the case in Figure 4. A clock is displayed in the upper right corner of the window, showing the time from the simulation start. The observant reader may have noticed that in this figure you can see four avatars, meaning that this particular screenshot is captured from the server. The tutor controls the server and can navigate in the virtual environment but does not have a visual representation (avatar), thus the tutor is invisible to the other participants. Still, all participants and tutor see the same virtual emergency room (ER), distinguished only by the individual viewpoints. The avatars have different coloured vests with a nametag indicating their role[6]. When the participants navigate (more on this in the next section) the other users can observe avatars moving across the room in a 'floating' fashion, as both arms and legs are statically modelled. Regarding the patient, he is not showing any voluntary or involuntary body movements except for the rising and sinking chest, matching the current respiration rate. In addition, animations are incorporated to illustrate certain procedures that can be activated through the menu system. For instance, when an X-ray is chosen, the camera device makes a travel on a rail in the roof, lowers towards the patient and shortly after returns via the same path. Such animations are only presented for certain procedures, namely the X-rays, laparotomy procedure and intravenous needle.

ECG window

The ECG window is continuously plotting the curves representing heart rhythm and blood pressure. I addition, numerical values of the heart rate, systolic/diastolic blood pressure, and the saturation value are displayed.

Text window

The text window gives the user feedback from the application, usually as a response to a menu choice. The (text) message is only given to the particular user who

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[6] Hard to see in Figure 4, as it is represented in greyscale with low resolution.

requested the procedure. In some cases the text window gives 'global' messages, e.g. "The patient is dead" (if patient is not saved after 35 minutes).

Result window

The result window gives each participant feedback on requested procedures, such as x-ray images, haemoglobin (HB) values, and 'vital signs'.

2.2.5. The modes of interaction

MATADOR supports three modes of user interaction by means of two physical devices, namely the mouse and the headset with microphone. Originally, plans to include a tactile feedback device existed, but the idea was abandoned.

Navigating and selecting in the main window

The spatial navigation of the avatar is done by the use of a mouse. When the mouse pointer is within bounds of the main window the avatar will move in corresponding directions to the mouse as long as either the right or left button is pressed (see Appendix B). Further, the main window includes certain objects and areas that are modelled as selectable. Specifically, these options are available three times during the simulation by using the middle mouse button:

1) Choosing a role by selecting the corresponding vest in the adjacent washing room.
2) Obtaining the ambulance casuistry report when the paramedic enters.
3) When the cannula insertion procedure is chosen, one must select an insertion point by clicking the patient's arm.

Initiating procedures with the menu system

Corresponding to the graphical WIMP model (windows, icons, menus, and pointing) (Preece et al., 1994; Shneiderman, 1998), the actions and procedures are effectuated with the mouse through the use of a pull-down menu bar (Figure 5).
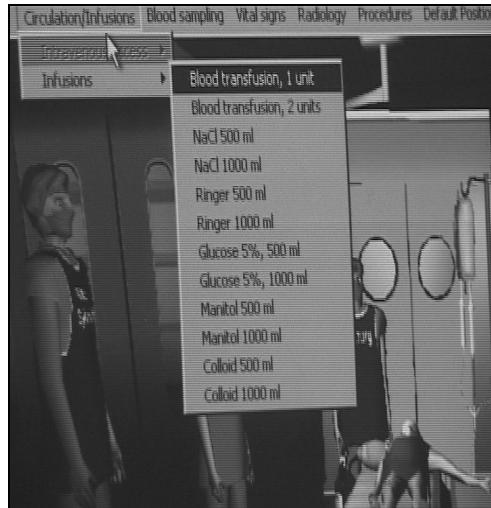
Figure 5. Illustrating the pull-down menu.

The top level (main menu) in the menu hierarchy includes the following options: 'Airways/Breathing', 'Circulation/Infusions', 'Blood sampling', 'Vital signs', 'Radiology', 'Procedures', 'Default Position', and 'Time control' (only on server). Further sub levels and sub-sub levels are specified in the 'Developers Notes' (Hagen et al., 2002, p. 6). The 'Default Position' option should be considered as a special category. This option is offered to aid participants who get lost in the virtual environment. By clicking 'Default Position' the avatar 'jumps' back to a pre-programmed position matching the role.

Verbal interaction through headsets and microphone

The MATADOR application supports a real-time, distributed sound system, enabling the participants to communicate by wearing a headset with a microphone. All the participants can hear what the others are saying, thus simulating face-to-face conversations. The sound system works independently of the simulation, so that the participants may interact verbally prior to, and after the simulation, as long as the application is running.

2.3. The MATADOR field trial

As a research undertaking, the MATADOR prototype had to be tested in some way. For that reason a field trial was arranged for four days in April 2002. The research team was located at Rikshospitalets Ferdighetssenter (RH) in Oslo, Norway, and Norrlands University Hospital in Umeå (UMU), Sweden. Given the distributed nature

of the field trial, the process of planning was meticulously taken care of. Telenor had the overall responsibility for carrying out the field trial, and by meticulous planning from the project leader, a tight and rigid time schedule was set up. The schedule stated clearly the intended plan of progress and the necessity of following it. The plan also included back-up plans in case of contingencies. The final version of the time schedule is to find in Appendix A. The week previous to the field trial was used for final testing of the application, setting up recording equipment for data collection, testing the video conferencing equipment for the debrief sessions and for coordinating the staff at both sites.

2.3.1. The staff

The staff counted six at UMU and nine at RH, and it is worth mentioning that not all staff was present at every stage of the field trial.

2.3.2. The participants

A total of 24 participants were involved in the field trial, with twelve from each country. Half the participants were medical students at the final stage of education (6th year students), the other half were professional medical practitioners (doctors and nurses) with varying degree of experience. The local university staff involved in the MATADOR project had made the selections of attendants, and the participants were paid 500 NOK for their involvement. In case of no-shows, there had been arranged for back-up participants who could step in.

2.3.3. Arranging the participants in teams

The participants were pre-arranged in six teams with four in each. Every team included two participants from each country, and every 'team within the team'[7] was from the same country. The first three teams were medical students, whilst the three last ones were professionals (anaesthetic and surgical nurses/doctors). The participants came from Sweden, Norway and Denmark[8]. The language issues might have hampered the teamwork. But as the languages are somewhat similar, and the

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[7] Surgical / Anaesthetic.
[8] One Danish person, in a 'Norwegian' team.

practitioners are used to working across the Scandinavian borders, this did not turn out to be a particular problem.

2.3.4. Describing a 'typical' session

Efforts were made to ensure matching conditions across team sessions. For that reason guides for the tutor and instructors were prepared. The sessions were structured, and no changes were made to the application during the week of the field trial[9].

Introduction and training

The participants were first introduced to the local staff with a general briefing. Then, after handing in the first questionnaire (Appendix E), a personal training session in front of the computer was carried out. As mentioned, there were guidelines for training in an attempt to assure that the same issues were discussed with all participants (Appendix C). Next, the participants put on their headsets and emerged in the virtual room to meet the rest of the team and the tutor. The tutor functioned as a facilitator in the initial stage, and guided the participants if they ran into trouble. In this stage the tutor was typically busy checking the team members' presence in the virtual environment and making each member pick a role according to the existing plan. The tutor then encouraged the team to make themselves familiar with different aspects of the virtual environment, such as navigation and talking to each other. When the tutor felt it appropriate he made sure that the team was ready, and then initiated the simulation (for the tutor guidelines, see Appendix D).

The medical simulation (scenario)

When the simulation starts, the clock in the upper right corner of the main window starts ticking, and the scenario is running. After approximately 30 seconds a paramedic pushes the patient, placed on a stretcher, through the door into the ER. Besides observing this event, the team is notified through this 'global' message in the text window: "Note that the ambulance-guy might have some more information for you. (Hint: use the middle mouse-button)" (Hagen et al., 2002, p. 33). If a participant performs the proposed action, a brief textual report appears in the text window. Should nobody pursue the driver, he leaves the room after 5 minutes.

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[9] At least none that had direct impact on the user interface level.

As soon as the patient is brought into the room, the monitor showing his physiological status is displayed in the ECG window (Figure 4). The patient in this case is a 12-year-old boy who was run over by a car while bicycling. An apparent clinical sign is bleeding from the skull. Initially the heart rate (HR) and blood pressure (BP) readings show normal values, although slightly higher HR and lower BP. According to the ambulance report, he is conscious but drowsy. During the initial assessment the team is supposed to make efforts to diagnose and handle the patient's injuries according to accepted medical procedures.

When evaluating the team effort, an important assessment criterion is to observe if the team chooses to prioritise the (less important) head injury by transporting the patient to the CT-lab. The crux is that a massive abdominal bleeding is developing quickly, and will be fatal if not treated surgically. As the surgical procedure is impossible to perform in the CT-lab, the patient will die if the team should choose this option.

The second questionnaire

When the simulation ended the tutor directed the team members to stay put, as they were supposed to fill in the second questionnaire (Appendix F).

The debrief

The local participants met and went together with the staff to the videoconferencing facilities. When the videoconference was over the participants were thanked for their efforts, and the staff made themselves and the equipment ready for the next group.

Chapter summary

In this chapter I have covered what I consider as important aspects of the MATADOR project, application, and the field trial. All in all constituting the case on which this thesis is based.

The next two chapters will be devoted to theoretical aspects.

3&4

theory

In these two chapters the goals are to:

- Place the current study in a theoretical context by:

    o considering theoretical tradition and frameworks.
       (chapter 3)

    o accounting for different empirical and theoretical findings in
       related research.
       (chapter 4)

3. Conceptual framework

Typically, theory building in scientific communities, at least those involved in the study of humans, starts out as a critique in opposition to the mainstream research or paradigm. Below I will introduce some theories concerning and connecting humans, computers and learning.

3.1. The study of computers and humans

The theories that have guided the study of information systems have been co-evolving along with the development of computer technology. Parallel to this evolution the classical positivistic scientific approach has been disputed and criticised in several scientific milieus. From the batch job processing on mainframe computers and clumsy punch-card interface design, the field of computing has taken big steps. With the development of more interactive systems and GUIs[10], it became appropriate to study the human *interaction* with the computer. This led to a merge of theories into the new field of human computer interaction (HCI) in the 1980s. The influences guiding HCI came from such diverse fields as computer science and cognitive psychology. The view of the human as an information processing entity was evident and fitted well into the models adopted by the HCI community. The next step in the computer technology evolution was the increasing use of computer networks and the introduction of computers in people's daily life. Both at work and in private homes the use of computers exploded in numbers. Several researchers were displeased with the attempts to apply conceptual frameworks derived from its information processing psychology-based main predecessor, HCI (Kuutti, 1996). Promoters of a new approach often complained of lack of means to describe aspects such as context, situation, and practice (Nardi, 1996). As well as noting that HCI " […] pretty much ignored the study of artefacts, insisting on mental representations as the proper locus of study" (p. 14).

Advocacy started for founding a new and fresh interdisciplinary approach. The 'birth' of computer supported cooperative work (CSCW) was a fact in 1985. Ellis, Gibbs, and Rein (1991) have traced CSCW origins from the diverse scientific fields of distributed systems, communications, human computer interaction, artificial

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[10] Graphical User Interfaces.

intelligence and social theory. Surfacing in the mid-1980s as a multidisciplinary field, CSCW had its focus on groups of people working together with the support of computers (Grudin, 1994). The CSCW applications have been labelled Groupware, distinguishing them from the research field itself. Figure 6 is meant to illustrate the research and development context for CSCW on four levels, and Table 3 is provided to explain the levels in the figure.
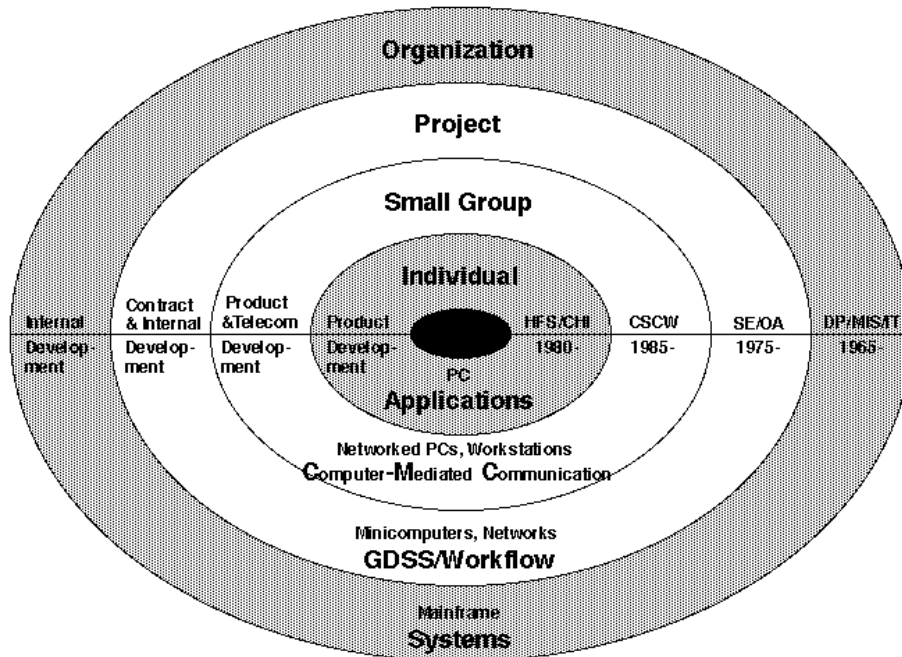
Figure 6. Research and development context for CSCW (From Grudin, 1994).

Upwards	Who the system is developed for
Left	Who does the development
Downwards	What kind of hardware is used
Right	The corresponding research area and time period

Table 3. Explaining the four levels of Figure 6.

Grudin argues that the direction for research and development in 1994 pointed *away* from the inner- and outermost rings and *towards* increased interest in the two middle rings of the figure. And now, almost 10 years later, it is fair to say that it has kept up steam. The Internet has an obvious influence in many individual and corporate lives, and much groupware and research has been brought forward.

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3.2. Learning and computers

As mentioned above, CSCW is an interdisciplinary field. And from the very start a substantial number of researchers have been devoted to the pedagogical issues of CSCW and groupware. In their opinion the pedagogical direction had not received weighty focus within the CSCW community, where the main interest was centred on group work and cooperative work amongst employees.

This led to a new direction of research originated from CSCW labelled computer supported collaborative learning (CSCL). Besides the emphasis on the differences between learning and work, note the dissimilar meaning of the second 'C' in the two acronyms. In the case of 'Collaborative' in CSCL, the underlying pedagogy implies that such learning occurs in the interaction between pupils at the same level of competence (i.e. peer level). The CSCW way is to focus on cooperation with the support of computers, in the meaning of teamwork and division of labour where each person is responsible for a portion of the problem solving process (implying *different* competences). There are of course divergent views on this issue within the CSCL community, but as concerns this issue I follow the ideas of Roschelle and Teasley (1996).

In line with CSCW, CSCL has made a shift in focus from the individual to the group level. Dillenbourg et al. (1995) draw an imagined 'axis of evolution' within the study of collaborative learning. They map different theoretical approaches to the axis, and stress the need for variation (Figure 7).
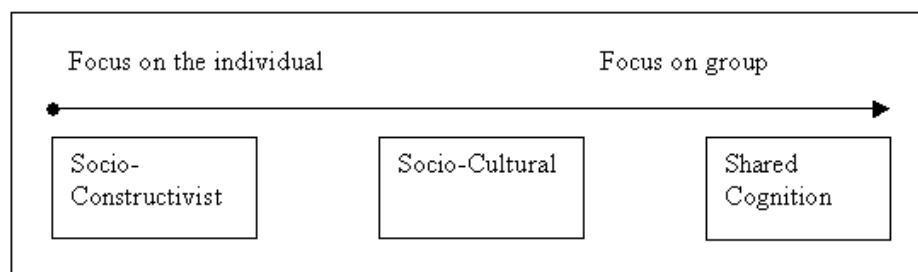
Figure 7. The evolution of research on collaborative learning (interpretation of Dillenbourg et al., 1995).

Secondly, Dillenbourg, Baker, Blaye and O'Malley (1995) point out that "[…] empirical studies have more recently started to focus less on establishing parameters for effective collaboration and more trying to understand the role which such variables play in mediation interaction" (p. 190). This argument was based upon the conflicting and unexpected empirical findings of learning effects where different variables were manipulated by researchers (e.g. group size, communication media)(ibid.).

More recently, Stahl (2002) has done efforts to describe a visionary "[…] rich, multi-dimensional starting point for conceptualizing and studying CSCL" (p. 1). More specifically he contributes by offering the following four tightly interwoven themes: Collaborative knowledge building (1), group and personal perspectives (2), mediation by artefacts (3), and interaction analysis[11] (4). The rationale for an attempt of this kind is based on the notion that "the task of designing effective computer support along with appropriate pedagogy and social practices is simply much more complex than imagined" (p. 2). Basically this can be taken as an account for the lack of abundant success stories within the field, and thus relating to two of the 'classic' findings by Grudin (1988). Grudin claims that part of the answer lies in the unique lack of management intuition for groupware applications, as well as pointing to how little is learnt from experience, mainly due to the extreme difficulty of evaluating such applications (ibid.).

3.3. Sociocultural perspectives

The view of the social world as the basis for understanding human activity constitutes the general assumption shared amongst the family of theories in the sociocultural tradition (Wertsch, Del Rio, & Alvarez, 1995; Wertsch, 1998). In that sense they oppose the cognitive stance, where mental structures and processes are considered the proper units of analysis. The western rediscovery of Vygotsky's work is considered the source of this tradition. Some examples of theories 'in the family' are: Activity Theory (Engeström, 1987; Engeström, Miettinen, & Punamäki-Gitai, 1999), Distributed Cognition (Hutchins, 1995a), and Cultural Psychology (Cole, 1996).

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[11] Not corresponding to Jordan and Henderson (1995) style of interaction analysis.

Situated Action (Suchman, 1987; Lave, 1988) and Symbolic Interactionism (Star, 1995) are considered slightly less-connected 'family members'.

3.3.1. What is an artefact?

Artefact is a key concept in this context, and my impression is that it easily gets misconstrued. For that reason I would like to address it by citing (Cole, 1996):

> […] an artifact is an aspect of the material world that has been modified over the history of its incorporation into goal-directed human action. By virtue of the changes wrought in the process of their creation and use, artifacts are simultaneously *ideal* (conceptual) and material. They are ideal in that their material form has been shaped by their participation in the interactions of which they were previously a part and which they mediate in the present.
> (p. 117)

In other words, artefacts constitute the ordinary material objects manufactured by humans, but that is only a part of the story. Abstract concepts, like language, are also considered artefacts, making the idea harder to grasp. An important point is that artefacts have gone through several iterations (and generations) of refinement.

By holding such an 'all-embracing' view of an artefact one also assumes that the higher cognitive function in humans is due to social interaction, and not biological make-up or abstract mental representations alone (Bronckart, cited by Wertsch et al., 1995; Säljö, 2000). Further, social interaction is considered a reciprocal process tightly connected to the existing cultural artefacts; hence the historical 'product' becomes the continuous refinement of both the individual and the culture in which he or she may reside (Vygotsky, 1978). However, this stance is problematic in the sense that it cannot avoid the dualistic view of the individual *and* the society, as criticised by Matusov and Hayes (2000). They declare that in the contemporary sociocultural view " […] the social is neither just an individual's environment nor a plane of actions but the aspect of any human activity together with other aspects such as individual, cultural, and historical" (p. 217).

3.3.2. The concept of mediated action

Another fundamental principle within the sociocultural approach, only just mentioned in the citation above (Cole, 1996), is the concept of mediation. The main idea is that artefacts mediate human action (Vygotsky, 1978), and that "[b]y focusing on mediational means it forces us to go beyond the individual agent when trying to understand the forces that shape human action" (Wertsch, 1998, p. 24). Mediation is thus considered a reciprocal process where human action is made possible through mediation, and at the same time the mediated action refines the artefact in itself. To study human activity one should highlight the interplay between agents and their cultural tools, as expressed by Wertsch: "The task of a sociocultural approach is to explicate the relationships between human action, on the one hand, and the cultural, institutional, and historical contexts on which this action occurs, on the other" (1998, p. 24).

3.3.3. Other critiques against the cognitive science field

It is worth noting that cognitive science has been heavily criticised from other research fields besides the sociocultural. Concerned with how evolutionary theory has revolutionised biological sciences, several researchers have pointed to how the cognitive sciences have neglected the evolutionary history of the human mind (Donald, 1991; Plotkin & Oakley, 1979; Plotkin, 1988). They claim that evolutionary theory has a lot to offer both psychology and the social sciences. As put by Donald (1991), " […] the question of human cognitive origins has not been in the forefront of cognitive science. In fact, cognitive science has built its edifice mostly on the study of two recent, and highly specialized, kinds of mind: literate English-speaking adults and computers" (p. 1).

3.4. Distributed cognition as a guiding theoretical framework

On the sociocultural train of thought, Hutchins (1995a) made a radical approach in his book, *Cognition in the wild*. The argument that cognition is not exclusively constituted in the individual mind, opposed the traditional individual approach of cognitive psychology. Hutchins argues that cognitive processes happen in interplay with external resources (agents), including both artefacts and other individuals. Thus designating the whole functional (cognitive) system as the proper level of analysis.

This has at least one important and interesting methodological implication. With highlighting *how* information flows within the functional system as the appropriate object of inquiry, it is implied that any information crossing the 'horizon of observation' is not only available to the rest of the individuals, but also the researchers. This constitutes a compelling concept for looking closer into complex group work, such as studies done by Hutchins (1995a) and Heath and Luff (1991).

3.4.1. Elements of Distributed Cognition (DCOG) theory

Calling for a naturalistic turn

Hutchins shows his disregard for the study of mental representations carried out in controlled experiments by cognitive psychologists. DCOG, on the other hand, favours the examination of real-life settings where teamwork and technological tools are present. The study of the navigation of ships (Hutchins, 1990) and how a cockpit remembers its speed (Hutchins, 1995b), are examples of studies under the theoretical influence of distributed cognition, and will be described further in the 'related studies' section (4.1.4.).

The functional system

In the DCOG view it is how the entire system performs that is of interest. Thus making it hard to apply either a pure cognitive or social science approach. The former fails in considering the influence of context, whilst the problem for the social science approach is the insufficient accounting for importance of artefacts within such a system. A clarifying note needs to be added to these ideas. Even though one speaks of cognition distributed within the functional system, it is not implied that for instance a pen exhibits mental processes. But rather that it, in interplay with other agents, facilitates such cognitive processes in the individual mind.

The methodological link

When it comes to the actual fieldwork, the DCOG framework leans heavily on the established techniques of ethnography. Some researchers criticise DCOG on these grounds, pointing to its lack of theoretical model building (Nardi, 2002). As noted by Artman (1999), this can be said to be partially true, as Hutchins' work is mostly based

on empirical research. On the other hand Hollan, Hutchins, and Kirsh (2000) have made efforts to counter the critique by proposing what they call 'cognitive ethnography' as a novel methodological approach. In any case it is not straightforward to adapt DCOG principles in research, as practical guidance in respect to the process of analytic work is vague. Some even argue that the theory and principles are hard to learn (Rogers, 2001). Still, I have summed up essential DCOG principles in Table 4.

Basic DCOG principles
'Propagation of representational states across media' in terms of trajectories of information and the transformation that takes place.
The whole functional system as the locus of study.
The importance of artefacts to the functional system.

Table 4. 'Analytic guidance' afforded by distributed cognition.

By adopting a DCOG framework Rogers (1997) notes that one may be able to

> […] highlight the complex interdependencies between people and between people and artefacts in their collaborative activities, which in turn, can lead to a better understanding of why seemingly trivial breakdowns in the communications and interactions between them can have significant and sometimes drastic consequences. (p. 4)

A further discussion of this will be continued in the methodology section (5.2.2.).

3.5. Trouble in paradise?

One never ceases to wonder about the 'incompatibilities' between theory and practice, and in the case of interaction design, nothing seems to dishonour that impression. Rogers (2001) asks what new theoretical approaches can offer HCI in terms of knowledge transfer. Knowledge transfer is here meant as "[…] the translation of research findings (e.g. theory, empirical results, descriptive accounts, cognitive models) from one discipline (e.g. cognitive psychology, sociology) into practical concerns that can be applied to interaction design" (p. 2). Examples of the new theoretical approaches are theories such as activity theory, ecological psychology, DCOG, and external cognition. As mentioned in a previous section (3.1.), these

represented a shift in thinking that occurred in the late 1980s following the loss of faith in the 'traditional' theories originated from, and influenced by, cognitive psychology. Alongside the critique of recent theoretical developments, Rogers (2001) also presents a survey of what practitioners currently use, indicating an interesting finding: Theory-based approaches have very little impact on the practice of interaction design.

> Designers, consultants, producers and others involved in the practice of interaction design are much less likely to have the time to develop and practice the skills necessary to use the new analytic frameworks, (e.g. carry out an activity theory or distributed cognition analysis) – echoing a similar complaint that was often made about traditional cognitive theories brought into HCI. (p. 21)

As to why there seems to be so little knowledge transfer, Rogers (2001) discusses a few suggestions on the issue. For one, theories do not 'do design' as "[…] theory cannot provide prescriptive guidance in the sense of telling a designer what and how to design." (p. 21). Further, it takes time to learn to use the theories in practical terms; alas the theory needs time to mature before one should expect results. And even choosing amongst alternatives is a difficult task in this respect. The general movement towards historical and sociocultural approaches is described as "[…] a double edged sword" that has provided new insights, but at the same time has drowned designers in detail, "[…] not knowing what to make of it" (p. 23).

4. Related studies

The fields of CSCW and CSCL are known as interdisciplinary by history and nature, thus making it easy to incorporate other disciplines into action when efforts are made within the field. In fact exactly this eclectic conduct has brought forward a substantial amount of criticism. Still, I argue that it is important to elaborate on a few theoretical concepts and empirical findings that I view as connected to issues concerning the MATADOR project and application. First a distinction is made between research based mainly on human factors, and research based on some sort of interaction with computers.

4.1. Studies on non-computer issues

Besides the work in the field of CRM described to some detail in the introduction, there is need for a few notes on cultural issues concerning both the field of medicine and the Internet.

4.1.1. Culture in the field of medicine

An interesting account based on cultural issues, more specifically in the medical profession, is a study by Cicourel (1990). He analysed routine discourses that occurred in a hospital setting, and showed that the process of reaching a medical diagnosis is not merely an intellectual undertaking. It involves complex social processes between practitioners who vary in status and areas of expertise. The processes of exchanging observations and assessing each other's credibility become important factors when a diagnosis is to be put forward. In that sense Cicourel shows how crucial trust is in the matter of providing sources for solution and decision. He concludes that whatever information system or technology is to be launched into this setting; it must provide some evidence of its own credibility.

4.1.2. Trust on the Internet

Jarvenpaa and Leidner (1998) discuss the formation and maintenance of trust in global virtual teams. In their view, such teams are characterised by what Kristof, Brown, Sims Jr., and Smith (1995) have defined to be temporary, culturally diverse,

geographically dispersed, and communicating by electronic means. Jervenpaa and Leidner point to some limitations in their exploratory study. For instance, how the trust concept in the study assumes risk for the participants, and that the participants actually have a choice. The communication that surfaced in their case study was primarily asynchronous. Further, the risk and rewards were grade based, as the participants in the study were master students. Handy (1995) argues that trust requires touch, and that the excessive uncertainty in the electronic environment may rule out the possibility of formation of trust. This claim is challenged by Jarvenpaa and Leidner (1998) who state that certain communication behaviours and member actions suggest that trust can exist in purely virtual teams.

4.1.3. Naturalistic decision-making

In a series of case studies reported by Klein (1998), the common denominator founds a critique against the classical decision making studies. Klein takes a completely different stance as he and his colleagues move out of the laboratory and into the environment where the decision-making naturally takes place, hence the term naturalistic decision-making. Klein and his colleagues treated the participants as the experts in contrast to the laboratory settings.

> [We] came to respect and admire them. This admiration may have biased our work, or it may have informed it. When we study naïve subjects who are performing unfamiliar tasks, and we know what the right answers are, then the best our subjects can do is not get it wrong. (p. 287)

This fresh methodological approach has reported new insights; specifically Klein and colleagues have put forward a model of Recognition-Primed Decisions. A key point is that the way experts decide for action in many cases does not involve formal analysis and comparison. What typically is preferred is the first workable option, not necessarily the best option. This has implications regarding the training that should be done to educate newcomers. The focus ought to be on rapid responses to realistic scenarios, and incorporating both the odd and the common cases. The locus of study involves expert individuals in settings of time pressure, high stakes, inadequate information, ill-defined goals, poorly defined procedures, cue learning, context,

dynamic conditions and team coordination (Orasanu & Connolly, 1993, cited in Klein, 1998).

4.1.4. Communication and coordination studies influenced by DCOG

The studies and theoretical foundation put forward by Ed Hutchins have many similarities to the study of naturalistic decision-making. The goal is to examine the knowledge in action, hence the perceived strength of 'out of the laboratory' studies becomes the common denominator in the case of both Hutchins and Klein (1998). When it comes to the differences, it is mainly Hutchins' focus and emphasis on the functional system that separates them. As previously described, the 'merging' of human and non-human actors makes up the unit of analysis in the DCOG approach (section 3.4.). Whereas Klein typically seems to 'lift forward' the leader, not surprising, as the goal is to build models of decision-making, commonly considered a leader task.

In Hutchins' (1990) description of the joint navigational activity performed when navigating a large ship he shows how " […] the detection of error requires access to errorful performance and the correction of error requires a functionally redundant distribution of knowledge" (p. 291). He illustrates these points with examples from navigational practice where technology often has a key role in defining 'horizons of observation', as making parts of the joint task visible to the team members. This concept illustrates the need for 'open tools' and 'open interactions'[12] when people are collaborating in technology-rich environments. Hutchins argues further for the idea that this horizon only accounts for part of the picture. Besides the openness, there is a need for some overlap in existing knowledge. If the team members have no idea of each other's domain or the whole picture (no overlap) it is easy to imagine the problems the team will encounter when they are to solve problems.

In the article *Distributed cognition in an airline cockpit* (1995b), Hutchins and Klausen make an effort to map data onto theory; something they argue is not a straightforward task. The study can be treated as explorative, however they identify several empirical findings and elaborate on these issues while 'moving through' an

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[12] Thus enabling 'workspace awareness' (see section 4.2.1.).

event analysis based on video/audio recordings from a simulated flight. Hutchins and Klausen show examples that make it clear how such concepts as expectations, intersubjectivity, redundancy, and access to information are vital to coordinate the socially distributed cognitive task of flying a modern airliner. A key point in DCOG theory is that one cannot know who knows what at any given time in the cognitive system, but by following the trajectories of information one can look for evidence to support what paths the information must have taken.

Artman (1999) has looked into understanding how people work in coordination centres, where their task is to control dynamic environments. His doctoral thesis sheds light on how different theoretical perspectives can be used in combination to solve some of the complex puzzles when analysing cognition, cooperation and technology within dynamic decision-making. He sees DCOG as a promising theoretical foundation for this type of study, as well as suggesting development to this framework in regard to including concepts of coordination and situation awareness. His empirical work is based on four studies, two micro-world, and two real-world studies. The micro-world studies have been carried out to investigate the hypothesis originated from the analysis of the real-world studies. Artman (1999) claims that coordination is dependent upon what material resources the actors have and use, as well as on each individual's knowledge and the goals of the system (i). He further notes that situation awareness should be regarded as a constructive process (ii), and that situation awareness and coordination practices should be regarded as interdependent (iii). Finally he claims that situation awareness is dependent upon information processing procedures and information representation (iv).

4.2. Studies on computer-specific issues

4.2.1. Groupware issues

As mentioned in the previous chapter, groupware is the computer technology that makes distributed work possible. There are different opinions on what should be considered groupware within CSCW research and development. Grudin (1994) compared and commented some of these controversies (Figure 8). Omitting this discussion I choose not to rule out other categories, but to view the MATADOR application as a case of advanced groupware in line with Allen (1990). This kind of CVE makes use of the operating systems, networking hardware and TCP/IP as fundamental building blocks rather than groupware per se.
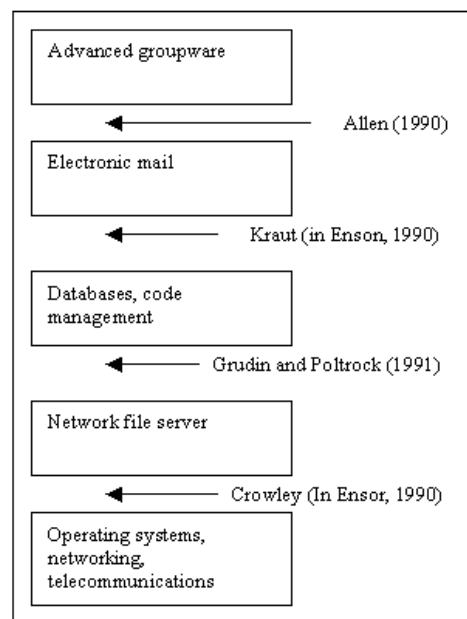
Figure 8. Groupware and its substrate. The authors define all items listed above their names as groupware. Their orientation progresses from the system level (bottom) to the advanced application level (top) (from Grudin, 1994).

Since Grudin (1994) wrote the article a seemingly ever-growing number of groupware has become available. And presently there is an abundance of applications that fit the criteria, all with very different ways to support teamwork. Nevertheless, some general issues must be managed by the groupware. A central tenet is to include ways to provide awareness.

Awareness

So what does it mean, when it is stated that one should design for awareness in groupware applications? Based on common understanding of the concept, Ehrlich (1999) states that "[a]wareness of the location and activity of other people is a critical mechanism for regulating and coordinating our behaviour with others" (p. 15). For instance, by interpreting cues in our physical environment, such as an open door, we anticipate whether our colleagues are available or not. On the other hand, when collaboration is mediated through computer technology, such 'social protocols' need to be incorporated into the groupware. Ehrlich (1999) thus calls for novel and alternative ways of representing such physical cues. A contemporary example may be found in the many instant messenger[13] services. Such applications are typically using (newly established) techniques for providing awareness by showing who is online/offline/busy, and so on. In Schmidt's (2002) opinion the concept of awareness is in a confusing state. Actually to the degree that " […] it is becoming increasingly clear that the term 'awareness' does not denote a set of related practices. In fact, it is hardly a concept any longer" (p. 287). Nevertheless, I will take a closer look at some 'specialised' types of awareness in the following sections.

Situation awareness

Gutwin and Greenberg (2002) mention that awareness-based research has its roots in military aviation. Dominated by a focus on situation awareness (SA), it has become widely acknowledged within other fields, such as commercial aviation, air traffic control, anaesthesiology and command-and-control settings, to mention a few. In terms of commercial aviation the introduction of new technology on the flight deck has freed the pilot of cognitive workload, making it possible for the pilot to undertake other complex tasks (Noble, 1993, referred in Artman, 1999). The quest for determining the connection between SA, cognitive functions and components of the mental apparatus has received considerable focus in certain cognitive psychology communities (Artman, 1999).

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[13] Such as ICQ, MSN Messenger, AIM, Yahoo Messenger.

A definition of situation awareness is the " […] up-to-the minute cognizance required to operate or maintain a system" (Adams et al 1995, cited by Gutwin & Greenberg, 2002, p. 9).

"Most simply put, SA is about knowing what is going on around you" (Endsley, 2000, p. 2). Further, proposing a three-level definition of SA that is more process oriented:

Level 1: *perception* of relevant elements of the environment

Level 2: *comprehension* of those elements

Level 3: *prediction* of the states of those elements *in the near future*

Workspace awareness

Gutwin and Greenberg (2002) have proposed a framework for supporting workspace awareness in real-time groupware where they define workspace awareness as " […] up-to-the-moment understanding of another person's interaction with a shared workspace" (p. 417). The key point here is the awareness of other people and their interactions rather than, as in general SA, the workspace itself. A further distinction is voiced by suggesting that: "WA is limited to events happening in the workspace--- inside the temporal and physical bounds of the task that the group is carrying out" (p. 417). In Gutwin and Greenberg's view WA is a specialisation of SA. They point to the fact that when you are alone on a task your focus can be exclusively on the task itself, contrary to the need for awareness of others when the task is solved through collaboration. In daily life, the process of collecting WA is rather effortless compared to what can be the situation when groupware is used, with its technological constraints. Gutwin and Greenberg's (2002) descriptive framework concentrates on "[…] what information to present, and on presenting that information so that people can maintain awareness easily and naturally" (p. 419).

4.2.2. Virtual reality and collaborative virtual environments

Jaron Lanier coined the term virtual reality (VR) in the late 1980s. However, the original idea and technology itself stemmed from Ivan Sunderland's work on interactive computing and head-mounted displays in the mid 1960s (Schroeder, 1996). Currently, many different terms and definitions are used when referring to the concept

of virtual reality: collaborative virtual environment (CVE), cyberspace, synthetic environment, artificial reality, and 'the Matrix'. Constituting a disputed term, VR in a common sense can be described in an undemanding way, as once stated by John P. Marlow: "Cyberspace is the place you are when you are on the phone" (cited by Pimentel & Teixeira, 1993, p. 3).

VR classifications

Omitting an extensive description of the history of VR, I now turn to a brief description of different classification schemes. McLellan (1996) refers to the four types of VR suggested by Jacobson (1993) (Table 5).

Type of VR	Typical Features	Illustration
Immersive	Head-mounted display, Haptic interfaces try to mimic natural experiences through e.g. mechanical feedback.	
Desktop	Software running on a typical consumer PC. Traditional interfaces, i.e. mouse and keyboard.	
Projection	Projected image for one or more people to view. Typically little interaction, more like a theatre.	
Simulation	VR enhanced simulators. Different kinds exist. Usually for entertainment or experiences.	

Table 5. Illustrating the four types of VR suggested by Jacobson (1993).

Thurman and Mattoon (1994) suggest a scale with two end points referring to the degree of verity (Figure 9). The degree of verity refers to how the VR application

corresponds to physical reality. On the left end of the scale are the applications that mimic the real world. On the other end, no efforts are made to restrict the application in this respect.

Figure 9. Thurman and Mattoon's Verity scale (from McLellan, 1996).

Thurman and Mattoon (1994) have proposed two other dimensions to include, namely 'integration' and 'interface'. The integration dimension focuses on how humans are integrated into the computer system, the three modes mentioned are 'batch', 'shared control' and 'total inclusion'. The interface dimension ranges from natural to artificial. Moore (1995) has interpreted the three dimensions into a 3D model and given a few examples of corresponding applications. Integration equals the immersive aspect, thus making cyberspace 'score high' (Figure 10).
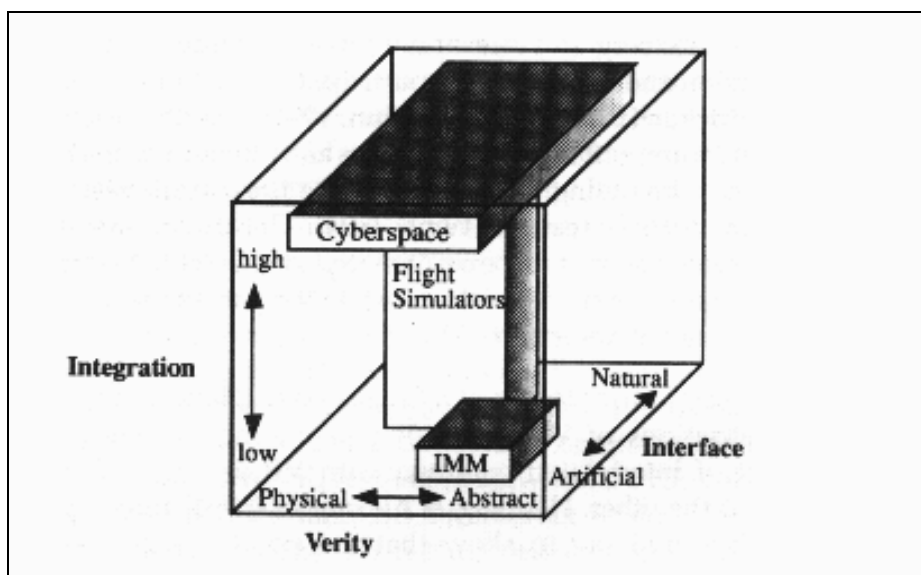
Figure 10. An interpretation of Thurman and Mattoon's 3D Virtual Reality Classification (from Moore, 1995).

Focus on collaborative virtual environments (CVEs)

Following Thurman and Mattoon (1994) the computer system itself normally consists of hardware and software components that make it useable in a VR environment. Obviously such a computer system needs to be highly interactive regarding user input and output processing. A special feature in the case of the (distributed) collaborative virtual environment (CVE) is that it somehow must be connected to other computers in a network.

The COVEN project has made an extensive description of CVE requirements and definitions in their guidelines for building CVE applications (COVEN, 1997). A CVE may be viewed as a kind of refinement of a Shared Virtual Environment (SVE), which in turn is a specialisation of the Virtual Environment (VE). See Table 6 for details on the issue.

Acronym	Name	Property
VE	Virtual Environment	A computer system that generates 3D virtual environments. The user can interact and receive real-time feedback.
SVE	Shared Virtual Environment	Supports multiple simultaneous users. These users may be able to interact with other users.
CVE	Collaborative Virtual Environment	A SVE that aims at collaborative tasks. A 'world' populated by objects and representations of users (avatars).

Table 6. What it takes to 'be a CVE'.

At another level, they describe a range of aspects or dimensions in which a CVE may differ (Table 7).

Dimension	Property
Presence	The users feeling as a part of the environment, of 'being there'.
Immersiveness	The CVE's degree of surrounding the user (e.g. desktop or head mounted).
Interaction with reality	Must the user interact with anything else than the VE system, or is it purely artificial?
Distributed or not?	Are users at the same location?
Persistent?	Is the 'world' there despite all users logging off?
Input/output means	Head mounted display, data glove, and speech? Determines which senses in the user directly involved.

Table 7. Some of the differing dimensions in CVEs (from COVEN, 1997).

4.2.3. Pedagogical groupware

Gredler (1996) ascribes the increased interest in games and simulations to the advances in computer technology, continuously offering increased power and flexibility. However, the technology in her opinion faces two major problems. First the comprehensive design paradigms derived from learning principles have not been available. And secondly, there is a general misconception as to what constitutes a simulation.

Gredler (1996) calls for design models and well-designed research studies to counter the situation. There have been carried out comparative studies with classroom teaching, but this is generally a bad idea, as these have very different characteristics and merits. Her argument is that simulations offer better possibilities for developing mental models of complexity and problem-solving skills.

Further Gredler provides 'a definitive framework' for games and simulations, separating the surface structure from the deep structure. The surface structure has to do with observable mechanics and tools, whereas the deep structure refers to the psychological nature of interactions between learners, and between learner and major tasks (e.g. degrees of student control, type of decision sequence, either linear or branching).

Aside from the structure aspect, games are generally about winning and simulations are about taking on responsibilities. In addition games are typically linear, whereas simulations are non-linear. In games, rules do not need to relate to real-world events.

In the discussion of experimental simulations, Gredler (1996) cites Crookall, Coleman, & Oxford, (1992) and states that when team decision-making is required, computers are out of the question as they cannot replicate social situations. Hence revealing that she has not considered CVEs as a potential tool for simulation.

So what are the implications of instructional design derived from research? According to Gredler there are generally three essential factors for effective design: The reinforcement structure, the role of prior knowledge, and the complexity of problem solving. Making a short note on these issues, the mix of games and simulations might startle conflicting tasks reinforcement structure, and should therefore be avoided.

Prior knowledge is important, both regarding knowledge on domain and strategy. As with the complexity of problem solving one concern is that what might be learnt is situational heuristics, and not general principles.

4.2.4. Interactive VR in education and training

In several articles a Norwegian group of researchers have argued for the use of activity theory and sociocultural frameworks to gain understanding of distributed learning in 3D environments (Fjuk & Krange, 1999; Fjuk & Ludvigsen, 2001; Krange & Fjuk, 1999; Krange, Larsen, Fjuk, & Ludvigsen, 2002; Ludvigsen, 2000; Ludvigsen & Fjuk, 2001). In one of these articles, Krange et al. (2002) analysed empirical data in a school setting where interactive 3D was used[14], and they report an identification of general collaboration patterns. Specifically described as (i) sequential and (ii) dynamic collaboration patterns. The authors split the sequential pattern in two sub-patterns; either the hypothesis testing or the trial-and-error pattern. Whilst the sequential pattern groups typically seem to prefer and stick to one of the mentioned sub-patterns, the dynamic collaboration groups move back and forth between the sub-patterns as the interaction is evolving. The authors argue that the dynamic collaboration seems like a more fruitful approach for the students, even though the students with sequential pattern signs seem to solve the problem as well. Regarding the teachers' involvement, it is reported that the teacher is far more involved with the sequential groups. Something that they argue might, in fact, hamper the students own problem-solving strategies (ibid.).

4.2.5. VR and situated learning principles

McLellan (1991) analysed a training programme for pilots featuring VR simulators, and suggested that the model fit the criteria of situated learning as proposed by Brown, Collins, and Duguid (1989), "[…] knowledge must be learned in a context, in the actual work setting or a highly realistic or 'virtual' surrogate of the actual work environment" (cited by McLellan, 1996, p. 472). The study suggests that the main situated learning components are present in the simulated environment; apprenticeship, collaboration, reflection, coaching, multiple practice, and articulation of learning skills.

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[14] Using the EduAction application, mentioned in chapter 2.

5

method

In this chapter the goal is to:

- Spell out some methodological assumptions

- Discuss different methodological approaches

- Take a closer look at the method adopted in this study by describing:

    o modes of data collection.
    o how the data were sampled.
    o how the data were organised prior to the process of analysis.

5.   Method

5.1.   Methodological considerations

An inquiry in the Merriam-Webster Dictionary reveals that 'methodology' encompasses a far from unproblematic and precise term, as it can properly refer to: "1: a body of methods, rules, and postulates employed by a discipline: a particular procedure or set of procedures" *or* "2: the theoretical analysis of the methods appropriate to a field of study". Consequently, the question becomes: Have *I* managed to separate the 'theoretical', 'methodological', and 'method' realms? The short answer is that they appear closely intertwined, and in some cases they seem inseparable (e.g. grounded theory (Glaser & Strauss, 1967; Strauss & Corbin, 1990). The long answer: Read chapter 3, 4 and 5 and make up your own opinion.

A less disputed idea is that all " […] research is based on some underlying assumptions about what constitutes valid research and which methods are appropriate" (Myers, 1997).

In some sense, we are all scientists, constantly monitoring our surroundings. The important aspect is to recognise that these mundane observations are as unique as the individual perceiver. We interpret and make sense of the world through subjective observations. The fundamental challenge for *scientific research* is thus to supply theoretical and methodological foundations as well as explicit methods. The overall goal is to enable researchers within a given field to exchange ideas and findings based on their scientific endeavours. When looking at these issues from a sociocultural perspective, one might add that this process itself is paramount to the evolution within the scientific community.

5.1.1.   A qualitative approach:

The particular ontology of this study is based within the tradition of interpretative research. A basic assumption is grounded in the view of social constructions as a proper locus of study (LeCompte & Schensul, 1999). Hence it becomes imperative to focus upon such human constructs as language and meaning (Burns, 2000; Savenye &

Robinson, 1996). The methodological foundation for this thesis is placed mainly in the qualitative tradition. According to Burns (2000):

> The task of the qualitative methodologist is to capture what people say and do as a product of how they interpret the complexity of their world, to understand events from the viewpoints of the participants. It is the lifeworld of the participants that constitutes the investigative field. 'Truth' within this context is bound to humanistic caprices. Thus conventional attempts to emphasize the imperatives of science place unrealistic constraints on research. (p. 11)

5.1.2. An explorative case study

The current focus is explorative, and the analysis will be engaged in approaching the actual teamwork in a particular Collaborative Virtual Environment (CVE). The aim lies in producing insights into the actual collaboration that surfaces in the interaction, within both the team and the application. Hence, possibly bringing forward hypotheses for future research within related work. Consequently one should not expect the analysis to conclude, in general terms, such aspects as 'learning effect' or outcome (see, for instance Rystedt, 2002). This particular stance comprises a criticised part of qualitative methods, as it violates the positivistic quest for reliable and valid results based on hypothesis testing.

Two drawbacks that often receive focus when comparing qualitative to quantitative methods is the time-consuming process of the qualitative analysis, as well as the effects of the presence of the observer. On the other hand, qualitative methods have their strengths. "[L]ike the nets of deep-sea explorers, qualitative studies may pull up unexpected and striking things for us to gaze on" (Barton & Lazarfeld 1969, cited by Burns, 2000, p. 13).

5.2. Ethnography

The literal meaning of the word 'ethnography' is 'writing about people'. No wonder then, that there is little consensus within the social sciences what it means to 'do an ethnography' (Harper, 2000). Nevertheless, there seems to be a shared view of its historical heritage where ethnography denoted the 'classical' anthropological

undertaking. A researcher would set out into 'the unknown' to study rites, custom, and beliefs and the result would be a 'thick description' (Geertz, 1973).

LeCompte and Schensul (1999) mention that a hallmark in ethnographic research is to assure that events occur in natural settings. This means that the ethnographer does not "[…] manipulate or create the settings or situations in which responses to interventions are solicited, obtained or measured" (p. 10). According to Burns (2000), ethnographic research also shares a set of general commitments or orientations to research which is rather different from those of the experimental and survey styles. He points to the necessity to view the social world as a world of meaning and interpretation, including a clear concern towards process and 'dynamism'. Further encouraging looking beyond public and official versions and towards actors' own terms of reference with the use of multiple fieldwork techniques.

5.2.1. Ethnographic flavours

Arrays of ethnographical variations have been put forward to serve different practices and interests within CSCW and CSCL research, some examples mentioned by Hughes, King, Rodden, and Andersen (1994) are 'Quick and dirty', 'concurrent', 'evaluative'. Other varieties include 'Rapid ethnography' (Norman, 1998), 'Virtual ethnography' (Hine, 2000; Ruhleder, 2000), Cognitive ethnography (Hollan et al., 2000).

In my opinion a particularly interesting study in this respect was done by Suchman and Trigg (1991). Their ethnographic work on airline operation rooms used video to capture some of the complex activities taking place. The mode of analysis blended the ethnographic style with a new framework proposed for studying videotaped data, namely interaction analysis (Jordan & Henderson, 1995).

5.2.2. Interaction analysis

As pointed out by Jordan and Henderson (1995), Interaction Analysis (IA) should not be considered a fully developed approach but rather as an interdisciplinary method with roots in ethnography, sociolinguistics, ethnomethodology, conversation analysis, kinesics, proxemics, and ethology. The authors' intention is to take a stock on a specific community of practice (including themselves) where the method is used and

continuously refined. The framing assumptions of IA seem to blend well with those of the sociocultural 'family', when assuming that " […] knowledge and action are fundamentally social in origin, organization, and use and are situated in particular social and material ecologies" (p. 4[15]). In the same section a 'link' to distributed cognition is made by stating that " […] expert knowledge and practice are seen not so much as located in the heads of individuals but as situated in the interactions between members of a particular community engaged with the material world" (p. 4). And that the "work as analysts lies in specifying the ways in which participants make the orderliness and projectability apparent to each other and incidentally to us, the analysts"(p. 5).

Since Jordan and Henderson (1995) provide some kind of IA 'cookbook' the authors' mention foci of analysis that they like to see as fitting the method and vice versa. These are: The structure of events (1), the temporal organization of activity (2), turn-taking (3), participant structures (4), trouble and repair (5), the spatial organization of activity (6), and artefacts and documents (7). Certainly not all of these foci are compatible with every research setting, but by suggesting guidelines the authors give valuable clues to newcomers, such as myself.

As will become clear when the analysis section of this thesis is read, a special focus is based on the participants' 'trouble and repair' action. Hence it is reasonable to briefly note what Jordan and Henderson (1995) have to say on the issue. By paying attention to moments where normal stream of activity is broken one can " […] often reveal the unspoken rules by which people organize their lives" (p. 37). Conversation analysts have done several studies of how trouble occurs and gets repaired in talk, but as mentioned by Jordan and Henderson, with IA it gets even more complicated, as one has to include how other channels (than audio) are utilised. An interesting observation reported is that "troubles in ordinary talk, such as mishearing and lack of understanding, are commonly repaired without participants being aware of what they do" (p. 39), making the observing of the repair process just as impossible for the observer. However, a detailed analysis based on taped material may uncover such hidden events. Finally a parallel is drawn toward the investigation of trouble and

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[15] The page numbers used when referring this article are not based on the journal article, but rather on the electronic source.

repair based on humans and machines. Humans generally assume that they share rules of interpretation, an assumption that becomes problematic when trouble surfaces in the human-computer interaction. The machine has no clue as to how the misunderstanding emerged, and is rendered totally helpless in the effort to repair the situation; alas any restitution must be due to human learning.

5.3. How 'wild' is the field trial?

I am sure you have noticed that I have been unrelentingly pointing to the advantages and fundamental need for studying interaction in naturalistic settings. In addition, I am sure that you have noticed that the field trial setting described in chapter 2 does not correspond very well to the theoretical and methodological elaborations I have put forward. Thus leading to the unavoidable question that needs to be addressed: How 'wild' is the field trial setting?

Surely, the interactions that occur in these simulations are by no means natural in the sense that they resemble their real world counterpart. Neither may we expect that the participants involved considered what they did as an ordinary and everyday undertaking. Thus the setting was highly constructed and un-naturalistic, although not resembling a well-controlled experiment. Still, what I see as essential is that the interaction that took place between the participants (and tutor) during each simulation can be considered as occurring naturally. There was no specific guidance or plan as to what they were supposed to do besides drawing on their inherent skills and experience. Further, the participants report in questionnaire 2 that they were highly concentrated on the task at hand. On a scale from 1 (low) to 5 (high) the question of '*being absorbed by the work*' yielded a mean score of 4.26. Whereas the question of degree of '*focus on the task at hand*' yielded a mean score of 4.67, indicating that they paid little attention to other contexts than what was provided in the simulation during the 'action'.

5.4. The method

The following section is committed to the description of the 'bits and pieces' that made up the research setting. This section does to some extent overlap chapter 2, still its main focus covers the aspects of the method and techniques rather than the project and application issues covered previously. Figure 11 is applied to structure the following section.
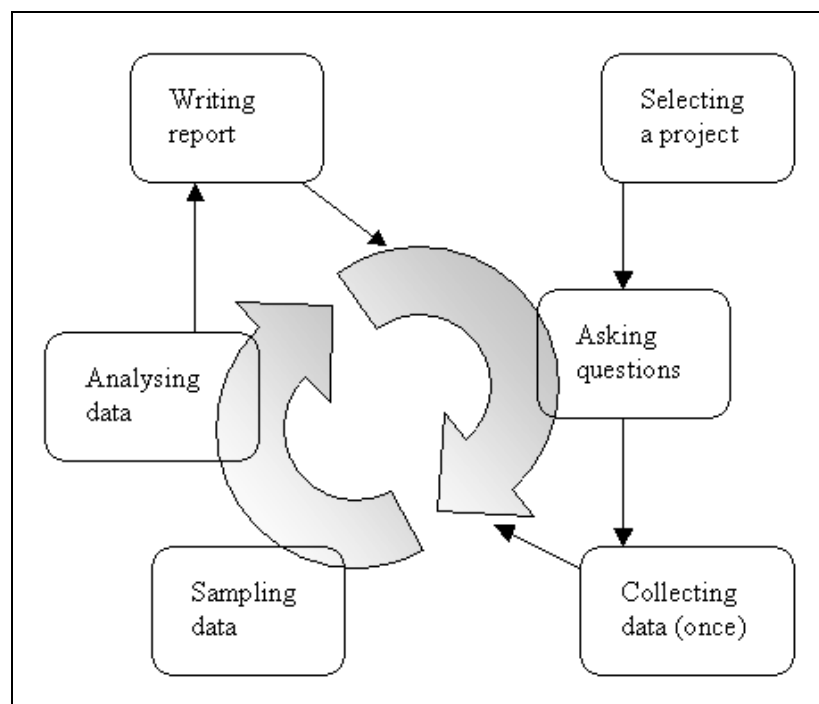
Figure 11. The research cycle (inspired by Burns, 2000).

5.4.1. Selecting a project and gaining access

Often, the selection of a project constitutes the first step in the ethnographic research cycle (Burns, 2000) (Figure 11). Dealing with learning, computers, communication and emergency medicine, the MATADOR project matched several areas of personal interest. Nevertheless, the challenge was to come across it the first place. In retrospect I ascribe it to 'luck and coincidence' that I ultimately found MATADOR, after having been thrown into a search for a new project as my original thesis project failed to be accomplished. Gaining access, on the other hand, was not very hard; even though uncertainty grew a few times before official access was granted. At an early stage in

the process I made direct contact with the project leader[16] who initially was open-minded and seemed willing to let me in on the project. In any case, it had to be coordinated with my supervisors at the time, who fortunately had connections to other people in the MATADOR project. Ultimately, I was considered a 'researcher' with the same access and privileges as the rest of the partners.

5.4.2. Asking the first questions

Initially I formulated some general research questions to guide further work and to indicate my interests to the project leader and the rest of the partners. As many different researchers were associated with the project, it was important that our research interests could live in peaceful coexistence. In an e-mail 'proposal' to the project leader I wrote that I had some tentative questions that illustrated my interests and mindset. The main question was:

How does MATADOR support a distributed group?

This question was backed by some more tangible and practically oriented 'helping' questions, such as:

> *How do the participants interpret each other's non-verbal interaction?*
> *How is a group led in the virtual environment?*
> *How does the group orient themselves on the patient's state?*

I would like to point out that these questions were formulated before I had seen or tested the application

5.4.3. Collecting data

Data were collected in several modes throughout the different stages of the field trial. Unlike typical ethnographical studies, going back into the field to bring in more sources was not an option. For that reason it made good sense to gather lots of data, from which one could easily sample at a later stage.

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[16] Corresponding to the 'gatekeeper' in ethnographic terms.

The application (audio/video recording)

The application server was connected to a digital video deck (DV-deck) that recorded the screen from the viewpoint of the server (See Figure 12). Additionally, the DV recorded all the audio broadcasted from the connected computers. See Appendix G for detailed technical set-up of the video and audio capturing.

Figure 12. Capturing audio and video from the application.

An issue that should be mentioned is that to avoid broadcasting feedback into the system, the audio interaction in the first simulations was made accessible to the tutor and the pedagogical consultant by using headphones. Since the two last simulations used telephone-based conferencing over loudspeakers[17], they were accessible to those present in the server-room. In any case the staff located in the server room had to keep quiet, in order not to disturb the participants and the recording.

Individual user interaction (audio/video recording)

Of the four participants in the simulation, one was recorded using a digital video camera permanently placed on a tripod in one of the rooms at RH (Figure 13). The camera captured the user, the area of the mouse, and partially the screen. There existed no plan as to who was to be recorded, as the participants and staff chose rooms at random.

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[17] I will explain why in the next chapter.

Figure 13. Recording an individual user.

The questionnaires

The questionnaires were designed in advance. The participants filled in one of the questionnaires prior to the session, and the second immediately after the simulation ended. The latter was filled in individually, with no time and place for discussing with the rest of the team. See Appendix E and F for the questionnaires used.

The debrief (audio/video recording)

A videoconferencing session was held after the simulation ended (see Figure 14). The participants, tutor, pedagogical consultant and remote staff attended, making a total of seven. Prior to the videoconferencing session, the participants were encouraged not to discuss the medical simulation they just completed. The debrief sessions were recorded through the conferencing system in a DV-deck, and backed up by a digital video camera placed in the conference room at RH. Should the conference recordings fail, the camera could at least capture sound from both parties, but only the video from Oslo. The debrief session typically had a quite structured group interview approach. The tutor initially discussed some of the medical aspects and procedures done by the team. Later, the pedagogical consultant conducted a group interview focusing on feedback from the participants with respect to aspects such as communication, collaboration and leadership. Urging for feedback regarding the application design was an important aspect of the debriefing sessions.

Figure 14. Debrief by videoconferencing.

The application (log files, text-based)

The application was set up to log each user's interaction with the menu-system, and log files were collected from all the sessions. The format is tab separated text files, with the following variables: "Time, machine number, role, option" (Figure 15). It is essential to emphasize that only the interaction with the menu-system was recorded. Interactions with the mouse for navigation and movement purposes were not recorded, but could to some extent be observed in the video recording of the server, as mentioned above.

```
09:57:19 ,9, ANESTESISYKEPLEIER, valgte 'Platelets', 1467
09:57:23 ,9, ANESTESISYKEPLEIER, valgte 'Electrolytes', 1470
09:57:27 ,9, ANESTESISYKEPLEIER, valgte 'Arterial blood gas', 1474
09:57:41 ,9, ANESTESISYKEPLEIER, valgte 'vital signs, level of consciousness', 1489
09:57:45 ,9, ANESTESISYKEPLEIER, valgte 'vital signs, respirationrate', 1493
09:57:50 ,9, ANESTESISYKEPLEIER, valgte 'vital signs, capillary refill', 1498
10:10:24 ,9, ANESTESISYKEPLEIER, valgte 'Default Position', 2252
```

Figure 15. Segment from a 'raw' log file.

The field notes (text, handwriting)

Some field notes were taken during the two weeks of field trail. For two reasons I realised that the field notes never would have anything but 'recollectional' value. For one, it was actually not possible for me to make records of the medical simulation on the fly, as the audio was broadcasted through the headsets. Secondly, everything would be available through the recording for a detailed analysis at a later stage. Hence, it made sense to just 'hang out' while the action was taking place. And

accordingly the intentions for the field notes became to describe what was going on besides the simulations and the debrief sessions. Some notes were made of special comments or situations that arose. In retrospect, I see that what I thought to be interesting at the time did not necessarily fulfil the expectations.

Figure 16. Pedagogical consultant and tutor at work in the server room.

5.4.4. Sampling

The process of selecting, transcribing and presenting the data is considered a key part of every study. In the previous section I gave a general description of how the data was collected during the field trial, and what kind of data that was accessible.

Parallel to working with the data material I was looking for the 'right' angle to attack the thesis on the theoretical account. It was rather obvious that my study would fall within bounds of the sociocultural approaches, but different frameworks were considered. As discussed in the theory section, I fell down on what one might call a 'distributed cognition informed ethnography with a touch of interaction analysis'. This choice narrowed down the potential sources of data for the analysis. Consequently, the sampling task became less overwhelming.

5.4.5. What was ruled out?

This section's mission is to describe which data sources were considered inadequate for informing the further analysis, and a few notes on why.

The recordings of the individual user interaction

Capturing individual users' interactions in the way it was done here cannot be regarded as a fruitful approach to an analysis guided by DCOG principles. These recordings could not offer anything interesting that wasn't available through other sources. I have actually never scanned through any of the tapes, an amusing fact as this recording was my own idea[18].

The recording of the debrief sessions

At an early stage I ruled out using the taped data from the debrief sessions. The actual interaction seemed much more interesting than how the teams rated their own efforts in retrospect. However, I looked through the tapes and made notes of the issues discussed in the debrief sessions. That process did to a certain degree guide the analysis of the MATADOR simulations, and many of the discussions and comments made in the debrief sessions are certainly interesting.

The questionnaires

Likewise, the questionnaires were analysed in a rather superficial manner, producing some insights into the participants' views on issues such as evaluation of own efforts compared to the others, and the team as a whole. The statistical analysis was done by coding and analysing the questionnaires in SPSS[19]. Similarly to the debrief sessions, these data gave insights to the participants' experience in the CVE. Now more on the individual account, as the feedback was given 'privately' without discussing with the team or staff.

The field notes

These notes were never really 'fine grained' enough to carry out an analysis of the trajectories of information in a complex environment, following DCOG principles. As with the questionnaires and the debrief recordings they represented a kind of support for guiding the way into the main material, a path that is covered in the following chapter.

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[18] Actually, this was also my *only* idea on the data collection issue.

[19] SPSS® is a statistical software package.

6

analysis

In this chapter the goal is to:

- Give an insight as to how and why certain 'interaction elements' were chosen as candidates for closer analysis.

- Provide an overview of the three selected sessions by describing some aspects of the teamwork that occurred.

- Search for similarities across the groups.
  o suggesting a common problem.

- Analyse and discuss the 'problem' and findings.

- Consider the trustworthiness of the findings.

6.   Analysis

At some point the metaphorical 'research cycle' (Figure 11, previous chapter) must be broken. Even though this chapter picks up where the previous left, there is still a fine distinction. The commitment is now to discuss the work on the main material.

6.1.   Working the log files

At the time of the field trial I was not aware that every interaction with the menu system would be reflected in a log file. As the interactions captured in these log files comprise the only way for the team to treat the patient, they undisputedly have analytic value. The first step in the analysis of the data thus became to take a close look at the actions that the team members initiated through the menu system. The idea was to make a team-log file, in order to get the full picture of how each team treated the patient.

6.1.1.   Constructing team-log files by merging the log files

In order to make the team-log file, the individual log files were collected and imported from each session into a separate MS Excel® file (see example in Figure 17). As every interaction was logged on time, it was uncomplicated to sort the events based on the time from 'simulation start' (first column). The second column shows which role (participant) initiated the action, and the last column reveals the chosen procedure.

00:03:45	ANESTESILEGE	vital signs, peripheral temperature
00:03:48	ANESTESILEGE	vital signs, capillary refill
00:04:05	ANESTESISYKEPLEIER	Ringer 1000 ml
00:04:28	KIRURG	Chest x-ray
00:04:50	KIRURG	Default Position

Figure 17. A segment from a prepared log file.

6.1.2.   The first question

Equipped with the merged team-log files, the first question was constructed to identify potential patterns across the teams:

What was initiated when, and by whom, in each simulation?

To answer this question I examined the team-log files in detail. I plotted the procedures initiated by each team into statistical software in order to compare the

initiated procedures across the teams, as well as observe the sequence of procedures within each team. A total of 28 different procedures were at some point chosen by one or more teams. As my quest was to reveal potential patterns across the teams, I deemed some interactions more interesting than others, and eventually selected five specific procedures. As elaborated on below, these procedures require initiation in a certain order. The procedures are presented in Table 8 in an orderly fashion along with a short explanation focused on sequence, and held within the frames of the actual scenario.

1. Intravenous (IV) access	An early step in an emergency room setting, at least in the case of missing IV access upon arrival. Further steps often depend on IV access, and a rule of the thumb is to assure at least two working access points.
2. (General) anaesthesia	In order to do surgical procedures on a conscious patient this procedure must be undertaken. By means of medication, the patient is put in a state of painlessness. As in this case of general anaesthesia the patient is 'put to sleep', as if unconscious.
3. Intubation	When the patient is 'put under' by general anaesthesia the breathing function comes to a halt, and the patient is dependent on external help. A respirator normally does the artificial breathing, pushing air through a plastic tube inserted via the patient's mouth and secured in the airways just below the larynx. The term 'intubation' refers to the tube insertion procedure.
4. Peritoneal lavage	A (diagnostic) surgical procedure done to clarify possible intra-abdominal bleeding. A small incision is made, and a saline solution is infused via a catheter and later drained back. Presence of blood, bacteria or bile in the saline after removal indicates a serious intra-abdominal injury.
5. Laparotomy	A surgical procedure done to stop internal bleeding or bacterial contamination within the abdominal cavity.

Table 8. Explaining the five chosen procedures.

6.1.3. The first findings

The selected procedures initiated by each of the teams are shown in Figure 18. The x-axis illustrates a timeline, marked in five-minute intervals. The procedures are ordered corresponding to the above-mentioned description.
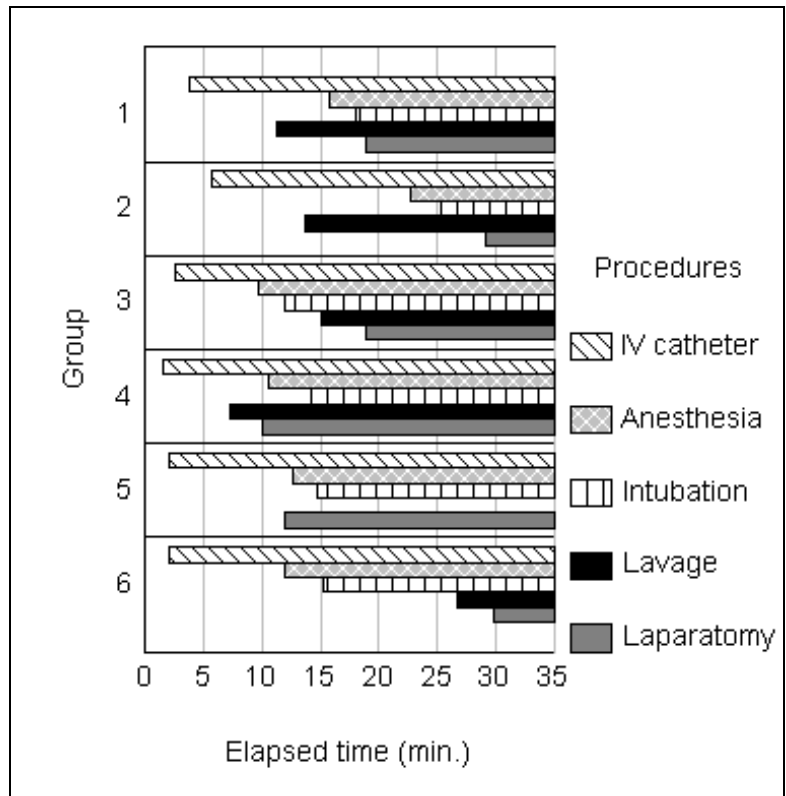
Figure 18. The sequence of procedures in the six teams
(from Halvorsrud, Hagen, Fagernes, Mjelstad, & Romundstad, 2003).

A closer look at Figure 18 reveals an interesting sequence pattern. We see that four out of six teams initiate surgical procedures prior to putting the patient in a state of painlessness. To illustrate the point, consider the six teams in Figure 18. We can see that Team 1, 2, 4, and 5 initiate surgical procedures on the patient prior to 'putting him under' by means of general anaesthesia. Team 3 and 6 does it right sequence-wise, and as a result the bars resemble a staircase. When considering each team within the team (anaesthetic / surgical) we observe that all anaesthetic teams perform the anaesthetic procedure prior to the intubation. Likewise, in the surgical discipline all teams performed the procedures in the correct sequence, doing peritoneal lavage prior to the laparotomy[20]. Further findings show that all teams manage to establish IV-access before doing anything else.

The fact that four out of six teams had sequence-based problems certainly seems unsettling, not to mention highly surprising. However, I argue that we need to move

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[20] Team 5 did not perform the peritoneal lavage procedure.

beyond the team-log files in order to establish what these surprising findings suggest. And this is where the server recordings come into play.

6.2. The server recordings

By means of the server recording insights could be gained regarding the spatial movements of the avatars, patient, and other visual cues. But more importantly, the recording made it possible to analyse the interaction that took place in form of talk. The server recording was first viewed and transcribed in a coarse fashion (i.e. content log) in line with Jordan and Henderson's guidelines for Interaction Analysis (IA) (1995). This was done to gain insight as to what happened in each simulation, and to possibly uncover and make notes of impending 'hotspots'.

6.2.1. Connecting log files and server recordings

Amongst other things, the server recordings displayed the simulation time window. For this reason it was straightforward to monitor what the team members said, how they moved, *and* at the same time 'connect' these observations with what they did via the team-log file. As a consequence, a relatively detailed analysis was made possible. Recalling the issues related to 'trouble and repair' discussed by Jordan and Henderson (1995) and DCOG's view on visible interaction (Hutchins, 1990), it seemed clear that we in retrospect shared the same 'horizon of observation' as the participants, and sometimes even more (i.e. log file). 'Armoured' with the sampled data and some degree of domain knowledge a fine-grained and iterative analysis was within reach.

6.3. Preparing the net[21]

In line with Jordan and Henderson's (1995) recommendations for Interaction Analysis (IA), we formed an 'IA-lab'. The first session was devoted to get a hold of the general ideas, as well as 'a feel' for the data and domain. The subsequent sessions iteratively refined aspects that seemed interesting for further analysis at an increasingly detailed level. Loosely guided by the intention to account for the surprising findings revealed in the team log files we set out looking at the recently connected data.

6.3.1. Naming convention in the transcripts (a technical note)

Table 9 shows how the mapping is done from letters to roles in the excerpts throughout the chapter. The application language is English, however I choose to deviate from the official role-naming convention. The reason is partly to make a more

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[21] 'net' as in deep-sea explorers net (see section 5.1.2.).

apparent 'connection' to the teams within the team[22]. As to why I chose 'Anaesthetic doctor' and not 'Anaesthesiologist', I'm not really sure. All transcripts presented have been translated from the original language to English (see Appendix H for originals).

Letter	Role Name (in thesis)	Role Name (official)
S	Surgeon	Surgeon
SN	Surgical nurse	Emergency nurse
AD	Anaesthetic doctor	Anaesthesiologist
AN	Anaesthetic nurse	Anaesthetic nurse

Table 9. Mapping letters to role.

6.3.2. Sampling (revisited)

In an early stage of the IA it became clear that a further separation could prove fruitful, and the decision was made to only incorporate the professional sessions. Thus leaving three sessions for further analysis. The argument for choosing the professionals was partly due to the amount of data, as well as the general interest of studying experts at work as suggested by Klein (1998). The rationale was also to match the principles that informed the application design, where strategies and experience from real-life collaboration by professionals played a major role (Brattebø et al., 2001). In the student teams some participants had to act as nurses, thus breaking the natural team dynamics. Further, they would be on a similar level of knowledge, and therefore greatly overlapping each other's domain. As an example of how this might have interfered with the natural process of problem solving in the team, consider Excerpt 1 from Team 3, where the student playing surgeon, demonstrates that he knows little about surgical procedures.

S:	Maybe it is time for a peritoneal lavage at this point, or maybe a laparotomy?
AD:	Who is asking?
S:	Me, the surgeon ((laughing))
AD:	Well, I think YOU will have to decide this
S:	Thing is, I have very little experience with these kind of things
AD:	Maybe the anaesthetic nurse has any ideas?
AN:	He is not stable, and we have not identified any source of bleeding. And so it might be a good idea to do a peritoneal lavage to see if there is anything in the abdomen.
S:	Ok, I'll try that
SN:	It sounds reasonable to me

Excerpt 1. An example of non-professional problem solving.

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[22] Hence 'Surgical nurse' instead of 'Emergency nurse'.

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6.3.3. Recalling the modes of interaction

Before describing the three sessions, let us recall from the case description (section 2.2.5.) how the different interaction modes are modelled in MATADOR.

As mentioned, there are three ways for the participants to interact with the application and each other:

1. Spatial navigation in the main window (with the mouse)
2. Choosing procedures through the menu bar (with the mouse)
3. Talking to each other (with the headset and microphone)

To illustrate how this happens, I provide a simplified and schematic figure. Figure 19 is centred on an individual user (participant) and exemplifies a typical situation that might occur at any point in a simulation. Assuming the user is viewing the screen, the 3D scene is continuously rendered and perceived. Hence, the patient is under constant observation and if his state changes it may be spotted immediately. Let us imagine that the user wants to assess the patient's level of consciousness. She will then use the mouse to interact (event number 1 in figure) with the menu system by clicking 'Vital signs' at the main menu level, then 'Level of consciousness' at the sub level. The feedback from the application is done via the result window (event 2). At a later stage the user may want to update the rest of the team on the issue, and in that case she would make use of the shared audio space provided by the application. In Figure 19 she verbalises her understanding of the situation to the rest of the team by stating: "He is conscious" (event 3).
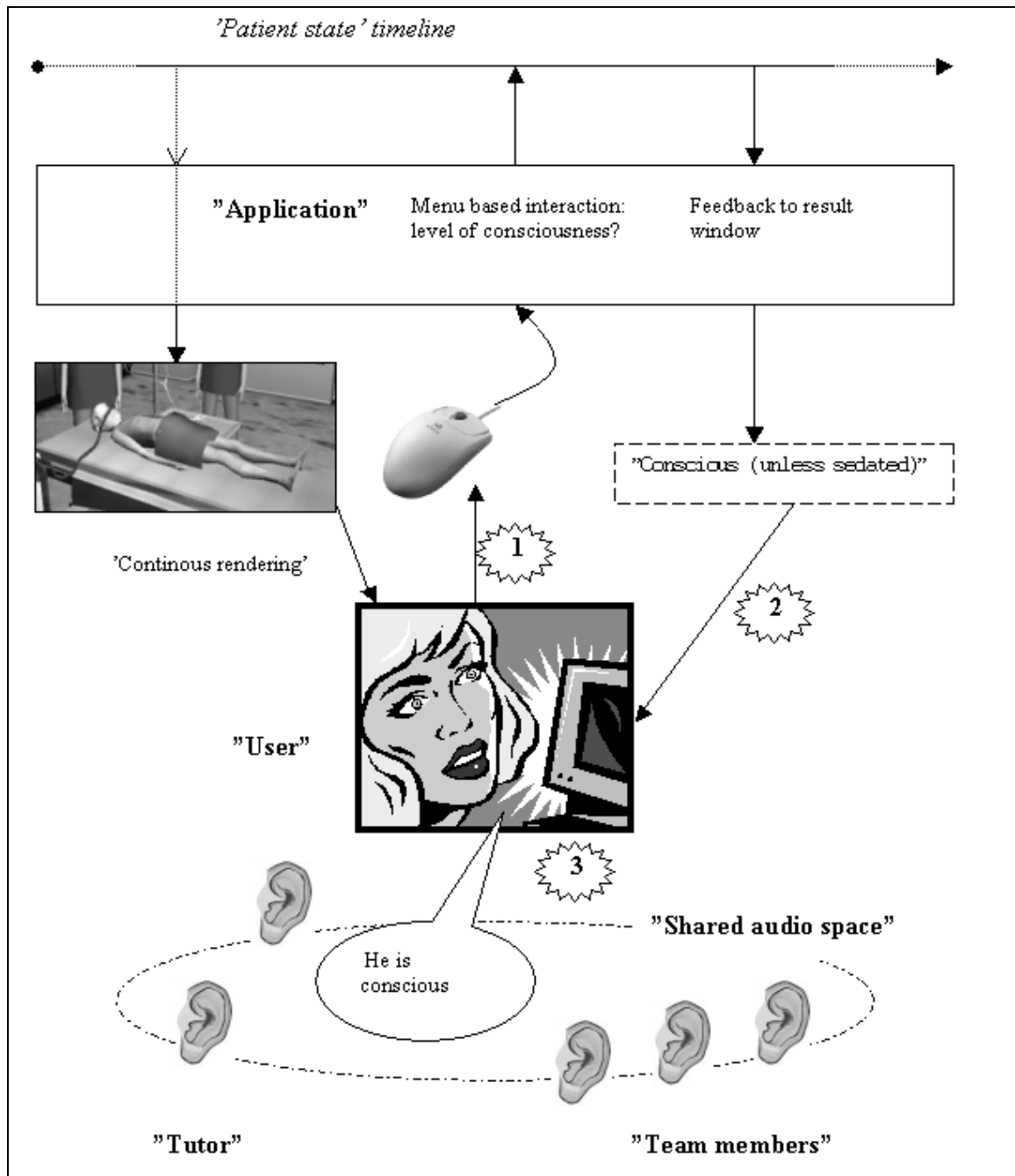
Figure 19. An example of computer- and team-interaction.

6.4. Overview of the simulations

The next steps of the analysis require a closer look at the sampled simulations. Hence I will now provide an overview of each team's interactions based on both the team-log file and the server recording. Following the overview of each team, I indicate particular experienced problems that might be interesting when it comes to explaining the above-mentioned sequence issues. After the three teams have been covered, I will go into detail on these categories, and point towards an even more detailed analysis.

6.4.1. Team 4, professionals

The members and level of experience

In this simulation the surgical team was in Oslo and the anaesthetic team were located in Umeå. The surgical team was led by a surgeon with 0-4 years of experience and 20-30 actual stabilisations of trauma patients during the last 6 months (see Table 10).

Location	Role	Trained as	Age	Experience (years)	Multi-trauma cases last 6 months
Oslo	Surgeon	Surgeon	31	0-4	20-30
Oslo	Surgical nurse	Anaesthetic nurse	49	10+	0
Umeå	Anaesthetic doctor	Anaesthetic doctor	37	5-9	2-3
Umeå	Anaesthetic nurse	IVA-SSK[23]	38	10+	5-10

Table 10. Team 4 information (from questionnaire 1).

The initial phase

After the tutor starts the simulation, the surgeon makes a summary of the case, informing on the patient's heart rate, blood pressure and saturation values. This information originated from the main window of the application, as no team member clicked to get the ambulance report[24]. The first menu interaction upon the patient's arrival is the anaesthetic doctor's check on consciousness, followed by her check on respiration rate and a follow-up on the level of consciousness. She announces the

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[23] Swedish acronym for nurse trained specifically in intensive care.
[24] The application hinted in the log window that the paramedic might have more info, and how this info might be attained.

information concerning the respiration rate, but makes no comment on the level of consciousness.

IV uncertainty

The surgeon now formulates an open-ended question: "Shall we insert some IV cannulas?" The surgical nurse asks if he should start the procedure. Worth noting here is that the surgeon had already clicked on the IV procedure via the menu system, thus leaving the impression that his question was a rhetorical one. More uncertainty is introduced when the anaesthetic doctor asks whether an IV access is in place. The surgical nurse replies that he does not know how to do it, and the anaesthetic nurse reports that she is working on it, and later states that she has finished the procedure and that the IV access is functioning. This is interesting, as the log file does not indicate that she actually had anything to do with the procedure. In other words it is not straightforward to establish who actually performed the cannulation procedure. The anaesthetic nurse reported it orally, but the log shows that the surgeon did the job[25]. Studying the videotapes cannot reveal an answer to the question, as the IV can be inserted from distance[26]. The anaesthetic nurse eventually gets Ringer 1000 ml running in the IV, and reports it to the team orally.

Audio problems

The surgeon utters a new open-ended question, "shall we do an X-ray?" And shortly after he clicks on the chest x-ray procedure in the menu system. Now the anaesthetic doctor enters a discussion with the tutor regarding the patient's condition. She wants to know if she can talk to him and ask him if he is in pain. The tutor offers little help, but indicates that such questions should be sought answered through the application. When the surgical nurse a little later wants to examine the pupil's light reaction, the tutor breaks into the conversation and mentions that the application does not support this type of examination, and 'fills in the holes' by telling the team that the pupils are equal on both sides and react to light. The anaesthetic doctor then starts a summary of the patient's status. This summary coincides with technical (audio) problems leading to difficulties in getting the message transmitted to the rest of the team. The other three can communicate, but the anaesthetic doctor is left out of the audio loop. At this

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[25] The surgeon never expressed that he had anything to do with the IV procedure.
[26] Something that constitutes a clear discrepancy compared to a realistic situation.

point the surgeon starts a summary on the patient's status, reporting that the patient is unconscious. He also informs on the heart rate, blood pressure, saturation, as well as the results of the chest x-ray. Further he states that he has 'asked for' (and hence, actually performed) a peritoneal lavage to uncover if there might be 'something' in the abdomen.

An asymmetry that never recovers

The audio problem seems to be solved, and the anaesthetic doctor states that she has heard the others' conversation all along. She now provides a summary of her own, probably hoping to uncover the misunderstanding regarding the level of consciousness. She reports that the patient breathes spontaneously, is awake and has normal pupils. But now she is encountering technical audio problems once again. Shortly thereafter the surgeon reports that the lavage revealed signs of abdominal bleeding, and that the next step has to be a laparotomy, a procedure that he just initiated. This information leads to the agreement between the surgical nurse and the anaesthetic doctor that they will have to start an anaesthetic procedure and intubate the patient. The laparotomy procedure is completed while the anaesthetic procedure is being performed, and before the tube is in place (intubation).

6.4.2. Experienced problems and possible explanations, Team 4

Audio

Team 4 was set up to use the audio features within the application. It seems fair to say that the audio problems experienced by Team 4 made a difficult situation even harder to manage. The anaesthetic doctor obviously knew that the patient was conscious and that he had to be sedated before surgical procedures were initiated. But due to the technical problems she was not 'allowed' to clear up the misunderstanding and stop the chain of events. Still, a possible reason to the asymmetry in the first place may be found in the design of the patient's level of consciousness (more in section 6.6.).

Interpretation

The IV uncertainty observed here might have more than one reason. First, the surgeon never made clear who was in charge of the IV procedure, and secondly, the 'design model' of the IV opens to a bit of confusion (see same section regarding Team 5).

Tutor guidance

The tutor had to 'fill in a few holes' in this simulation by giving feedback on the pupils' light reaction.

Other issues

The team-leader's inclination towards open-ended questions may have added to the difficulties experienced by this team. At two points in the simulation he asked for a procedure, and shortly thereafter performed the action himself. From our data it is impossible to ascertain whether he actually misunderstood the application design, thinking that he didn't initiate procedures through the menu system. In any case, it is clear that the other team members interpreted his questions as commands, and made efforts to effectuate them.

6.4.3. Team 5, professionals

The team members and their experience levels

A Swedish surgeon led Team 5, aged 42 with 5-9 years of experience in the field. The anaesthetic doctor in Oslo was Danish; consequently this team spoke three different languages. For more information see Table 11. The audio interaction in this simulation was done through telephone conferencing, and not through the application as the case was with Team 4.

Location	Role	Trained as	Age	Experience (years)	Multi trauma cases last 6 months
Umeå	Surgeon	Surgeon	42	5-9	5
Umeå	Surgical nurse	Surgical nurse	59	10+	3-6
Oslo	Anaesthetic doctor	Anaesthetic doctor	36	2,5	6
Oslo	Anaesthetic nurse	Anaesthetic nurse	43	10+	0

Table 11. Team 5 information (from questionnaire 1).

IV uncertainty in the initial phase

As the paramedic appears in the room the surgeon calls out for his attention[27]. Soon she realises that in order to interact with the driver she must make use of the mouse, and a couple of seconds later she reads the ambulance report off her screen. She communicates a summary of the report to the team, and the anaesthetic nurse asks if

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[27] Her 'instinctive' reaction is to try to talk to him. An interesting point as the paramedic is an 'agent' (but there is no way she can know).

she should get some IV running. The surgeon replies that 500 ml is currently running, leading to an immediate response by the anaesthetic nurse stating: "I cannot see it"[28].

There seems to be an uncertainty as to the IV access of the patient, leading to the tutor's intervention. The tutor informs that only one access point is allowed for in the simulation.

Asking for more

At this stage, the anaesthetic doctor wants to stethoscope the lungs, a procedure that is not implemented in the simulator. The tutor intervenes and tells the anaesthetic doctor that "you can say what you want to do, and I will tell you what you find". Hence offering to help by 'filling in the holes' of the application.

It is about three minutes into the simulation, and the surgeon views the patient as fairly stable. Still, she is announcing that she is considering a CT scan of the head, in addition to X-rays of chest and pelvis. However, these procedures are not initiated. What follows is a discussion on the patient's condition and level of consciousness. I will return to this discussion at a later stage.

The surgeon has palpated the abdomen, and as soon as the ongoing discussion has ended she reads the report of the palpation to the team, and suggests a laparotomy procedure instantly. The anaesthetic doctor supports the choice, but the surgeon first wants to take the X-ray images of the chest and pelvis that she mentioned at a previous stage.

Contextually based problems?

The surgeon and the anaesthetic doctor seem to agree that there is an abdominal bleeding that needs to be attended. However, after the discussion on CT versus operation the surgeon decides that the patient should be operated, and expresses "I want to pull him to the operating theatre". She clicks on the laparotomy procedure a few seconds later. I will argue that this last menu interaction suggests that she is unaware that her choice actually starts the operative procedure. My guess is that she believes that by clicking on 'laparotomy' she initiates for moving the patient from the

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[28] Another example of 'instinctive' reactions (she is right that no IV is present).

emergency room to the operating theatre. As it is rather uncommon to do surgical procedures in the emergency room and her interpretation constitutes the standard procedure in most hospitals, her choice makes sense[29]. However, this misinterpretation leads to a shift in events, as the team has not made ready for the initiated surgical procedure by putting the patient to sleep through anaesthesia.

6.4.4. Experienced problems and possible explanations, Team 5

Audio

This team used telephone conferencing, and did not experience particular problems.

Interpretation

Team 5 demonstrated that the professionals often had trouble interpreting the way the IV is implemented in the application. The ambulance report states that the patient had 500 ml IV Ringer running during transport, indicating that a cannula must have been present. But when initiating IV-fluids upon ER arrival, the application responds: "You must insert an IV cannula" (Hagen et al., 2002, p. 26). The tutor frequently had to comment that the cannula must have fallen out at some point. A plausible explanation in itself, but in a novel environment it might add to potential confusion.

Obviously the surgeon was uncertain as how to make contact with the paramedic. First she tried to speak with him, but after a short while she discovered that the mouse had to be used.

The surgeon seems to think that clicking an option means something else than what is modelled to happen when she chooses the laparotomy procedure.

This team has a detailed discussion concerning the level of consciousness. This issue will be covered later.

Tutor guidance

Team 5 'made use' of the tutor to stethoscope the lungs.

6.4.5. Team 6, professionals

The members and experience levels

A 45-year-old surgeon in Umeå led Team 6. Generally this team scored high on experience. All except the anaesthetic doctor had ten years or more of experience. However, the anaesthetic doctor had experienced many multi trauma cases lately

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[29] Also considering that she shortly before viewed the patient as fairly stable.

(Table 12). In this simulation a telephone conference was used for distributing audio, similarly to Team 5.

Location	Role	Trained as	Age	Experience (years)	Multi trauma cases last 6 months
Umeå	Surgeon	Surgeon	45	10+	6
Umeå	Surgical nurse	Surgical nurse	43	10+	2
Oslo	Anaesthetic doctor	Anaesthetic doctor	40	0-4	10-15
Oslo	Anaesthetic nurse	Anaesthetic nurse	46	15	0

Table 12. Team 6 information (from questionnaire 1).

Initial phase

The surgeon clicks the paramedic for the report shortly after he enters the room with the patient. When he sees the report on his screen the surgeon asks if the rest of the team can see the same report[30]. The co-located helper probably shakes his head, in view of the fact that the surgeon replies "oh well, then I will read the report out loud for them to hear." After the report is read he summarises that the patient is unconscious and probably has a brain injury. None of the team members object to the diagnosis, however the tutor intervenes by asking if the patient is unconscious, suggesting a check on the vital signs menu. The surgeon acts on the tutor's hint and reaches the conclusion that the patient actually is conscious.

Asking for more

Ascertained of the level of consciousness the team discusses the IV access and neck collar options. The surgeon proposes the use of more than one IV access and the tutor explains that it is not implemented in the current prototype. As a backup the surgeon wants to use an intraosseous needle, but neither this nor the neck collar options are implemented, and thus not available.

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[30] The surgeon had somebody (local helper) in his physical vicinity, unclear to me who.

Getting on with it

The surgical nurse reports the haemoglobin (HB) level to be 110 (g/l)[31]. The surgeon comments that this might indicate a bleeding. However, the examination continues in a systematic way. Looking at the patient, the surgeon observes possible contusion marks on the patient's right flank. The tutor encourages the surgeon to move closer to see in more detail. The surgeon concludes that he can see discolouring and asks the surgical nurse to take a closer look from her side of the patient. She follows up the request and shortly after proposes a chest x-ray. The x-ray is taken and viewed by both. After a little while the surgeon comments that the boy might suffer some internal bleeding.

Sorting out a potential problem

The anaesthetic nurse observes the interaction and predicts that the patient will have to be intubated. She asks the anaesthetic doctor whether they should make ready for the intubation procedure, he confirms and replies that in his understanding of the application it is prepared, and as soon as they click for intubation it will be initiated. His interpretation is confirmed to be correct by the tutor, and a potential problem is sorted out.

6.4.6. Experienced problems and possible explanations, Team 6

Audio

Team 6 used telephone conferencing, and no particular problem was experienced.

Interpretation

The surgeon illustrates the problem of awareness regarding 'who sees what' in the application. In the initial phase he is unsure if the others can read the ambulance report. Further this team has problems with understanding how the IV is modelled. Furthermore, they also orally request procedures and equipment not supported by the application, such as neck collar and intraosseous needle.

The surgeon was initially uncertain of the patient's level of consciousness, but was 'saved' by the tutor.

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[31] '110' refers to grams per litre (g/l), and constitutes the Swedish way to report. '11.0' would be the Norwegian counter, referring to grams per decilitre (g/dl).

On the positive side, the anaesthetic team correctly predicted the application's model of the intubation procedure.

Tutor guidance

The tutor made possible a systematic examination, and filled in the application 'holes' to a large extent. As mentioned above, he actually saved the team from a possible fatal misunderstanding in the initial phase.

Other issues

This team seemed to share more information from the 3D scene than the others, specifically by moving and looking closer at the patient.

Recalling that this team performed the procedures in the desired sequence, it is worth mentioning that they used more time to save the patient.

6.5. Proposing categories of experienced problems

Following the overview of the participants' interactions with each other and the application, we notice that some problems seem to be recurring. In the following section I suggest a way to categorise these findings. Before describing the particular problems, two categories are put forward, namely 'interpreting the application' and 'understanding each other' (Figure 20). The application and the audio problem connected to it (upper left corner of figure) should not be considered a category, and will thus only be mentioned in a few words. As we can see from Figure 20, most of the experienced problems seem to be related to difficulties interpreting the application.
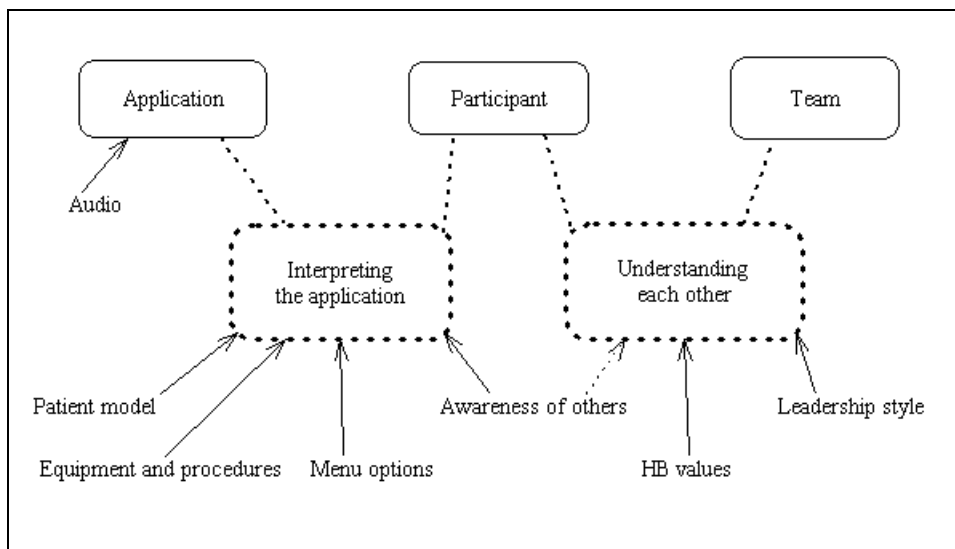
Figure 20. Two categories of experienced problems.

6.5.1. Application problem

The technical audio problem experienced by Team 4 is considered a pure application-based problem where technical issues obviously hampered the teamwork.

6.5.2. Problems with understanding each other

Regarding problems with understanding each other, two particular instances were found. As mentioned previously, the surgeon (team leader) in Team 4 prefers open-ended questions instead of the more concise command style when communicating certain orders to the team. This is a style of communicating that seems to lead to confusion in the rest of the team. It is also a well-known problem, even to the degree that it is specified in the role description: "It is important that you as a team leader […] give clear messages and alert the other members of the team if some of the responsibility is delegated to the others" (Hagen et al., 2002, p. 12).

Another observed problem relates to how the HB-level is reported. Different national standards exist (i.e. cultural differences), as briefly mentioned in section 6.4.5.

6.5.3. Problems with interpreting the application

Interestingly, most of the experienced problems may be attributed to how the participants struggled with interpreting the application. Table 13 describes examples of such problems, and the teams that experienced them.

Problem	Specific	Describing the problem	Team
Interpreting (1)	Patient model	Especially LOC	All
Interpreting (2)	Menu options	"What happens when I click this option?"	Team 4 and 5
Interpreting (3)	Equipment and Procedures	"Why can't we use/do this and that?"	Team 5 and 6
Interpreting (4)	Awareness	"Who knows and sees what?"	Team 6

Table 13. Interpretation-based problem categories.

Interpreting how the patient's level of consciousness (LOC) (1) is modelled was a problem for all the teams, and will, for that reason, be scrutinised from section 6.6 and onward. Assessing the appropriateness of the user interface, such as interpreting menu options (2), is considered a typical HCI undertaking, and will not be covered in detail here. However, it is worth mentioning that the basic assumption is that an intuitive

user interface reduces uncertainties connected to how an application is interpreted (Shneiderman, 1998). In this respect one may hold the application design responsible for failing to make the menu options predictable (insufficiently 'transparent'), rather than blaming the users for being ignorant. During the simulations the teams often requested equipment and procedures (3) that were not modelled, and therefore unavailable. Such requests were frequently commented and accounted for on the fly by the tutor. Awareness issues (4), such as knowing who was doing and seeing what, were expressed in Team 6, and mentioned in section 6.4.6. Even though this was only observed in one team (thanks to the 'local helper'), it is assumed that the lack of awareness information was a problem for the other teams as well. Still, it did not surface in the interaction, and thus cannot be accounted for empirically.

6.5.4. Tutor as the problem solver

There is little doubt as to the importance of the tutor's problem solving skills in the three professional teams. On many occasions he graciously smoothes over the 'troubled waters' that the teams' frequently find themselves in. This is an observation that appears to be especially relevant when it comes to explaining why the team cannot do 'this and that' procedure, or why 'this or that' equipment is unavailable to them.

6.6. Consciousness, a recurring issue

As mentioned above, a recurring problem was concerned with the interpretation of the patient's level of consciousness (LOC). Since consciousness is of major importance to any patient, monitoring it becomes essential to any trauma team. For this reason, a focus was set on looking at the discussions concerning the LOC. This approach seemed viable as an illustration of the teams' communication and collaboration processes. In addition, it might provide insight to the participant's interaction with, and interpretation of specific aspects of the application. By scrutinising consciousness issues, a tangible focus for further analysis was established. At this point I formulated a 'helping question' to guide further work:

"Why is it difficult to obtain a shared understanding of the patient's level of consciousness?"

The remainder of this section will be devoted to an attempt to answer this question. Initially a brief introduction to consciousness is presented, followed by a description of how the application 'treats' the issue. A focused analysis of the trajectories of consciousness information in the three teams wraps it up.

6.6.1. Why is consciousness important?

In (emergency) medicine it is crucial to accurately assess and keep track of changes to the patient's LOC, and thereby supply information that often plays an essential part in guiding further treatment. There are of course several reasons as to why the LOC might drop. However, in cases of accidents and trauma, the reason is normally found to be due either to an injury to the head, or hypovolemia[32], or both.

6.6.2. Assessing 'real-life' consciousness

A person's level of consciousness is more or less sensed automatically by others in the vicinity. Not implying that one normally utilises paranormal senses, but rather that a bit of attention and a quick glance often is sufficient to establish the current state of affairs. An important point is that it is often assessed without need for technology and often even without touching the patient. The visual cues accompanied by the possibility for verbal interaction make the foundation for the evaluation.

6.6.3. Consciousness measurement scales

As analogue creatures, we don't necessarily operate in only two states, either conscious or unconscious. This makes the assessment of consciousness more of a science, at least in professional terms, where a finer level of detail is required. Below I mention two well-known scales to categorise a patient's level of consciousness.

AVPU (Alert/Verbal/Pain/Unresponsive)

This is a basic scaling 'method'. Each of the letters in the acronym corresponds to a particular state (Table 14), and mapping a patient to the AVPU scale is done swiftly.

A	Alert
V	Verbal stimuli response
P	Pain stimuli response
U	Unresponsive

Table 14. The AVPU scale.

---

[32] Insufficient blood volume in the circulatory system, a condition that in trauma cases often is due to internal and/or external bleeding.

GCS (Glasgow Coma Score)

A widely accepted international scaling method is the Glasgow Coma Score (GCS) (Teasdale & Jennett, 1974). It is composed of three different parameters, namely Best Eye Response (1), Best Verbal Response (2), and Best Motor Response (3). The patient's response to each of these parameters is given points (Table 15). Finally the points are summed, and the score will be between 3 (worst) and 15 (best).

Best Eye Response	Best Verbal Response	Best Motor Response
Eyes open spontaneously = 4	Orientated = 5	Obeys commands = 6
Eye opening to verbal command = 3	Confused = 4	Localising pain = 5
Eye opening to pain = 2	Inappropriate words = 3	Withdrawal from pain = 4
No eye opening = 1	Incomprehensible sounds = 2	Flexion to pain = 3
	No verbal response = 1	Extension to pain = 2
		No motor response = 1

Table 15. Glasgow Coma Score.

6.6.4. How is consciousness modelled in MATADOR?

As mentioned in the case description (section 2.2.3.), the patient's parameters are parsed at start-up. The time-dependent values of consciousness are mapped as seen in Table 16.

1	Conscious (unless sedated)
2	Somnolent
3	Unconscious
4	Dead

Table 16. MATADOR, patient LOC grading scheme.

In the current scenario the patient starts out on level 1 'Conscious (unless sedated)', and then follows the deterministic path depicted in Figure 21. Note that these values are modelled to work independently of chosen procedures, and as the simulation proceeds, the value changes only at certain times[33]. As we can see from Figure 21, the consciousness level remains unchanged until 26 minutes into the simulation.

```
Milestones (min)     = 0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34
Consciousness; value = 1 1 1 1 1  1  1  1  1  1  1  1  1  1  2  2  3  3  0
```

Figure 21. The patient's consciousness (time-dependent) parameters.

---

[33] In MATADOR each step is called a 'milestone' and the time-frame is set at 2 minutes.

6.6.5. How to assess 'MATADOR' consciousness

An important point is that there are three ways for the team members to orient themselves through the application, thus making the task of analysis easier than one could suspect (see Table 17). At any point in the simulation each participant can make use of the menu system (1) or the visual information in the 3D scene (2). Once during every simulation one participant may acquire consciousness information provided in the ambulance report (3). Of course, as we recall from earlier notes on 'modes of interaction' (section 2.2.4), a more indirect and effortless way for the team members to update each other is through talk. However, before any information may be shared it first has to be acquired by at least one of the participants[34].

How	What	Where (interface)	Channel	Mode	'Message'	Note
Via menu system (1)	Report on level of consciousness	Result window	Visual	Text	The first 26 minutes of simulation: 'conscious (unless sedated)'.	May be checked at any time by any participant.
No specific input required (2)	The virtual emergency room	3D scene	Visual	Continuous visual rendering	Sees patient on table, without movements.	
Must click on the paramedic within 5 minutes (3)	The Ambulance Report	Log window	Visual	Text	'The patient has been unconscious but is now conscious but drowsy'.	Available for one participant, on one occasion.

Table 17. Consciousness model in the MATADOR application.

Menu-system inquiry (1)

MATADOR makes it possible for the participant to use the menu system in order to assess the level of consciousness. The procedure is done by clicking at a menu option called 'Vital signs', then by choosing the option 'Level of consciousness'. The response to such an interaction would be a textual response stating either: 'Conscious', 'Somnolent', 'Unconscious' or 'Dead', depending on the time of the query.

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[34] A peripheral route exists, namely by asking the tutor or others that might be co-located.

It is worth noting that an application design flaw was detected during the testing week. If the patient was given anaesthesia the application still reported that he was 'Conscious'. In other words the procedure did not affect the state of the patient's consciousness, as it clearly should (by 'putting him under'). It was considered that by changing the textual message the problem was solved in the easiest and least risky way. The textual output was changed to 'Conscious (unless sedated)'. As I will show in a later section, the new and somewhat ambiguous message brought out uncertainties in (at least) one participant (see section 6.7.3.).

The passive route (2)

By looking at the patient rendered in the 3D scene, one is offered a passive way to assess the level of consciousness. This way is what most closely resembles the 'real life' assessment method. Only attention and no direct interaction or inquiry is necessary on behalf of the participant.

The ambulance report (3)

At an early stage in the simulation the consciousness level is mentioned if one of the participants should request the ambulance report. It is then stated textually: "Unconscious when the ambulance arrived after 6 minutes. 10 minutes after the injury the patient woke up, drowsy." (Hagen et al., 2002, p. 8).

6.7. Trajectories of the state of consciousness

In the previous section I have pointed to the importance of monitoring a patients level of consciousness. It has been described how this is done in 'real-life', as well as in the MATADOR application. Finally it is time to follow each team and their mode of discourse and styles of monitoring the patient's level of consciousness.

6.7.1. Team 4, professionals

At the start of the simulation this team misses vital information by not clicking, as hinted in the application, on the paramedic. They never got the information that the boy had been unconscious for a few minutes, and so they have to rely on getting the status through the menu system and the 3D scene. According to the log, the anaesthetic doctor checks the consciousness level at 00:47, then again at 01:23 and 03:35. At none of these occasions does she communicate the status to the team. She

asks the tutor if the patient is awake and able to talk (4:49). The tutor replies that she will have to check vital signs to answer the question (Excerpt 2).

```
4:49   AD:   The Anaesthetic doctor wants to ask the Tutor: Is he awake and able to talk?
       T:    You'll have to take a look at the vital signs.
```

Excerpt 2. Is he awake, tutor?

The next interaction concerning the level of consciousness happens at 06:15 as the surgical nurse asks openly if anybody has checked the level of consciousness (Excerpt 3). He 'answers' himself after about 0.2 sec stating: "He is unconscious, right?" The surgeon's response confirms the misconception with "yes, he is unconscious". Note that neither the surgeon nor the surgical nurse has used the menu system. Hence they must be relying on visual cues from the 3D scene for this information, since no ambulance report has been attained and no discourse has taken place between the participants on the issue. What happens next is that the Swedish part of the team probably is trying to correct the surgical team's misconception, but due to the poor audio link the message never makes it through to the Norwegian side. Thus leading to an unsymmetrical view on level of consciousness within the team. It seems clear that the anaesthetic nurse has a correct understanding of the status, as she is the only one to have queried via the menu system at this point.

```
6:15   SN:   Has anyone made a check on consciousness? He IS unconscious, right?
       S:    He is unconscious.
             ((The Swedes are making efforts to counter the misunderstanding, but fails))
```

Excerpt 3. "He IS unconscious, right?"

A few seconds later (06:22) the surgeon checks the level of consciousness through the menu system, but as we see later he does not change his opinion on the issue. This opens for a speculation in why he does not correct his own and the surgical nurse's misconception. Three alternatives can be suggested: Either he does not read the message closely enough (1) or he misunderstands the somewhat obscure message ('Conscious (unless sedated)') (2). Or he thinks that the anaesthetic team actually has sedated the patient without noticing him (3). The important point is anyway that he still believes the patient to be unconscious, confirmed by the summary he makes to

the team at 07:53: "shall we do a quick summary?" (Excerpt 4). No protests are put forward from the rest of the team, but the technical problems are still noticeable. Note that the surgical nurse shortly before (07:28) still seems to be uncertain of the level of consciousness: "is he awake?"

```
07:28   SN:    is he awake?
07:35   AN:    are there any Norwegians that can hear the anaesthetic doctor?
07:53   S:     shall we do a quick summary? We have a patient who is unconscious, as
               far as I can see.
               ((no protests are audible, but the anaesthetic doctor is still 'clipping' in
               and out on the audio due to technical problems))
        S:     unconscious ((continues to sum status and report on chest x-ray))
               I have asked for a lavage
```

Excerpt 4. "Can any Norwegians hear the anaesthetic doctor?"

Later the surgeon chooses to do a surgical procedure (lavage), and commences the procedure before the patient is sedated.

6.7.2. Team 5, professionals

Approximately 15 seconds after the paramedic enters the room, the surgeon clicks to get the report. She reads the report briefly and reads it back to the team 20 seconds later. She does an instant translation, as the text message is in English. Excerpt 5 shows how she recites the report.

```
01:05   S:     ((sums the information gained from the ambulance report, takes about 30 sec))
               Ok, I have talked to the ambulance driver, and this is it: The boy was riding
               a bike and got hit by a car. Unconscious when the ambulance arrived 6 minutes
               after the accident. 10 minutes later he woke up, but still a bit degraded
               consciously. No outer signs of injury except some bruises. He has infusion
               running, and at the present time it is 30 minutes since the accident. OK
```

Excerpt 5. Broadcasting the ambulance report.

During the surgeon's summary of the report the anaesthetic doctor checks on the consciousness level through the menu system (01:21). The next interaction with the level of consciousness appears to be when the surgeon two times in 5 seconds checks via the menu system (02:24 and 02:29). Then at 03:37 the anaesthetic doctor makes a new check, and at 05:16 the surgical nurse does the same. Prior to the discussion that

occurs at 05:28 all but the anaesthetic nurse has made a check on the level of consciousness via the menu system.

The discussion on the level of consciousness is probably 'triggered' by a question from anaesthetic nurse (Excerpt 6).

```
05:28  AN:   Shall we insert the catheter, as he is unconscious?
05:34  SN:   May I ask, is the patient conscious or unconscious?
       S:    No, the patient is unconscious
       SN:   because of sedation or what?
       S:    No, he is not sedated
       SN:   when you click ... it says that he is conscious
       AD:   That's right
       T:    Guess that means he is conscious then.
       SN:   What does the anaesthetic doctor have to say?
       AD:   Parameters are normal, and he is conscious
       S:    I read unconscious, but maybe I read wrong
       SN:   In case he is conscious he needs some pain relief
```

Excerpt 6. "when you click… it says that he is conscious".

During the discussion the anaesthetic nurse checks the level of consciousness through the menu, but does not engage in the verbal interaction. In any case, this detailed discussion seems to build a shared, and correct, understanding of the patient's level of consciousness. Still, the team seems to run into trouble at a later stage when the surgeon starts the laparotomy procedure (11:59) prior to the sedation (12:35) and intubation (14:41) of the patient.

6.7.3. Team 6, professionals

Similar to Team 5 this team gets hold of the paramedic and the report he offers. The surgeon receives the textual report, reads it for himself and immediately reads it back to the team. It is worth noting that the surgeon performs a spontaneous translation of the text presented to him in English. The following sequence indicates that he has an (unknown) helper present in the room (Excerpt 7).

S:	((to unknown)) Do they read the same report as me?
Unknown:	((no audible sound, probably shaking head or something..))
S:	((to unknown)) Ok, so I'll read it to them
S:	It is a 12-year-old boy who has been run down by a car. He was unconscious when the ambulance arrived after 6 minutes. After 10 minutes he woke up, but was TIRED. He had no signs of injuries except some lacerations on leg and face. He was transported to the hospital by ambulance, and was given oxygen and Ringer 500 ml IV on the way. The ambulance arrived at the hospital 30 minutes after the injury. At this time it is 30 minutes since the accident.
S:	(speaking to the room): I now click on the right mouse button.. no now he disappeared. I would like some info from the ambulance but but ...
Unknown:	That was it.
S:	That was it right there, OK
S:	(to the room) That was what happened during transportation.

Excerpt 7. "Do they read the same report as me?"

Worth noting on the progress of Team 6 is how the surgeon less than one minute after telling the others that they are dealing with a conscious patient seems to think that the patient is unconscious (02:35), (Excerpt 8). This occurs subsequently to his comment/question on lack of movement of legs and arms. It seems fair to interpret that his change in opinion is based on the visual cues (typically unconscious behaviour).

02:25	S:	Have you seen him move a leg or an arm? No?
	AD:	As far as I can see he breaths spontaneously, and well. OK blood pressure and saturation
	S:	He is in other words unconscious.. And that may indicate a brain injury.. unconscious .. then we need to check his neurological status.
	T:	Tutor asks, is he unconscious? Take a look at vital signs
	S:	unless sedated.., what is that supposed to mean?
03:38	S:	level of consciousness now says that he is conscious
	T:	Yes he is conscious, but he is drowsy
	S:	He is drowsy, alright.. Then there is no indication for intubation At this moment, but I would like to have control over the airways

Excerpt 8. "unless sedated…. what is that supposed to mean?"

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An interesting event takes place at this point as the tutor breaks into the communication with a 'leading' question regarding the level of consciousness. " […] is he unconscious? Take a look at vital signs". In the log we now see that the surgeon clicks vital signs and level of consciousness, and then speaks to himself repeating the text "unless sedated.., what is that supposed to mean?" Nobody answers this question, but a short while after he draws a new conclusion, stating, "[…] level of consciousness now says that he is conscious". The tutor replies, "Yes he is conscious, but he is drowsy".

Another interesting situation arises when the surgeon thinks it is time to intubate (10:52). This leads to a response from the anaesthetic doctor who makes a qualified guess that the surgeon plans to put in a thoracic drainage as a next step, something he affirms (Excerpt 9).

	AD:	Let's intubate
	S:	Yes let's do it. Let's intubate
	AD:	Here we go, but the first thing we will have to do is to administer anaesthesia, as the patient is awake.
	AN:	Yes, I have the drugs all ready to go
11:15	S:	Wait! What is his Glasgow coma score? How is his neurological function? Have you seen him move any legs?
	AD:	I haven't seen him move at all, and was about to ask Johan, the tutor, about this. I would normally…
	T:	He moves
	AD:	So he moves
	S:	Does he move all his legs?
	T:	Yes
	T:	But he is drowsy, conscious but drowsy
	AD:	yes, all right
	S:	Yes, I see, he is a RLS 2 in other words?
	T:	Yes
	S:	Ok, and he is moving all legs

Excerpt 9. "He moves".

6.8. Discussion

Summing up the analysis, it is evident that the three professional groups experienced problems. These problems were manifested through an unnaturally high degree of unexpected sequence errors. Still, I argue that the erroneous performance observed

should not be attributed to poor skills. Instead, these problems should to a large extent be recognised as related to the application design.

To illustrate the point, I cautiously analysed how the three professional teams interpreted and discussed the patient's level of consciousness. The findings suggest that the participants experienced major problems with regard to assessing the patient's level of consciousness. When trying to explain why this turned out to be a problem, I propose that the way consciousness was modelled, and thus presented to the participants, might give an indication.

It appears that the participants rely on what they can see in the 3D model as a main source of assessing consciousness. And as previously mentioned, this constitutes the way it is normally done, and should therefore come as no surprise. However, in the simulation, the inappropriate way the patient was modelled in the 3D scene probably contributed to the abundance of misinterpretations.

The application clearly provides paradoxical information of the patient's LOC. While the menu system reflects the 'correct' LOC, the 3D scene keeps emitting totally different signals. And on the face of it, there is no way for the participants to establish which is reflecting the correct state. When we recall that the patient never moves (see section 2.2.3) during the simulation, he thus signals unconscious behaviour. Still, as mentioned (section 6.6.4), the patient is supposed to be conscious until 26 minutes into the simulation.

This concludes the empirically based analysis conducted throughout the study. In the following section I discuss issues concerning analytic methods.

6.9. Discussing the study

The current thesis is focused on human interaction mediated through computer technology. The socio-technical system was tested in a field trial in April 2002 in Sweden and Norway. In this section a few crucial issues regarding the study will be discussed.

6.9.1. Methodological issues

The quest for reliable and valid results is a general concern in scientific research. However, as mentioned in section 5.1, these requirements do not apply in quite the same way within the qualitative approaches as the case is with quantitative research. It lies in the nature of the qualitative case study that one is not pursuing results that are thought to be valid and reliable across large populations and many different situations. Rather, the goal is less ambitious, as one typically strives for objectivity by describing social interaction in ways that can be subjected to empirical testing (Peräkylä, 1997). Consequently, the question is: How trustworthy are the findings presented in the current thesis?

Reliability

As described in the Method chapter, the data sampled for this study are based more or less entirely on videotaped or computer-logged material. And as a consequence, other researchers may re-examine the findings described. This is an opportunity that is rather uncommon compared to typical ethnographical studies that are often impossible to repeat. Still, seeking to solve the reliability issues by taping introduces new problems, as going from the taped material to analytic findings is a far from straightforward task. Peräkylä (1997) points out that capturing social interaction using videotapes typically introduces problems with inclusiveness. One must, for instance, acknowledge that it is practically impossible to fully capture interactions with longer temporal spans and events that are ambulant in nature. Other questions that need to be assessed are how much to record in the first place, the technical quality of the recordings, as well as the adequacy of the transcripts (ibid.). Jordan and Henderson (1995) also point to the fact that videotapes, as a representation of reality, should be questioned. "In analysing a tape, we are then dealing with a *transformation* of that world, and not simply with an objective, faithful re-presentation" (p. 19, italics in original). They further point to how the operator of the camera determines what is visible and audible, and what is not. In addition the technology has limitations in itself, as it is far more restricted than the human sensory apparatus.

In the current study, the interactions happen in a synthetic environment that is isolated, controlled, and predictable regarding temporal aspects. The tasks undertaken by the teams are clearly stated, time is limited, and there is only one room where

everything happens. In the virtual ER all interactions observable to the whole team, are also captured on the videotape. Hence inclusiveness and limitations of the technology can be considered a minor problem. Intuitively, the limited planes of action in the synthetic environment make it easier to claim that reliability issues represent less of a challenge than what the case would be in a natural, and thus richer environment.

Validity

The concept of validity in qualitative studies concerns the quality of interpretations, or as Silverman (2000) puts it, "[…] another word for truth" (p. 175). As to the extent of how the findings relate to validity, I claim that this is mostly sought for by making visible the process of analysis. Thus hopefully providing what is labelled 'apparent validity' (Kirk & Miller, 1986). In practice, this is done by describing both the steps of the analysis, and by including transcript excerpts. However, there is always the problem of 'anecdotalism' when it comes to such issues. By relating to qualitative researchers in general, Silverman asks: "How are they to convince themselves (and their audience) that their 'findings' are genuinely based on critical investigation of all their data and do not depend on a few well-chosen 'examples'?" (2000, p. 176). Often the solution to this is to suggest method and data triangulation and/or respondent validation. However, such solutions cannot guarantee validity. Triangulation attempts to get a 'true fix' on a situation, an assumption that is basically incompatible with qualitative research. And moreover, respondent validation becomes a problem if one assumes that respondents have privileged status as commentators of their actions (ibid.).

In an attempt to improve the quality of the interpretations, a certain style of working was adapted in the course of the analysis. Following the recommendations of interaction analysis (IA) we jointly viewed tapes, transcripts, and log-files. For instance, Jordan and Henderson (1995) state that some biases on part of the individual analysts are challenged by group work undertaken in the IA-lab, as "[c]ollaborative viewing is particularly powerful for neutralizing preconceived notions on the part of researchers, and discourages the tendency to see in the interaction what one is conditioned to see or even wants to see" (p. 9). Additionally, one of the main ideas of IA is that assertions about what is happening on the tape should be grounded in the

materials at hand, and thus escaping the temptation to engage in ungrounded speculation (ibid.).

Eventually, as it is practice that matters, the question of validity cannot be assured by merely theoretical accounting. In other words it is *you* who must draw the bottom line, by choosing to approve or disapprove the claims put forward.

Chapter summary
In the current chapter I have made attempts to show how the process of analysis was conducted. I have sought to explain findings of unexpected sequence errors based on the data log analysis. Through a detailed analysis of the interactions I have found that the participants encountered certain difficulties with interpreting the application.

In the following chapter I will turn to a more general discussion regarding the MATADOR project and application. In addition, as an ethnographic 'gesture' I suggest a few ways to possibly improve the application, and finally a conclusion is drawn.

7,8,9

discussions
& conclusion

In these three chapters the goals are to:

- Discuss general issues connected to the MATADOR.

    - o   the technology
    - o   the rationale
    - o   the move from ER to VR

- Note some potential improvements.

- Draw some concluding remarks.

7. General discussion

Through a detailed study of the interactions in the virtual environment I have uncovered that the patient is modelled in a paradoxical way, often leaving the participants puzzled (chapter 6.0.). I argue that this finding is interesting if the quest is to analyse the application design. However, one will undoubtedly be displeased if the goal is to assess trauma team training, as the empirical analysis says little about the teams' interactions as such. Furthermore, I argue that *what* this finding suggests (paradoxical communication on behalf of the application) can be held responsible for the lack of empirical accounts of realistic professional interactions in the virtual ER. In this chapter I choose to broaden the scope, in an attempt to go beyond the empirical findings and discuss more general issues of MATADOR.

7.1. The technology

With no doubt it can be established that the MATADOR application worked. Mediated through computers connected to the Internet, it was possible for the participants to interact with each other and the virtual patient in an attempt to save his life (Halvorsrud et al., 2003).

Still, a single factor that seemed to recur as a technical problem was the audio distribution, which simply didn't seem sufficiently stable. Surely, the Internet is not built to distribute real-time sound, but from a user perspective precisely this feature appears to be fundamental. As pointed out in the analysis, Team 5[35] experienced more trouble related to audio communication than the other professional groups[36]. In the student simulations, where all three teams used IP-based audio, one could find more examples where such problems hampered the communication.

Further, the fact that hardware and software used for the field trail was thoroughly tested and controlled by the staff might have contributed to the stability of the application. It is not uncommon that end users experience particular problems when they configure hardware and software by themselves (Ruhleder, 2000). Nonetheless,

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[35] Used audio through application/Internet.
[36] Using telephone conference.

MATADOR is a prototype and this kind of discussion makes little sense as long as it is not meant for distribution.

7.2. The rationale

Having mentioned in the 'Case description' that the pedagogy is drawn from BEST, the MATADOR does not extend the basic ideas of its 'ancestor'. Thus, the MADADOR can be seen as a vehicle for bringing BEST principles to its community[37], adding the benefit of geographical freedom.

Bearing in mind the cultural (Cicourel, 1990, section 4.1.1.) and groupware issues (Grudin, 1988, section 3.3.) that need to be addressed, MATADOR's rationale seems intrinsically challenging.

First, a technology that simply provides a learning arena where training amongst peers is made possible doesn't seem to match the current cultural practice. As discussed by Cicourel (1990), nestors rule the hospital departments, and according to Sexton et al. (2000), hierarchy is 'beloved'. In order to cope with such issues one must carefully consider how the users can be given the necessary degree of self-confidence to believe they can manage on their own, a task that probably is not best left to technology.

Secondly, as noted in the analysis, the tutor played an important role as facilitator, at least amongst the professional teams. The tutor was supposed to sit back and observe the unfolding interaction and save his comments for the debrief session. However, this was not what actually happened, and it can easily be imagined how the sessions could have turned into havoc if the tutor was less willing to solve experienced problems immediately.

The last point to be made here relates to the question of providing evidence of own credibility as discussed in section 4.1.1 (Cicourel, 1990). As we recall, this is a requirement not only for the practitioners, but also for the information system or technology.

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[37] Emergency medicine.

Referring to the modes of problem solving mentioned by (Krange et al., 2002, section 4.2.4.), it should also be mentioned that emergency medicine in general is a rather structured undertaking. Due to standards, such as ATLS, one should not expect to see much variation of methods when it comes to the treatment of the patient. This is an argument that relates closely to the discussion in the analysis chapter (6.1.3.), where it is declared that some procedures must be performed in a certain sequence.

7.2.1. The move from ER to VR

This is not a study of the development process, but in my opinion it is interesting how knowledge transfer happens in a complex project with many different stakeholders and interests (Rogers, 2001).

Firmly based in the view that the MATDOR partners are experts within their particular fields, it is how the 'functional system' works that should be of concern, as we recall from the theoretical DCOG principles discussed in section 3.4.

Taking for granted the rationale discussed above, where BEST is the 'role model', and the aim is to adapt its principles into computer-generated reality, two questions are fundamental:

1. What are the 'philosophical' principles?
2. How can these principles be 'transferred' to a CVE?

The philosophy and pedagogical principles

BEST has its focus on 'communication, collaboration and leadership' (CCL), and not the treatment and procedures as such. Intuitively it is easy to bless the importance of such principles, but grasping what they really mean, and how they are integrated in the BEST practice, is harder.

Let me first make clear that I have not carried out studies of BEST, and that my view is not grounded in empirical material. Having said that, I propose that a key to the participants' reflection on CCL issues often lies in what happen *besides* the actual simulation. Consequently, it gets difficult to detach the 'treatment *from* the CCL' if one tries to understand this by focusing on the simulation alone. The point is that

when it comes to the simulation 'action', the two are hard to separate. For instance, it seems meaningless to boast of how well CCL issues were handled in the cockpit if the aircraft is totally wrecked or the patient dies in the ER.

Why is it difficult to overcome the challenges and 'transfer' successfully?

Seen from the participants' point of view, the co-located BEST model has a few advantages.

First, the participants will probably work with some of the same people again, and it makes sense to get to know each other in a relaxed social arena. Secondly, by using the same localities and equipment as they normally do, they get to discuss how equipment and routines can be improved.

There is yet another feature of BEST that relates to being co-located. By substituting a dummy for a patient, one tries to resemble 'learning by doing'. And in this sense BEST has more in common with successful[38] models, such as high-end flight simulators, than the case is with MATADOR. The point is that these flight simulators are only *partially* virtual, in the sense that the cockpit window is the 'boundary'. Everything outside the window is virtual, but the crew, instruments, and controls inside are real. Thus many issues concerning human communication and workspace awareness are left 'unmediated' by technology.

Furthermore, an aircraft is a human construction and the environment in which it operates is well understood[39], and hence easier to model. Conversely, in the ER no boundaries exist in the sense that one can naturally model by inside/outside metaphors. On the positive side, albeit the human body is not a work of engineering, it is fairly well understood (anatomy and physiology), so constructing a realistic casuistry is possible[40].

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[38] Much used in the industry.

[39] Formalised physics/aerodynamics.

[40] When the idea is to model acutely traumatised patients.

8.   Notes to developers

The link between ethnography and software design is much debated and closely associated to what theories[41] in general have to 'offer' practice (Halverson, 2002; Nardi, 2002), also mentioned in section 3.5. In a related dispute, several researchers have made it clear that there is little consensus concerning the room for ethnography in design (Bader & Nyce, 1998; Bowker, 1998; Dillon, 1998; Rosson, 1998; Simonsen & Kensing, 1998). Yet, in an attempt to 'be applied' I choose to come forward with some suggestions regarding the design of the prototype based on the observations made in the course of my study.

8.1.   The consciousness model

As illustrated in the analysis, MATADOR's way to inform participants on the patient's level of consciousness (LOC) cannot be considered perfect.

The main goal is to present consistent information through the application's channels. Therefore, if the patient is modelled unconscious in the text file[42], the patient should behave correspondingly in the 3D scene. In other words, more animation on behalf of the patient is 'prescribed'. Of course, another option is simply to change the LOC model in the text file, and thus adapt it to the current visual model. The latter solution might seem compelling, but the risk is that users soon will be bored if the patient always is unconscious.

In my opinion, this is where MATADOR has its potential advantage as a simulator. If MATADOR modeled a person in the role as patient, instead of a dummy, it would actually offer a qualitative improvement, also compared to its real-life counterparts. By providing a simulation environment where it is 'impossible' to separate agents[43] from avatars, the result becomes more realistic.

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[41] Specifically, Activity Theory and DCOG.
[42] Reflected in the vital signs menu.
[43] Computer-controlled avatars.

8.2. The IV model

In the analysis we saw several examples where participants had problems interpreting the application's 'IV model'. The ambulance report stated that the patient had received 500 ml Ringer during transport, thus implying an existing IV access point. But to the participants' surprise, when trying to administer IV fluids the application replied: "You must insert an IV cannula" (Hagen et al., 2002, p. 26). This often led to confusion, and in many cases the tutor had to break into the discussion and state that the IV cannula had fallen out, in order to reestablish the teams' understanding on the issue.

Yet another issue concerning the application's IV model is that it only allowed for one IV access point (and method). As mentioned previously (section 6.1.2.), this is not the way it is normally handled, where no less than two working access points are required.

8.2.1. Suggestions on 'solving' the IV model problem

An easy way to manage this contradiction is by changing the ambulance report. By leaving out information about IV fluids given prior to arrival, one doesn't build the impression that the IV access point is operational, when actually it is not.

Another way would be to model an existing IV access point from the ambulance, but allow for inserting another cannula. In any case one should model more than one possible access point to enhance credibility.

The cannulation procedure is also the only attempt to model some kind of 'hands-on' interaction in the simulation. It is 'fancy', but in my opinion it is not an especially important feature. A claim that I ground in the observation that it relates very little to how this normally is done. It is actually the only procedure that seems to require some spatial navigation, by lining up for aiming at the elbow. However, it was commented that the cannula could be inserted from the other end of the ER. And thus so far from reality that it better be left out altogether.

8.3. The radiology model

At any time during the simulation the participants could choose to perform different radiological procedures, specifically 'Head-CT' (1), 'Chest X-ray' (2), and 'Ultrasound abdomen' (3). This was done through the menu system and feedback was given to the participant who requested it (requester), see (Hagen et al., 2002, p. 26). I will not go into a detailed discussion on this subject, but briefly comment on the textual report offered by the system. Since MATADOR provides realistic images (x-ray and ultrasound) as a response to a request, why not just leave out the report and let the participants interpret the images? In this way, the participants would probably be more inclined towards discussing the images in a collaborative style.

8.4. The clinical void

The way Team 6 surveyed the patient illustrates an interesting problem. What seems clear is that it is the tutor, and not the application that supplies most of the patient information. Thus revealing that the demand for information exceeded what the application could supply on its own. Clearly, Team 6 was rather extreme in this sense, but other situations were observed where the tutor 'filled the holes' of the application. Furthermore, in the debrief sessions many groups mentioned that they missed the ability to do more clinical observations through MATADOR.

The current version of MATADOR only incorporates 'palpation of abdomen' as a kind of clinical observation method. I will argue that if the goal is to do simulations without an expert tutor, the issue needs to be reconsidered, and in my opinion more clinical options are needed. On the positive side, the clinical procedures can be rooted in the structure of ATLS.

8.5. Awareness model

My impression is that the participants had difficulties in staying orientated about who did what, who was busy with what and what information that was presented to the others. In other words, workspace awareness issues should be discussed.

As we recall from section 4.2.1, Gutwin and Greenberg (2002) stated that the goal is to let people maintain awareness easily and naturally.

MATADOR solves this by offering a shared audio space, and apart from that, very little information is presented by the application. The shared audio space certainly constitutes a natural way to maintain awareness, however it is hardly natural to leave team coordination entirely to verbal interaction. However, the fact that each team only had one 'go' during the field trial, might explain why it sometimes seemed difficult to adapt communication behaviors to fit the novel situation.

Aware that there is a thin line between too much and too little awareness information, I nevertheless would like to suggest that more such information should be left to the application.

For instance, when someone is busy doing certain procedures they are not able to initiate other procedures until they have finished what they are doing. Each participant is 'informed' about this indirectly, as the menu options remain visible but become 'unselectable'. Often during the simulations the participants informed each other about not being able to do anything, by stating that they were "grayed out". Technically, such information could be incorporated into the user interface either in a text window, or even better, in the 3D scene connected to the avatar in question. I will argue that this would be a more natural and easy way to keep the team informed.

Chapter summary

MATADOR is a *prototype* built mainly with the goal to guide improvement of the application, and hence general CVE technology. For that reason it makes sense to provide some feedback to the MATADOR team.

My general impression is that the MATADOR application could greatly benefit from certain improvements. Some of these are without doubt pure modelling flaws, however some are more related to general design principles. In this chapter I have discussed some of these issues, and furthermore humbly suggested potential improvements to be made.

9.   Conclusion

Armed with the luxury of time I set out to conduct a study of how professional trauma teams worked together in a particular training situation. The teams were formed in a novel way, as the individuals were distributed in space and connected only though computer technology. Each team was presented to a medical case where a computer-generated agent played the role as patient. In order to solve the case, and thus save the patient, the team had to perform certain medical procedures and at the same time avoid others.

To study such a phenomenon I adopted a theory that is considered to fall within the sociocultural perspective, namely 'distributed cognition'. As to the analysis, persistent recordings, such as computer log files and videotapes comprised the main material. Methods used to approach the material have generally been informed by ethnography, meaning that qualitative research has been brought forward in the current thesis.

As noted in the analysis (6.8), the computer technology utilised in the field trial had a few flaws. And as I have argued in the general discussion (7.0), some of these may very well be held accountable for some of the unexpected findings that surfaced when the team efforts were assessed. For that reason, the analysis took a new direction, as the team interactions seemed to found more of a basis for criticising the technology than for uncovering patterns within the teams' interactions.

Specifically, the analysis revealed that all the teams experienced problems connected to the assessment of the patient's level of consciousness. Grounded in the fact that the application provided paradoxical information on the issue, I claim that exactly this condition often led to unwarranted actions by the teams.

Through the general discussion I have argued that apart from the fact that the application made teamwork possible across physical boundaries, the basic rationale should be questioned. For example, the application's pedagogy is rooted in a training programme that is performed in a shared physical context (i.e. in the particular ER with designated teams, BEST model, see sections 1.2.2 and 2.1.1). In my opinion, by

simply transferring the programme into computer realms, little is gained and much is lost.

In an attempt to be both constructive and applied I have included a chapter that points out some design issues along with suggestions that may possibly solve some of the problems that were revealed during the course of the current study.

Finally, I would like to mention that it is certainly easy to be critical, though extremely hard to predict a potential success. One thing that is certain is that if you never try, you will never know. More generally, if sceptics like myself ruled the world, we would probably be hitting each other in the head with stones. Ever since cultures are evolutionary[44], it makes sense to develop technology that breaks new ground and potentially takes us one step forward.

As a counter to my own scepticism I note that the participants generally enjoyed training with MATADOR, and that 19 of the 24 participants would recommend it to their colleagues[45].

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[44] A fundamental sociocultural assumption (see section 3.3.).
[45] Data from questionnaire 2.

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APPENDIX

A. Schedule, field trial
B. Navigation instruction for participants
C. Guide to participant instruction
D. Tutor guide
E. Questionnaire 1
F. Questionnaire 2
G. Technical set-up for capturing data from server
H. Excerpts in original and translated language
I. Transcripts
J. Log files
K. Cultural acknowledgements

APPENDIX

A.   Schedule, field trial

Please note that telephone numbers, IP addresses, and participant names have been removed from the original.

Plan for feltforsøket i MATADOR

8. - 12. april 2002

Norrlands Universitetssjukhus, Umeå, Sverige

Rikshospitalet, Oslo, Norge
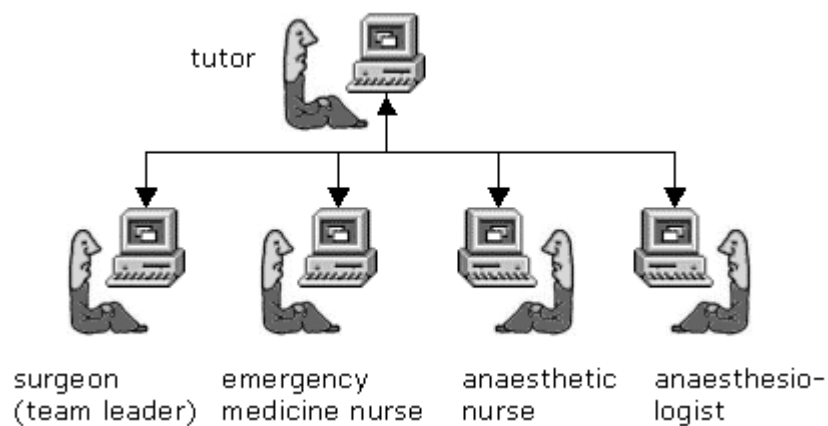
Mannskap og lokaler

Norrland Universitetssykehus, Umeå	Ferdighetssenteret Rikshospitalet,Oslo
Rom: B sal Telefon: +46 tlf IP: ip *Rom: Kandidatrum* Telefon: +46 tlf IP: ip	**Rom: Gyn/obstr. (server)** Telefon: +47 tlf IP: *Rom: Øre/Nese/hals* Telefon: +47 tlf IP: *Rom: Infusjon/sutur* Telefon: +47 tlf IP:
Videokonferanselokaler: Telemedicin-rummet ISDN: +46 90 tlf Tel:　+46 90 tlf	**Videokonferanselokaler:** Intervensjonssenteret **Telefonkonferanse:** tlf(fra Norge) #tlf +47 tlf(fra Sverige) #tlf (problemer, ring tlf)
Mannskap: Leif Hedman　　+46 tlf Peter Naredi Janne Karlsson　+46 tlf Martin Burman Calle Johansson +46 tlf 　　　　　　+46 tlf Jenny Marklund	**Mannskap:** Johann Pillgram-Larsen (tutor) Åse Brinchmann-Hansen　+47 tlf Luis Romundstad Sten Ludvigsen Simen Hagen　　　　　+47 tlf Siri Fagernes　　　　+47 tlf Stig Mjelstad　　　　+47 tlf Ragnhild Halvorsrud　　+47 tlf Kari J. Langseth　　　+47 tlf
	Gordon Simon, drift　(+47 tlf) Marit Henningsen, adm (+47 tlf)

Uke 14 - forberedelser

mandag 1. april	1. påskedag	
tirsdag 2. april	kl.09:00 - 12:00	Siste finpuss av applikasjonen.
	kl.13:00 - 17:00	Testing av applikasjon (release). Pakking av utstyr.
onsdag 3. april	kl.09:00 - 13:00	Rigging av datamaskiner i Ferdighetssenteret. Testing av applikasjonen og alt utstyr (Umeå, Oslo).
	kl.13:00 - 14:00	Videokonferanselokaler: Rigging og utprøving av opptaksutstyret som skal brukes for å filme debrifingen (Sten, Janne).
	kl.14:00 - 16:00	Videokonferanse med gjennomgang av siste detaljer til feltforsøket (alle).
torsdag 4. april	kl.09:00 - 13:00	Rigging av opptaksutstyr for tapping av lyd og bilde fra serveren (Oslo). Synkronisering av PC-klokkene i Oslo og Umeå. Applikasjonen som skal brukes på generalprøven må installeres i Umeå.
	kl.14:00 - 16:00	Generalprøven mellom Oslo og Umeå (alle). Vi kjører gjennom alle aktivitetene som hver gruppe skal gjennom. Inkludert timing av hvor lang tid de forskjellige ting tar.
fredag 5. april	kl.08:00 - 10:00	Møte med Johan Pillgram-Larsen (Luis, Ragnhild). Opplæring i applikasjonen, gjennomgang av program.
	kl.09:00 - 17:00	Justeringer og retting av eventuelle feil/problemer.

Uke 15 - feltforsøket

Her følger en oversikt over selve feltforsøket. Den første tabellen beskriver de fire hovedaktivitetene som alle gruppen skal gjennom, og tidspunktene for disse. Deretter følger en utfyllende plan for de forskjellige aktiviteter, og hvem som er ansvarlig for hva.

I Oslo har vi ikke noe slingringsmonn når det gjelder tidsforbruk. Både rommene som brukes under simuleringen, og videokonferanserommet, er opptatt utenfor de angitte

tidspunkter. Det er derfor veldig viktig at vi holder oss til tidsskjemaet. Alle bør føle et ansvar for at dette skal gå greit.

Timeplan

mandag 8. april	kl. 9 - 12 **Gruppe 1**	
	09:00 - 09:30 09:30 - 10:30 10:30 - 10:45 11:00 - 12:00	Introduksjon og opplæring MATADOR-simulering Spørreskjema Debrifing
	kl. 13-16: **Gruppe 2**	
	13:00 - 13:30 13:30 - 14:30 14:30 - 14:45 15:00 - 16:00	Introduksjon og opplæring MATADOR-simulering Spørreskjema Debrifing
tirsdag 9. april	kl. 9 - 12 **Gruppe 3**	
	09:00 - 09:30 09:30 - 10:30 10:30 - 10:45 11:00 - 12:00	Introduksjon og opplæring MATADOR-simulering Spørreskjema Debrifing
onsdag 10. april	kl. 9 - 12 **Gruppe 4**	
	09:00 - 09:30 09:30 - 10:30 10:30 - 10:45 11:00 - 12:00	Introduksjon og opplæring MATADOR-simulering Spørreskjema Debrifing
	kl. 13-16: **Gruppe 5**	
	13:00 - 13:30 13:30 - 14:30 14:30 - 14:45 15:00 - 16:00	Introduksjon og opplæring MATADOR-simulering Spørreskjema Debrifing
torsdag 11. april	kl. 9 - 12 **Gruppe 6**	
	09:00 - 09:30 09:30 - 10:30 10:30 - 10:45 11:00 - 12:00	Introduksjon og opplæring MATADOR-simulering Spørreskjema Debrifing

Generelle kommentarer

Om første del: *"introduksjon og opplæring".*
I Oslo kommer vi til å samle dem på et rom, der vi presenterer oss, der alle kan hilse på hverandre, og hvor deltagerne får en grov oversikt over hva som skal skje (opplæring, simulering, spørreskjema, debrifing) og noen praktiske opplysninger. Deltagerne får kaffe og kjeks/frukt. Denne introduksjonen skal ikke ta mer enn 10 min. Deretter følges de til sine plasser. Deltagerne må få beskjed om å skru av sine mobiltelefoner. (Vi som er mannskap bør ha dem påskrudd, men velge en diskret ringelyd).

Om andre del: *"MATADOR-simulering".*
Tutor har forhåpentligvis kunnet starte klokken 30 minutter etter at gruppen ankommer. Selve simuleringen skulle ikke ta mer enn 35-40 minutter. (Da har de enten reddet pasienten, eller pasienten har dødd). Straks dette punktet er nådd, så avsluttes simuleringsdelen. Tutor vil få hjelp til dette. Deltagerne blir sittende på sine plasser, og vi går direkte over i neste fase.

Når applikasjonen stanses så mister Oslo og Umeå midlertidig kontakten. Det vil nå bli en mellomfase hvor de to stedene opererer uavhengig, men i parallell med hverandre. Neste gang Oslo og Umeå har kontakt i plenum er ved debrifingen. Denne mellomfasen er ganske kort og hektisk, og det er viktig at alle deltagere sitter klar ved videokonferanserommet til avtalt tid.

Om tredje del: *"Spørreskjema".*
Spørreskjema må deles ut senest kl.10:30 (evt. 14:30). Deltagerne sitter på sine plasser og fyller ut skjemaet.. Hvis de ligger foran skjemaet, så er det pause fram til de skal følges over i videokonferanselokalene. Hvis ikke, følges de umiddelbart videre. Luis og Peter bør passe på at de tar med seg alle sakene sine videre til debrifingen.

Om fjerde del: *"Debrifing".*
Debrifingen må starte presis. Det er sikkert flere som ønsker å overvære debrifingen. Det er ingen god ide at disse sitter rundt selve møtebordet. Men det er likevel plass til noen tilhørere i rommet. Hvis deltagerne føler seg ukomfortable med å ha tilhørere, så bør vi andre trekke oss tilbake. Debrifingen vil bli videotapet. Det er derfor god anledning til å se den i etterkant.

> Første del ledet av Johan
> Tid: ca. 30/40 minutter
> Tilstede fra Umeå: 2 deltagere + Peter
> Tilstede fra Oslo: 2 deltagere + Johan + Luis
>
> Johan, Peter og Luis trekker seg tilbake, Åse og Leif tar over.
>
> Andre del ledet av Åse
> Tid: ca. 30/20 minutter

Tilstede fra Umeå: 2 deltagere + Leif
Tilstede fra Oslo: 2 deltagere + Åse

Etter debrifingen: Det blir sikkert endel småprat, faglige diskusjoner og utveksling av erfaringer. De dagene vi har 2 grupper, så er det bare en knapp time før neste gruppe kommer.

Ansvarsområder

(Calle stepper inn for Peter deler av mandag og onsdag).

Fra - til	Oppgave	Ansvarlig i Oslo	Ansvarlig i Umeå
08:00	Oppmøte for mannskap. Klargjøring av lokaler.	alle	alle
08:45 - 09:00	Sørge for at alt det tekniske er klart og at applikasjonen er startet i god tid før deltagerne ankommer. Sjekke at maskinene er synkronisert.	Simen	Janne
08:50 - 09:00	Møte testpersonene, følge dem inn i lokalene.	Luis	Peter[1]
09:00 - 09:10	Gi deltagerne en kort introduksjon ved ankomst. Alle bør være tilstede slik at vi kan presentere mannskapet som de vil ha rundt seg.	Ragnhild	Leif
09:10 - 09:30	Følge deltagerne til sine plasser. Vise deltagerne websiden med informasjon, gi dem en kort innføring i bruk av applikasjonen og headset.	Ragnhild, Siri	Leif, Janne
09:10 ->	Være i nærheten av serveren hele tiden for å fange opp eventuelle problemer som dukker opp underveis. Hjelpe Johan. Være bindeleddet til Umeå hvis vi mister kontakt underveis (mobiltelefon).	Simen	
09:30 - 10:30	Få audiell kontakt med de 4 deltagere, sjekke om alle er med, hjelpe dem til å velge rolle, spørre om de er klar, starte simuleringen, fungere som tutor under simuleringen.	Johan	
09:30 - 10:30	Være tilgjengelig for deltagerne (klientene) underveis i simuleringen hvis de trenger hjelp til noe. Fange opp relevant informasjon fra server-rommet ved eventuelle tekniske	Ragnhild, Siri, Åse, Luis, Sten	Leif, Janne, Peter, Calle

---

[1] Calle stepper inn for Peter deler av mandag og onsdag

	problemer.		
	MATADOR-simuleringen avsluttes når pasienten er reddet, eller pasienten dør. Tutor gir beskjed om dette når tiden er inne, og passer på at de ikke starter noen faglig eller teknisk diskusjon om ting som vedrører simuleringen. Tutor informerer deltagerne om at de får et spørreskjema, og at de kan bli sittende på sine plasser.	Johan	
10:30 - 10:45	Dele ut spørreskjema rett etter at MATADOR-simuleringen er avsluttet. Samle inn besvarte skjemaer	Åse	Leif
10:30 - 10:45	Dele ut skjema som skal fylles ut i forbindelse med honorar, samle dette inn igjen	Åse	Leif
10:50 - 10:55	Følge deltagere til videokonferanselokalene slik at de sitter klar rundt bordet 5 min. før debrifing starter.	Luis	Peter
11:00 - 12:00	Videomonitorering av debrifingen.	Sten	Janne?
11:00 - 12:00	Gjennomføring av selve debrifingen. Åse, som er ansvarlig for siste del av debrifingen, bør informere deltagerne helt til slutt om at de nå er ferdig.	Johan, Luis, Åse	Peter, Leif
12:00 ->	Følge deltagere ut av lokalene....	Luis	Peter

Kriseplan

Uansett hva som skulle oppstå av uforutsette situasjoner, så er det viktig at Ragnhild får beskjed (tlf).

Hvis vi mangler en deltager:
Forhåpentligvis vet vi dette på forhånd, og Luis og Peter har forhåpentligvis skaffet en reserve. (Hva med en telefon til deltagerne dagen i forveien for en muntlig bekreftelse på at de kommer?) Hvis en deltager ikke møter opp som avtalt tid har vi et problem. (Hvor raskt kan reservene komme?)

Hvis noe går galt under selve MATADOR-simuleringen:
Simen ringer til Janne og gir instrukser. Serveren vil merke hvis noen av klientene har problemer. Dette betyr at Simen, som befinner seg hos serveren, raskt vil avdekke et oppstått problem, enten det er av teknisk art eller annet. Simen må spre relevant informasjon videre.

Deltagere

Gruppe	Kategori	Sted	Rolle	Navn
gruppe 1 mandag 9 - 12	student	Oslo	kirurgipersonell	
		Umeå	anestesipersonell	
gruppe 2 mandag 13 - 16	student	Oslo	anestesipersonell	
		Umeå	kirurgipersonell	
gruppe 3 tirsdag 9 - 12	student	Oslo	kirurgipersonell	
		Umeå	anestesipersonell	
gruppe 4 onsdag 9 - 12	proff	Oslo	kirurg akuttsykepleier	
		Umeå	anestesipersonell	
gruppe 5 onsdag 13 - 16	proff	Oslo	Anestesilege Anestesisykepleier	
		Umeå	Kirurgipersonal	
gruppe 6 torsdag 9 - 12	proff	Oslo	anestesilege anestesisykepleier	
		Umeå	Kirurgipersonal	

APPENDIX

B.   Navigation instruction for participants

Slik navigerer man i akuttrommet:

Venstre musknapp:
Brukes til å bevege seg langs gulvet i rommet.
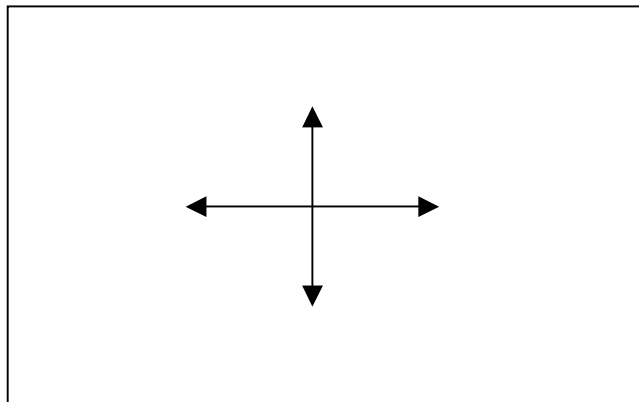
Høyre museknapp:
Brukes til å bevege seg sidelengs.
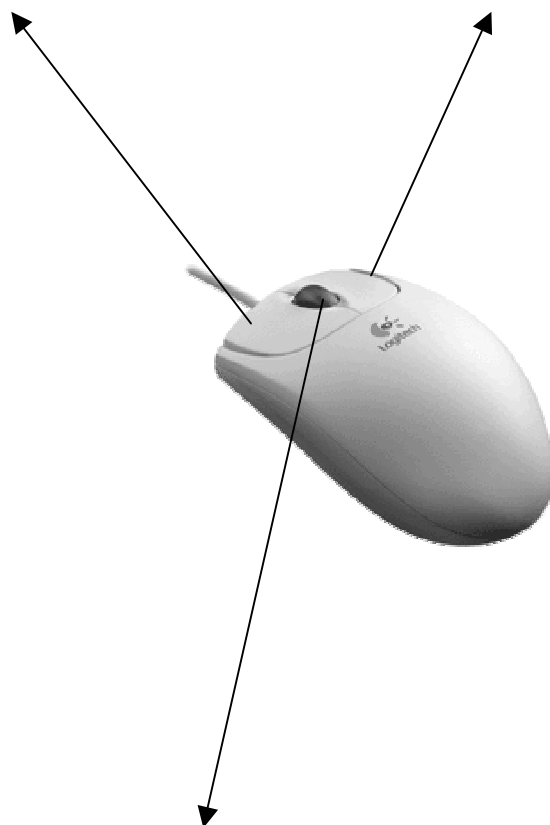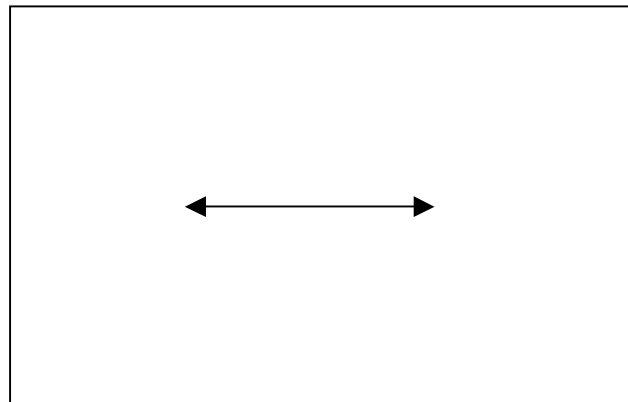
Midterste knapp ("hjulet"):
Brukes til å "peke" i 3D-scenen. F.eks. så velger man rolle ved å trykke på
midterste knapp når markøren er over en av xray-vestene.

APPENDIX

C.   ***Guide to participant instruction***

Til de som skal ha opplæring med deltagerne:

1. Deltagerne må følges til plassen sin bak datamaskinen. Både MATADOR-applikasjonen og websiden bør stå klar på skjermen. Vent med headset helt til slutt. Ellers vil deltageren høre andre stemmer samtidig som du forklarer.

2. På websiden finnes en illustrerende figur som viser de 4 deltagerne og tutor bak hver sin maskin.

3. Ta fram MATADOR-applikasjonen. Pek på de forskjellige moduler: menyene øverst, 3D-scenen, det grafiske vinduet, log-vinduet der det kommer fram beskjeder underveis, og vinduet nederst til høyre hvor man bl.a. kan få opp bilder. Vis dem også klokken, og at menyene ikke er aktive før tutor har startet klokken.

4. Forklar at man bruker kun mus til å interagere med programmet. Den brukes til å navigere i 3D-scenen, og gjøre menyvalg, samt å velge roller.

5. Forklar deretter den videre gangen i simuleringen:
   o at de kan trene på å navigere, og se på menyene som finnes
   o at de tar på headset og får kontakt med de andre
   o at de deretter velger roller
   o at tutor starter klokken når alle er klar

6. Gjør dem oppmerksom på at det kommer informasjon i log-vinduet underveis. Og at ikke alle nødvendigvis får den samme informasjonen, slik at de må videreformidle dette til gruppen.

7. Forklar dette med avatarer - at alle har en figur som representerer dem selv, og at de ikke kan se sin egen figur. Men de kan se de andre deltagerne.

8. Forklar at tutor er "usynlig", han kan bevege seg overalt i rommet, men har ingen avatar.

9. Gjør dem oppmerksom på knappen "default position", som bringer dem til en fornuftig plassering i rommet. Hvis man har gått seg bort, eller sitter fast et sted så er løsningen å bruke denne knappen.

10. Forklar at ikke alle menyvalgene gir en visuell forandring, men be dem holde øye med log-vinduet der det vil komme repspons. Noen av menyvalgene gjør at menyen blir "låst" (den blir lysegrå og inaktiv). Dette er for å simulere at en deltager er opptatt med noe, f.eks. å intubere pasienten. Når prosedyren er ferdig vil menyene låses opp igjen.

11. Vis deltageren hvordan headset'et virker (mikrofon kan skrues av og på, volum på øretelefonene kan reguleres. Ikke forlat deltageren før han/hun snakker med de andre.

APPENDIX

D. Tutor guide

Til tutor:

1. Tutor bør sitte klar med headset etter hvert som de fire deltagere er ferdige med opplæringen, og tar på sine headset.

2. Headset: pass på at mikrofonen er skrudd på (en liten bryter langs ledningen som kan stilles mellom "on" og "mute"). Det er også mulig å regulere volumet på høyttalerne (øreklokkene).

3. Før deltagerne har valgt rolle er de usynlige. Du vil høre dem, og de vil høre deg, men du vil ikke kunne se dem.

4. Som tutor er du usynlig for de andre under hele simuleringen, dvs. du har ingen visuell representasjon i akuttrommet.

5. Menyene er ikke aktive før simuleringen er startet (pkt. 6). Dette betyr at hvis man aktiverer noen menyvalg, f.eks. "vital signs" så kommer det ingen respons.

6. Når alle har fått på seg headset, kan rollevalget starte. Best å ta en av gangen. Måten de gjør det på er å klikke på en vest med sin midterste knapp. Alle må velge hver sin rolle, det kan ikke være to like rollevalg.

7. Når alle har valgt en rolle, og de er klar, så kan du starte simuleringen. Menyen heter "time control", og "start simulation". Klokken i høyre hjørne vil nå begynne å gå.

8. Bruk menyvalget "default position" hvis du har problemer med å finne fram i rommet.

9. Oppfordre deltagerne til å bruke rollenavn, ikke virkelige navn, når de snakker med hverandre.

10. Tutor bør ikke aktivere andre menyvalg enn "time control". (Tutor's menyer er også aktive).

11. Hvis det er tilrettelagt for "Pause simulation" (spør Simen) så kan den brukes hvis deltagerne får tekniske problemer, må forlate plassen et øyeblikk, e.l.

12. Prøv å posisjonere deg slik at vi ser deltagerne i scenen (for analysen sin del). Bruk gjerne "default position", dette er en fin posisjon for opptakets del. Men ikke føl deg bundet av dette.

Generelle kommentarer om veilederrollen fra Edvin:
Expert / tutor: You have decided to enter the role as an expert. This means that you will supervise the four team members (surgeon, anaesthetist, anaesthesia nurse, emergency nurse) during the simulation. You will be able to hear their conversation, and see their representation as avatars in the virtual environment on the screen. These team members will be able to hear you, but they will not see you. You will be able to see the different activities (movements of avatars, messages on the screen etc). However, only the one participant ordering blood samples / procedures etc will be given feedback in the form as a result. Such information must often be disseminated to the rest of the group- failing to do so is dangerous. This purpose of this simulator is to emphasise this. Therefore, you

should interfere as little as possible in the simulation; if the other participants have technical or other problems you may assist them. However, you should not try to solve the case for them, nor should you initiate any procedures. Please notice that the menus will not be active for the participants before you start the simulator.

APPENDIX

E. Questionnaire 1

Før vi setter i gang med MATADOR-forsøket ber vi deg svare på dette spørreskjemaet. Svarene er svært viktige for at vi skal kunne danne oss et bilde av ditt utgangspunkt og dine forutsetninger. De som er ansvarlige for undersøkelsen er Det medisinske fakultet, Universitetet i Oslo, Telenor FoU, Umeå universitet og Den norske lægeforening. Alle dataene blir behandlet konfidensielt og bare i forbindelse med forskning.

Jeg gir tillatelse til at de innsamlede dataene fra spørreskjemaet og videoopptakene fra MATADOR-simuleringen kan brukes til forskning og vanlig publisering.

Dato:……………… **Navn:……………………………………………** **Alder……….**

1. Hvilken erfaring har du med å bruke IKT i medisinsk sammenheng? Med IKT mener vi anvendelse av data for å lete etter og for å få informasjon, for å kunne kommunisere og samarbeide (sett bare ett kryss).

☐ *Søke etter informasjon i tidsskrifter/databaser på Internett*
☐ *Læreprogrammer på Internett*
☐ *Andre typer elektroniske læreprogrammer?*
☐ *Annen erfaring? Spesifiser: _____*

2. Angi hvordan påstandene nedenfor, som går på ditt engasjement ved bruk av IKT, stemmer for deg:

Marker bare ett siffer (1-5) per påstand.
1) Stemmer ikke i det hele tatt,
2) Stemmer ikke,
3) Hverken eller,
4) Stemmer i høy grad,
5) Stemmer helt

Ambisjon

	1	2	3	4	5
1. Jeg vil gjerne lære mer om IKT	1	2	3	4	5
2. Jeg vil gjerne bli bedre på IKT	1	2	3	4	5
3. Jeg vil gjerne kunne ta i bruk de mulighetene som ligger i IKT	1	2	3	4	5
4. Det er interessant å lære hvordan IKT fungerer	1	2	3	4	5

Enjoying

	1	2	3	4	5
5. Når jeg holder på med IKT har jeg vansker med å slutte	1	2	3	4	5
6. IKT kan berike mitt sosiale liv	1	2	3	4	5
7. Jeg synes IKT er underhollende	1	2	3	4	5
8. Jeg synes IKT er et morsomt leketøy	1	2	3	4	5
9. IKT kan gi meg nye kunnskaper om livet	1	2	3	4	5

Avoidance

	1	2	3	4	5
10. Jeg er redd bruk av IKT skal forandre min identitet	1	2	3	4	5
11. Jeg vil av og til droppe alt med IKT	1	2	3	4	5
12. Jeg funderer over den rollen som IKT spiller i mitt liv	1	2	3	4	5
13. Jeg funderer over hvor mye jeg bruker IKT	1	2	3	4	5
14. Jeg synes IKT truer med å innskrenke mitt liv	1	2	3	4	5

Frustrasjon

15. Når det blir problem med å anvende IKT føler jeg meg dum	1	2	3	4	5
16. Jeg opplever at andre synes jeg er dårlig med IKT	1	2	3	4	5
17. Jeg føler et press på meg for å lære meg IKT	1	2	3	4	5
18. Jeg er utilfreds med mitt mål om å mestre IKT	1	2	3	4	5
19. Når det blir problem med min bruk av IKT blir jeg livredd	1	2	3	4	5

Efficiency

20. Jeg kan organisere ting bedre ved bruk av IKT	1	2	3	4	5
21. Jeg kan være effektivere ved å bruke IKT	1	2	3	4	5
22. Jeg får bedre kontroll over livet gjennom ved å bruke IKT	1	2	3	4	5
23. Jeg kan få gjort flere ting ved å anvende IKT	1	2	3	4	5

3. Hvilken bakgrunn har du? (Sett ett kryss)

Kirurg   Anestesi-lege   Anestesi-sykepleier   Intensiv-sykepleier   Student

Annet:………………………

4. Hvor mange år har du arbeidet i faget ditt?
0
0 - 4
5 - 9
10 –

5. Har du tattt i mot og stabilisert en eller flera multitraumepasienter i løpet av de seneste seks månedene?
    ja   nei

Hvis ja, hvor mange ganger:…………

6. Har du deltatt i simulering eller noe lignende for å lære å ta i mot og stabilisere en eller flere multitraumepasienter?

Hvis ja, hva deltok du i?:…………………………………………………………………

……
…………………………

Hvis ja, hvilken erfaring fikk du? …………………………………………………………………

……
……………………………

Tusen takk for hjelpen!
☺ ☺ ☺ ☺ ☺

APPENDIX

F.   *Questionnaire 2*

Kjære deltaker. For at vi skal kunne lage en så god MATADOR-simulering som mulig, er vi avhengige av dine synspunkter. Vi ber deg derfor besvare dette spørreskjemaet på den måten som i størst mulig grad samsvarer med det du mener. Alle data blir behandlet konfidensielt.

1. Navn:_____

2. Alder:_____

3. Rolle(akuttsykepleier/kirurg/anestesilege/anestesisykepleier):_____
___

SPØRSMÅL OM SAMARBEID, LÆRING FAGLIG INNHOLD, ETC.

Vis hvordan påstandene nedenfor stemmer i forhold til deg. Marker kun ett alternativ.
1) Stemmer slett ikke,
2) Stemmer ikke,
3) Verken eller,
4) Stemmer,
5) Stemmer helt

4. Jeg synes at MATADOR-simuleringen var svært lærerik.

Stemmer slett ikke   Stemmer helt
      1   2   3   4   5

5. Jeg föler at ledelsen var god (ingenting trenger å forbedres)

Stemmer slett ikke   Stemmer helt
      1   2   3   4   5

6. Jeg föler at kommunikasjonen gikk godt

Stemmer slett ikke   Stemmer helt
      1   2   3   4   5

7. Jeg föler at samarbeidet var godt

Stemmer slett ikke   Stemmer helt
      1   2   3   4   5

8. Nå etter MATADOR-simuleringen føler jeg meg helt sikker på hva jeg skal gjøre (hva som er min rolle) i forbindelse med mottak og stabilisering av multitraumepasienter.

Stemmer ikke   Stemmer helt
      1   2   3   4   5

9. Nå etter simuleringen føler jeg meg helt sikker på rekkefølgen av det som skal gjøres i forbindelse med mottak og stabilisering av multitraumepasienter.

Stemmer ikke

| | 1 | 2 | 3 | 4 | Stemmer helt 5 |

| **SPØRSMÅL OM TEKNISKE ASPEKTER** |

10. Jeg føler at dokumentasjonen var god nok.

Stemmer slett ikke

| | 1 | 2 | 3 | 4 | 5 | Stemmer helt |

11. Jeg føler at utstyret var godt nok.

Stemmer slett ikke

| | 1 | 2 | 3 | 4 | 5 | Stemmer helt |

12. I MATADOR-simuleringen brukte dere datamusen til å navigere i det virtuelle miljøet. Hvordan synes du det var å bevege seg rundt i 3D-verdenen helt i begynnelsen?
Markere kun ett alternativ for hver alternativ:

☐ svært vanskelig   ☐ vanskelig ☐ middels   ☐ lett   ☐ meget lett

Kommentar: _____

13. Hvordan var det å bevege seg etter at du var blitt mer vant til det?
☐ svært vanskelig   ☐ vanskelig ☐ middels   ☐ lett   ☐ meget lett

Kommentar: _____

14. Hvordan var det å bruke menyene til å sette i gang prosedyrer?
☐ svært vanskelig   ☐ vanskelig ☐ middels   ☐ lett   ☐ meget lett

Kommentar: _____

15. Var det vanskelig å finne fram i menyene?
☐ svært vanskelig   ☐ vanskelig ☐ middels   ☐ lett   ☐ meget lett

Kommentar: _____

16. Hvordan opplevde du å bruke headset til å snakke med de andre?
☐ svært vanskelig   ☐ vanskelig ☐ middels   ☐ lett   ☐ meget lett
Kommentar: _____

17. Var det vanskelig å velge rolle?
☐ svært vanskelig   ☐ vanskelig ☐ middels   ☐ lett   ☐ meget lett

Kommentar: _____

SPØRSMÅL OM UTFORDRING

Påstandene nedenfor handler om dine følelser, din konsentrasjon, oppmerksomhet, kontroll o.s.v. når du brukte simuleringen. Sett en ring rundt et tallverdi. Markere kun ett alternativ for hver påstand.

Fornøyelse eller glede

18.	Interessant	5	4	3	2	1	Ikke interessant
19.	Morsomt	5	4	3	2	1	Ikke morsomt
20.	Spennende	5	4	3	2	1	Kjedelig
21.	Kult	5	4	3	2	1	Kjipt

Konsentrasjon

22. Absorbert av aktiviteten   5   4   3   2   1   Ikke absorbert av aktiviteten

23. Oppmerksomhet er rettet
 mot aktiviteten   5   4   3   2   1   Ikke oppmerksom mot aktiviteten

Kontroll

24. Vet akkurat hva jeg
skal gjøre   5   4   3   2   1   Føler med forvirret

25. Føler meg rolig   5   4   3   2   1   Føler meg urolig

26. Behersker situasjonen   5   4   3   2   1   Behersker ikke situasjonen

Eksperimentering
27. Eksperimenterer
(med forskjellige
kommandoer)   5   4   3   2   1   Eksperimenterer ikke

28. Prøver nye kommandoer   5   4   3   2   1   Prøver ikke

29. Prøver andre ting   5   4   3   2   1   Prøver ikke

30. Syntes du MATADOR- simuleringen representerte en utfordring?

I høy grad   5   4   3   2   1   I liten grad

SPØRSMÅL OM TILSTEDEVÆRELSE (PRESENCE)

Tilstedeværelse (presence) kan defineres som "følelsen av å befinne seg på en plass eller i et miljö, selv om man fysisk befinner seg et annet sted. Sett en ring rundt tallverdien du synes passer for hver påstand nedenfor:

31. Jeg hadde en følelse av å befinne meg i akuttrommet under simuleringen

Ikke i det hele tatt   1   2   3   4   5   I stor grad

32. Det var situasjoner i løpet av simuleringen hvor akuttrommet var virkelig for meg

Aldri   1   2   3   4   5   Nesten hele tiden

33. Tenker du tilbake på akuttrommet som *bilder* du så eller en *plass* du besøkte

Bilder jeg så   1   2   3   4   5   En plass jeg besøkte

34. Under forsøket, hvilken følelse var sterkest, følelsen av å befinne seg i akuttrommet eller følelsen av å befinne seg et annet sted

Befinne meg et annet sted 1   2   3   4   5   *Befinne meg i akuttrommet*

35. Jeg husker akuttrommet i simuleringen på tilsvarende måte som jeg husker andre steder jeg har vært i dag

Ikke i det hele tatt   1   2   3   4   5   I stor grad

36. På hvilken måte tror du at følelsen av tilstedeværelse i denne simuleringen skulle kunna forbedres?

_____
_

_____
__

_____
_____

37. Hvordan vil du vurdere din egen innsats under simuleringen?

Dårlig   *1*   *2*   *3*   *4*   *5*   *Meget god*

38. Hvordan vil du vurdere de øvrige gruppemedlemmenes innsats under simuleringen?

Dårlig   *1*   *2*   *3*   *4*   *5*   *Meget god*

39 .Hvordan vil du vurdere hele gruppens/teamets innsats under simuleringen?

Dårlig   1   2   3   4   5   Meget god

40. Hvordan vil du vurdere veilederens innsats?

Dårlig   *1*   *2*   *3*   *4*   *5*   *Meget god*

41. Hvordan vil du vurdere verdien av en MATADOR-simuleringen sammenlignet med en arrangert øvelsessituasjon på et akuttmottak?

Dårlig   *1*   *2*   *3*   *4*   *5*   *Meget god*

Kommentarer: _____

42. Hva var mest positivt med selve MATADOR-simuleringen?

Kommentar: _____

_____

43. Hva var mest negativt med selve MATADOR-simuleringen?

Kommentar: _____

_____

44. Ville du anbefalt en MATADOR-simulering til kolleger innenfor ditt felt?
☐ *ja*   ☐ *nei*   ☐ *vet ikke*

Begrunnelse: _____

_____

Tusen takk for hjelpen!
☺ ☺ ☺ ☺ ☺

APPENDIX

G.   *Technical set-up for capturing data from server*

Matador feltforsøk

Skisse oppsett for tekniske tester, 2 april 2002
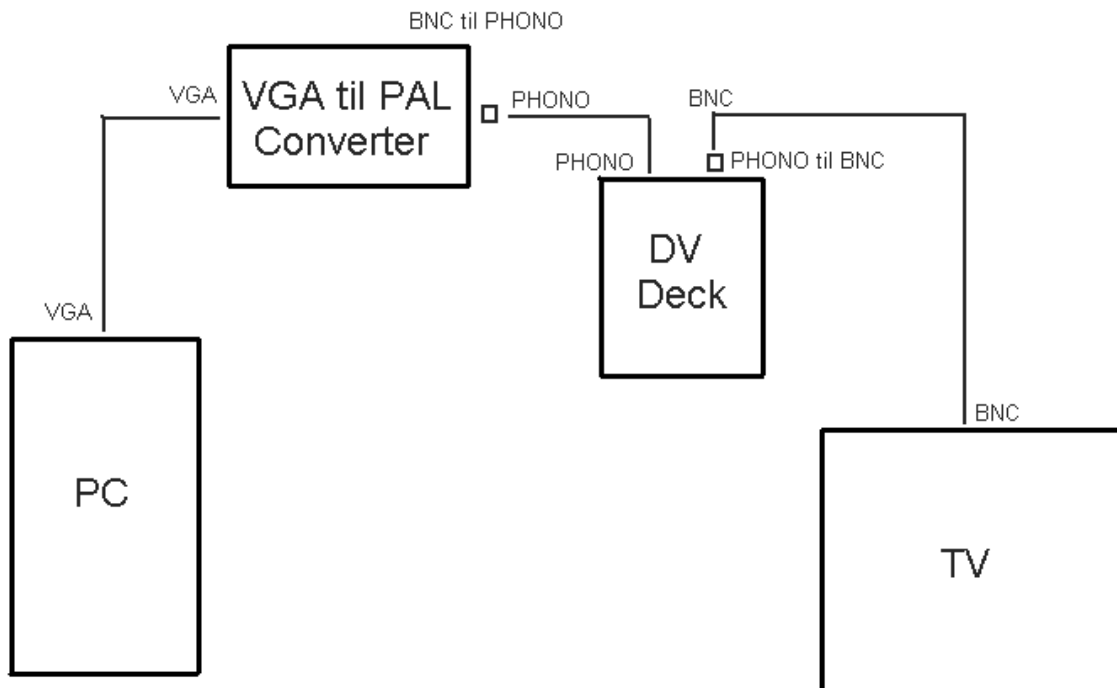
DATAINNSAMLING BILDE:

Kilde: PC m/ oppløsning 1024x 768 pixler, 60 Hz VGA monitor utgang

Liste kabler/overganger:

VGA han til VGA han kabel
Black Box VGA til PAL video converter "Scan Box HQ-II"
BNC til phono overgang
phono han til phono han kabel
DV opptager
phono til BNC han overgang
BNC til BNC kabel
TV med BNC inngang

PC

XLR han — Fostex Høyttaler

Mini Stereo Jack han   Mini Stereo Jack han

Stor Jack

XLR han   Stereo mikser 3 ch   XLR hun

XLR han   XLR hun

XLR han

Phono han   Phono han

DV Deck

Headset

Phono han   Phono han

Mini Stereo Jack han   Mini Stereo Jack hun
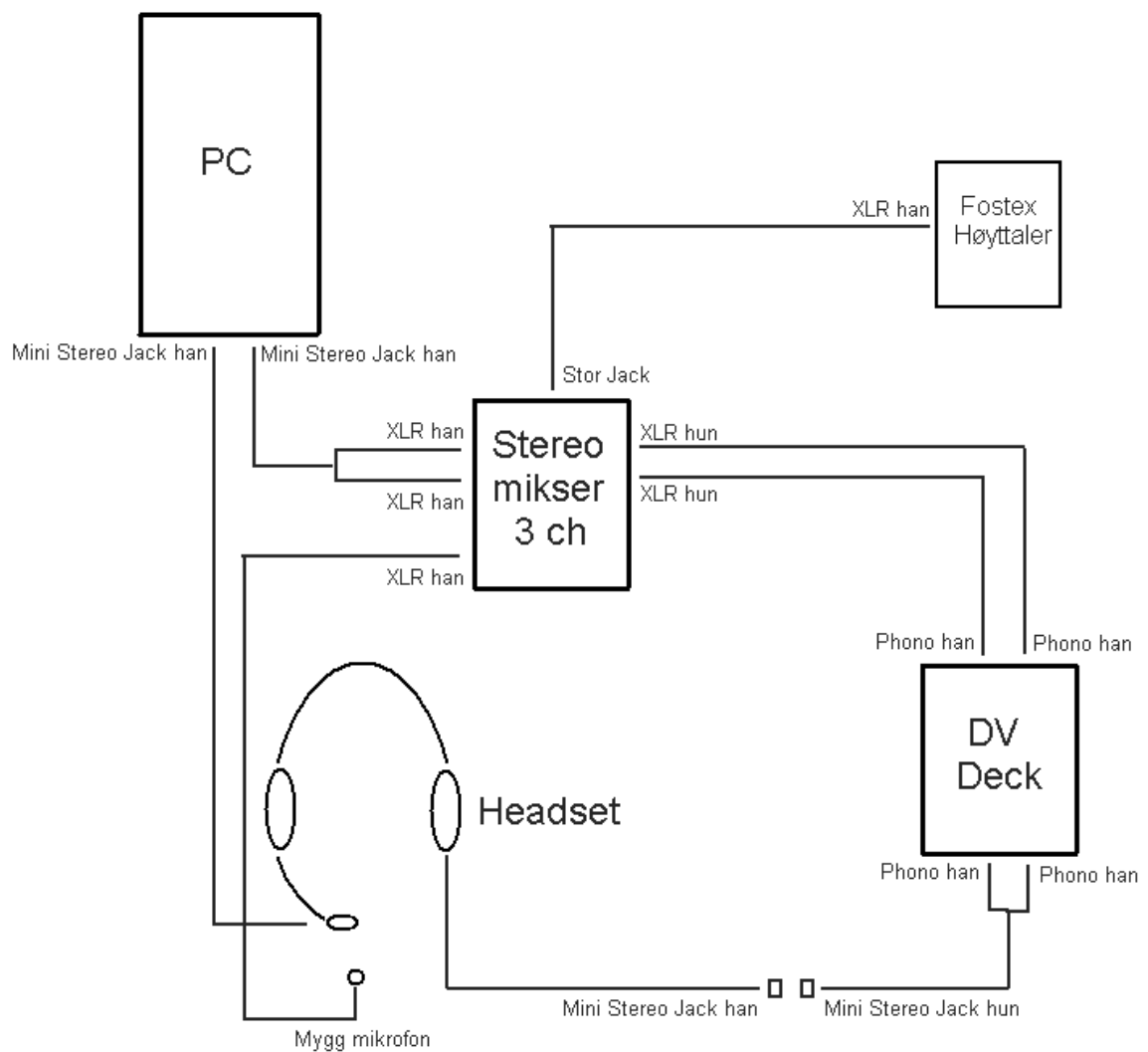
Mygg mikrofon

DATAINNSAMLING LYD:

Kilde: PC analog audio utgang
Retur: headset for PC

mini stereo jack han til 2 x XLR han
XLR hun til phono han
XLR hun til phono han
phono han x 2 til stereo mini jack HUN!!!! (kritisk punkt)
myggmikrofon til XLR han
stereo mikser m 3 ch
DV deck m loop through på lyd
stor stereo jack til XLR han, mot Fostex aktiv høyttaler, evt. kun headset.

26/3 2002   Kari Jeanette Langseth, InterMedia, Universitetet i Oslo

APPENDIX

H.   Excerpts in original and translated language

Excerpt 1

K: Kunne det nå vært på tide å ta en peritonela lavage eller skal man gjøre en laparotomy, mon tro
A: Hvem spør?
K: Kirurgen, ((ler))
A: Det må nesten kirurgen si
K: Jeg har liten erfaring med akkurat det her, for å være helt ærlig
A: Anestesisykepleieren har kanskje noen tips?
AS: Han er ikke helt stabil, og vi har ikke identifisert noen blødningskilde så det er vel bra å gjøre et peritoneal lavage kanskje så får man se om det er i buken
K: da prøver jeg det
KS: det høres fornuftig ut, synes akuttsykepleieren

S: Maybe it is time for a peritoneal lavage at this point, or maybe a laparotomy?
AD: Who is asking?
S: Me, the surgeon ((laughing))
AD: Well, I think YOU will have to decide this
S: Thing is, I have very little experience with these kind of things
AD: Maybe the anaesthetic nurse has any ideas?
AN: He is not stable, and we have not identified any source of bleeding. And so it might be a good idea to do a peritoneal lavage to see if there is anything in the abdomen.
S: Ok, I'll try that
SN: It sounds reasonable to me

Excerpt 2

4:49 A: Anestesilegen vil spørre Tutor: Er han våken og pratbar?
      T: Det må du se på vital signs

4:49 AD: The Anaesthetic doctor wants to ask the Tutor: Is he awake and able to talk?
      T: You'll have to take a look at the vital signs.

Excerpt 3

6:15	KS:	Er det noen som har sjekket bevissthet? Han er bevisstløs ikke sant?
	K:	han er bevisstløs
		[Svenskene forsøker tydligvis å oppklare misforståelsen, men lykkes ikke]

6:15	SN:	Has anyone made a check on consciousness? He IS unconscious, right?
	S:	He is unconscious.
		((The Swedes are making efforts to counter the misunderstanding, but fails))

Excerpt 4

07:28	KS:	er han våken?
07:35	AS:	er det noen nordmenn som hører A?
07:53	K:	Skal vi ta en liten oppsummering?
		Vi har en pasient som er bevisstløs, så vist jeg skjønner
		[ingen protester, A klipper inn og ut grunnet tekniske problemer]
		masse teknisk tullball
	K:	bevisstløs (oppsummerer) status og rtg thorax...
		Har bedt om lavage

07:28	SN:	is he awake?
07:35	AN:	are there any Norwegians that can hear the anaesthetic doctor?
07:53	S:	shall we do a quick summary? We have a patient who is unconscious, as far as I can see.
		((no protests are audible, but the anaesthetic doctor is still 'clipping' in and out on the audio due to technical problems))
	S:	unconscious ((continues to sum status and report on chest x-ray))
		I have asked for a lavage

Excerpt 5

01:05	K:	[oppsummerer info fra amb, tar ca 30 sek] OK. Jeg har pratet med ambulanseføreren. Og det her er altså, pojken har syklat blitt påkjørt av bil. Medvetsløs når amb kom etter 6 min. 10 min senere har han våknet opp, men han er fortsatt bevissthets-senkt. Inga ytre tecken til skader. Foruten noen blåmerker. Han har da fått påbegynt infusjon og det er nå 30 minutter etter ulykken, OK.

01:05	S:	((sums the information gained from the ambulance report, takes about 30 sec)) Ok, I have talked to the ambulance driver, and this is it: The boy was riding a bike and got hit by a car. Unconscious when the ambulance arrived 6 minutes after the accident. 10 minutes later he woke up, but still a bit degraded consciously. No outer signs of injury except some bruises. He has infusion running, and at the present time it is 30 minutes since the accident. OK

Excerpt 6

05:28	AS	Skal vi legge kateter siden han er bevisstløs?
05:34	KS	Får jeg spørre? Er pas bevisst eller ikke?
	K	Nei , pas er bevisstløs
	KS	pga sedering eller?
	K	Nei han er usedert
	KS	Når man tittar på, når jeg klikker den her så står det at pas er bevisst.
	A:	Ja det gjør det
	T	da er han vel det da
	KS	Hva sier A?
	A	Det er normale parametre, og han er medveten
	K:	Jeg leste medvetsløst, men kanskje jeg leste feil
	KS	Om han er bevisst må han få smertestillende

05:28	AN:	Shall we insert the catheter, as he is unconscious?
05:34	SN:	May I ask, is the patient conscious or unconscious?
	S:	No, the patient is unconscious
	SN:	because of sedation or what?
	S:	No, he is not sedated
	SN:	when you click … it says that he is conscious
	AD:	That's right
	T:	Guess that means he is conscious then.
	SN:	What does the anaesthetic doctor have to say?
	AD:	Parameters are normal, and he is conscious
	S:	I read unconscious, but maybe I read wrong
	SN:	In case he is conscious he needs some pain relief

Excerpt 7

K: ((til ukjent)) Leser de samme rapport som meg?
Ukjent: (ja)

K: ((svarer ukjent)) Å, så da leser jeg det til dem.

K: Det er en 12 år gammel pojke som har blitt påkjørt av bil. Han var bevisstløs når ambulansen kom etter 6 min. Etter 10 min
våknet han opp, han var da TRØTT. Han hadde ingen ytre tegn til skader, utenom noen blåmerker og laserasjoner på ben og ansikt. Han
transportert med ambulanse til sykehuset, under transporten fikk han O2 og Ringer 500ml IV. Ambulansen kom til sykehuset 30
minutter etter skaden. Det er 30 min etter skaden just nu.

K: ((snakker høyt om sin interaksjon))Nu høgerklikker jeg på ..nei nå forsvant han. Jeg vil nå ha info fra amb personalen om om om

Ukjent: Det var det.

K: ((til ukjent)) Det var det jeg fikk nå, OK.
K: Det var det som hadde hendt under under under transporten.

S: ((to unknown)) Do they read the same report as me?
Unknown: ((no audible sound, probably shaking head or something..))
S: ((to unknown)) Ok, so I'll read it to them
S: It is a 12-year-old boy who has been run down by a car. He was
            unconscious when the ambulance arrived after 6 minutes. After
            10 minutes he woke up, but was TIRED. He had no signs of injuries
            except some lacerations on leg and face. He was transported to the
            hospital by ambulance, and was given oxygen and Ringer 500 ml IV
            on the way. The ambulance arrived at the hospital 30 minutes after
            the injury. At this time it is 30 minutes since the accident.
S: (speaking to the room): I now click on the right mouse button.. no now
            he disappeared. I would like some info from the ambulance but but ...
Unknown: That was it.
S: That was it right there, OK
S: (to the room) That was what happened during transportation.

Excerpt 8

```
02:25   K: Har dere sett han bevege et ben eller arm? Nei.?

        A: Slik jeg forstår det har han nå egenresp, og puster godt OK BT og
           saturasjon

        K: Han er altså bevisstløs . Og det innebærer en hodeskade. Bevisstløs Vi må
           skaffe en oversikt over nevrologsisk status.

        T:   Tutor fråger, er han bevisstløs? Se på vital signs.
        K: ..unless sedated...
        KS   jeg får ikke inn IV nål
        K  Hva menes med det?
        T  det menes som i det virkelige liv tar det mer enn 3 sek

3:38
        K: Ok, han nu level of c er at han er medveten.
        T:      Han er conscious ja, men han sløj
        K:      Han er sløj , just det..da har vi inte indikasjon før intubasjon just nu, utan
                jeg vill ha kontroll over luftvegen.
```

```
02:25   S:      Have you seen him move a leg or an arm? No?
        AD:     As far as I can see he breaths spontaneously, and well. OK blood
                pressure and saturation
        S:      He is in other words unconscious.. And that may indicate a brain injury..
                unconscious .. then we need to check his neurological status.
        T:      Tutor asks, is he unconscious? Take a look at vital signs
        S:      unless sedated.., what is that supposed to mean?

03:38   S:      level of consciousness now says that he is conscious
        T:      Yes he is conscious, but he is drowsy
        S:      He is drowsy, alright.. Then there is no indication for intubation
                At this moment, but I would like to have control over the airways
```

Excerpt 9

```
A:    Da intuberer vi.
K:      Ja, da gjør vi det, da intuberer vi
A:    Vi må vel nesten legge ham i anestesi, i og med at han er våken
AS:     Ja, jeg har medisinene klare
A:      Ja, han er såpass...

11:15  K: Vent! Narkos .. akut.. Narkoselege,  Hva har han for GCS, hva er hans
            nevrologiske funksjon? Har du sett ham røre på noe ben?
A:    Jeg har ikke sett ham røre seg i det hele tatt, og skulle akkurat til å spørre
          Johan, altså tutor om det samme. Jeg ville jo i den situasjonen ..
T:    Han rør seg.
A:    Han rører seg, ja
K:    Han beveger alle sine ben?
T:    Ja
T:      Men han er sløj, han er altså conscious men sløj
A:    Ja riktig
K:    Ja just det han er minst en RLS 2, med andre ord
T:    Ja
K:    Ok, Og han beveger alle sine ben
```

```
AD:    Let's intubate
S:      Yes let's do it. Let's intubate
AD:    Here we go, but the first thing we will have to do is to administer
          anaesthesia, as the patient is awake.
AN:    Yes, I have the drugs all ready to go
11:15  S:    Wait! What is his Glasgow coma score? How is his neurological
          function? Have you seen him move any legs?
AD:    I haven't seen him move at all, and was about to ask Johan, the tutor,
          about this. I would normally…
T:    He moves
AD:    So he moves
S:    Does he move all his legs?
T:    Yes
T:    But he is drowsy, conscious but drowsy
AD:    yes, all right
S:    Yes, I see, he is a RLS 2 in other words?
T:    Yes
S:    Ok, and he is moving all legs
```

APPENDIX

I. Transcripts

Gruppe 4, simulering, versjon 1

Tapetider	Start	Slutt
Blir kjent	1:41:10	1:43:10
Simuleringen	1:43:11	2:04:05

Sim startes etter 2:24 på tape.
Veldig varierende volum, og lydtekniske problemer med A i store deler av
simuleringen.

00:10	K:	Alle går til default posisjoner
00:50	K:	(Oppsummerer) leser status på pas: gutt i trafikkulykke, puls, bt,sao2.egenresp
01:15	A:	rr er 20
	K:	gjenta rr
	A:	rr er 20
01:30	K:	få inn IV
01:55	KS:	skal jeg? ..få inn venflon?
	K:	ja det har jeg bedt om
02:18	A:	har vi fått inn venflon?
02:30	AS:	Ja, jeg har satt inn og det fungerer
	A:	Sett 1000 ringer
03:04	AS:	lettere sagt enn gjort
	T:	Dere kan bare sette 1 nål..
03:20	KS:	Faller i trykk, (leser opp trykket)
03:36	A:	(oppsummerer) bevisst.. ja, hud...normal, kapillærfylning...bra
04:00	AS:	Nål inne, væske igang
04:28	K:	Skal vi ta rtg. ? (velger selv rtg)
4:49	A	Anestesilegen vil spørre Tutor: Er han våken og pratbar?
	T:	Det må du se på vital signs
05:13	A:	kan vi lytte på lungene?
	T:	du hører resplyd på begge sider
	A:	gjør det vondt
	T:	det må du finne ut selv
	A:	finner ikke ut hvordan
	T:	gjør du ikke?
06:00	AS:	HB er 110
6:15	KS:	Er det noen som har sjekket bevissthet? Han er bevisstløs ikke sant?
	K:	han er bevisstløs [Svenskene forsøker tydligvis å oppklare misforståelsen, men lykkes ikke]
	KS	Er pupiller lukket?
	T:	Ingen mulighet for i programmet, men Pupiller er egale
7:05	AS:	Du forsvinner A, (Svært vanskeig å høre A)
07:28	KS:	er han våken?
07:35	AS:	er det noen nordmenn som hører A?
07:53	K:	Skal vi ta en liten oppsummering?

Vi har en pasient som er bevisstløs, så vist jeg skjønner
[ingen protester, A klipper inn og ut grunnet tekniske problemer]
[masse teknisk tullball]
K: bevisstløs (oppsummerer) status og rtg thorax...
       Har bedt om lavage
       [Lydtull]
K: Har fått svar på
KS: Da må han intuberes i så fall
A: Hører dere meg?
KS: intubér
A: Må iallefall gi anestesi, (jeg) gjør det
K,KS   Bra
12:08   "Pas. is stable" [fortsatt uten anestesi..]
14:00   [Simuleringen avsluttes av tutor
               tutor gir litt veiledning etter simuleringen]
               teamet fortsetter med bla pelvic og femur xray og Ctskalle og Foley

store lydproblemer
komm ikke bra
kirurg for rask med prosedyrer, manglende koordinering

Transcript, Team 4, versjon2

```
K:   OK,((kremter)) da har vi en gutt som er utsatt i
     trafikkulykke, kan det stemme? Han har puls på 120. BT på
     140 over 50 god saturasjon. Han er pustende selv.
A:   Han andas med en andingsfrekvens på () andetak pr minut
K:   Hvor mye?
A:   20 andetak pr minut
K:   20 åndetak pr minutt, ja.
K:   Skal vi få inn IV kanyler?
KS:  Skal jeg legge inn de[ A:vet vi noe]t
A:   mer om pas fra ambulanserapporten?
K:   Vi har ikke noe mer enn det som står på (.) oppslaget
A:   ((prøver å si noe))
T:   Ambulanse [det haster vel med å få lagt inn venefloner, gjør
     det ikke?]
K:   Jo, veneflon har jeg bedt om skal legges inn
T:   Simen ((spør teknisk boss som er i rommet)), den meldingen der
     note that the ambulance guy osv Får alle den? Den står for
     alle den, ikke sant? Ja
A:   Har vi fått inn en venflon
KS:  Jeg vet ikke åssen vi gjør det
A:   'Petra'!
AS:  Ja, altså jeg..
T:   Hvis du skal ha inn en venflon
AS:  Ja jeg har satt inn en nål og den fungerer.
A:   Ja, just det. Har vi satt noe drypp der då?
AS:  aeeh, alstå jeg setter inn, nei jeg holder på.. jeg kommer
     ikke inn.
T:   Nei det skal ta  litt tid. Da er du sperret for andre
     aktiviteter medan du gjør det. Det er en del av spillet
A:   Men sett en 1000 RInger aCetat på den , 'Petra'
AS:  Ja, det er lettere sagt enn gjort, men jeg holder på kan jeg
     si.
T:   dere kan bare sette en nål
KS:  han faller i trykk
A:   men frekv har også gått ned
A:   Han er fortsatt våken? ((svarer seg selv))Ja han er våken
A:   ser han ut i huden? normal hud
AS:  Nå har jeg fått inn en nål, og litt væske
AS:  Nål er satt , den fungerer og jeg har satt 1 ltr RingerAcetat
K:   Skal vi ta en rtg bilde?
A:   Ja
A:   Kan man () kan man prate med pasienten?
T:   Du må se på vital signs
A:   Jeg vil lytte på lungene
AS:  Nå tar jeg litt blodprøver
A:   Gjør det vondt då?
T:   Om det gjør ondt? Det får dere undersøke det vil ikke jeg
     svare på
A:   Hur gjør jeg det?
T:   Da må du gå på . feks prosedyrer, procedures og se om det gjør
     ondt det.. Thats a procedure.
AS:  Jeg har tatt HB det er 110
KS:  Er det noen som har sjekka bevisstheten?
KS:  Han er bevisstløs, ikke sant?
K:   Han er bevisstløs
AS:  hmm
```

```
KS:  Og pupillene er lukket?
T:   Dataprogrammet tillater ikke at
KS:  Det står ikke noe om pupiller på
T:   Tutor snakker. Pupillene kan dere ikke undersøke, men vi sier
     at de er egale, og at de reagerer på lys.
A:   OK
A:   OK, da som anestesiolog fortelle hva jeg har funnet. En pas
     som andas selv han ((klipper))
AS:  DU forsvinner, 'Anne'
AS:  'Anne', vi hører deg ikke
A:   Han er pratbar, våken
KS:  Er han våken?
A:   Er det ingen som hører meg?
AS:  'Anne' er borte for oss.
K:   Skal vi ta en liten oppsummering i første omgang. Vi har en
     pasient som er bevisstløs, så vidt jeg skjønner.
A:   ((klipper)) våken ((forsøker å rette opp Ks misoppfatning))
K:   Teamleder, kirurg som snakker igjen. Vetikke om vi har A med
     oss. Men vi har hvertfall pas som har egale pupiller rtg torax
     er normalt, hb11 blosgass er fin vi har fått opp infusjon jeg
     har bedt om en lavage. Skal vi se om det kan være noe i buken.
     Han er tachycard, han har BT på 115 over 55. God metning. rtg
     thorax viser costa frakturer på hø side.
A:   Hører dere meg nå da, det er A
KS:  JAja, NÅ hører vi deg veldig bra
A:   HÆRLIG
A:   Jeg har hørt dere hele tiden, nå har vi fått k's
     sammenfatning, nå tar vi min.
A:   pas puster selv, er våken, har norm pupiller, ((klipper
     igjen))
KS:  jeg hører bare bruddstykker
K:   pas har blod i buken etter lavage, og vi må gå over til videre
     laparotomi.
K:   Jeg har startet operasjonen på pas
KS:  Da må han intuberes
A:   ja, da må han intuberes, hører dere?
A:   hører dere?
KS:  A må intubere
A:   Ja, jeg gjør det nå da
A:   Da sover jeg på pento
K:   det er bra
AS:  jeg har satt en Ringer acetat til
K:   Da må vi bestille blod
KS:  Jeg kan bestille blod
T:   Dataprogrammet, er laget slik at blod..((forklarer at blod
     ikke trengs å bestilles i motsentning til real-life))
K:   Det er blødning fra ruptur i lever, så nå er starte å stoppe
     denne bøldningen
KS:  Vi må vel gi noe kolloider?
A:   Skulle vi tatt ny HB?
AS:  Jeg har tatt, fortsatt 110
A:   Se om jeg kan tube
A:   jeg forsøker å sove pas. snart skal jeg tube
AS:  hva var lavage
K:   blod i buken, fant .. som nå er stabilisert
T:   hør etter: her er bug i programmet, laparotomi før tubing er
     over, laparotomi er urealistisk snabb, uvanlig. ((ferdig))
```

Gruppe 5, simulering

Tapetider	Start	Slutt
Blir kjent	2:04:05	2:07:00
Simuleringen	2:07:05	2:26:50

Tutor råder teamet til å kvittere for mottatte beskjeder

00:45	K:	hallo! (roper etter ambmannen). Jeg skulle hatt tak i ambulanseføreren
00:50	A:	Fin metning og trykk, litt rask i frekvens (leser fra skjermen)
01:05	K	OK. Jeg har pratet med ambulanseføreren. Og det her er altså, pojken har syklat blitt påkjørt av bil. Medvetsløs når amb kom etter 6 min. 10 min senere har han våknet opp, men han er fortsatt bevissthets-senkt. Inga ytre tecken til skader. Foruten noen blåmerker. Han har da fått påbegynt infusjon og det er nå 30 minutter etter ulykken, OK
01:43	AS	skal jeg henge opp drypp?
	K:	ja, han har en 500 som går
	AS:	den ser jeg ikke
	K:	Og han har en bra, men hvor mange nåler har han?
01:53	A	Han har 2 innganger nå? (vanskelig å høre)
	A:	Men hvordan er GCS?
02:00	T	Når det gjelder IV det er bar en nål dere kan ha, men det er ikke i dataprogrammet enda ar vi kan legge inn flere nåler
02:12	K	Ja (bekreftende)
	AS:	han er tachycard og trykk faller litt fortsatt 117/57
02:19	A:	Kan jeg gjøre stetoskopi av lunger?
	T	Programmet har ikke lagt inn stetoskopi av lunger. Du kan si at du gjør det, og så skal jeg si hva du finner
	K:	Jaeg vil lytte
02:30	T:	På høyre side hører du Normal pustelyd
	A:	hva med v side? Er det ingen pustelyd der?
	T:	v side hører du normal pustelyd, men det går ikke så snabbt. Vi måste ta lite tid med det
02:42	T	Sånn, nå har du forvisset deg at det er pustelyd på begge sider
02:49	AS	'Camilla'?
	K	Ja...
	AS	Han har HB110
	K	Ja
02:50	K	Har du tatt noe annet? Har vi blodgass på ham?
	KS:	Nei, men Na/K er 4. Eh Kalium 4 och natrium 140
	K	OK, bra
03:05	KS	Vil du ha blodgass?
	K	Nei vi kan avvente med det
03:07	K	Han er ganske stabil Så jeg (tenker) røntgen av lunger og bekken og CT av skallen
03:22	KS	117 i BT just nu
	K:	Ja
	KS:	var det det det var da?
	AS	Nei, det var høyere da han kom inn

	K	Det var høyere, OK
3:34	AS	Klarer ikke legge venflon
03:35	T:	(avbryter teamet) Nålen er falt ut
05:15	K:	Pas er bevisstløs
05:28	AS	Skal vi legge kateter siden han er bevisstløs?
05:34	KS	Får jeg spørre? Er pas bevisst eller ikke?
	K	Nei , pas er bevisstløs
	KS	pga sedering eller?
	K	Nei han er usedert
	KS	Når man tittar på, når jeg klikker den her så står det at pas er bevisst.
	A:	Ja det gjør det
	T	da er han vel det da
	KS	Hva sier A?
	A	Det er normale parametre, og han er medveten
	K:	Jeg leste medvetsløst, men kanskje jeg leste feil
	KS	Om han er bevisst må han få smertestillende
6:31	K:	rapport fra palpasjon, foreslår straks laparatomi
	A:	lyder fornuftig
	K:	men først lungerøntgen + bekken
07:35	A:	(oppsummerer men blir avbrutt)
08:30	A:	han blør, det taler for operasjon
09:00	K:	leser res av ...Leverskade?
		CT eller operasjon? (bestemmer seg for operasjon)
		(Bestiller også røntgen nakke/rygg)
09:50	K:	Er anestesi fornøyd?
	A:	Nesten, men hva med nakken?
11:10	K:	Jeg vil dra ham på op
	KS:	hvorfor har dere ikke anestesi?
	AS:	Vi har startet
12:05		Vi går på op
12:20		((Anestesi startes))
15:00		pas er fortsatt bevisst.. (alle ler)
16:40		pas reddet
		hb er 0, men pas er like frisk ((alle ler))

Gruppe 6, simulering

Tapetider	Start	Slutt
Blir kjent	2:27:00	2:35:00
Simuleringen	2:35:00	3:07:57

Simulering starter etter 11:30 på tape.
Reddet etter 32 min simulering

	K:	Rolleavklaring
	K:	Rapport er bra
	AS:	Mitt ansvar er luftveier/med/væske
	KS:	Setter grov IV, tar prøver, stopper blødning, klipper klær, holder varm
	K:	Leder inne på salen. Vil vite alt av teamet, og skal forsøke å gi diagnose. Teamet er klart
00:33		((Døren åpnes og pas kommer inn))
	K:	((til ukjent)) Leser de samme rapport som meg?
	Ukjent:	(())
	K:	((svarer ukjent)) Å, så da leser jeg det til dem.
	K:	Det er en 12 år gammel pojke som har blitt påkjørt av bil. Han var bevisstløs når ambulansen kom etter 6 min. Etter 10 min våknet han opp, han var da TRØTT. Han hadde ingen tegn til skader, utenom noen laserasjoner på ben og ansikt. Han transportert med ambulanse til sykehuset, under transporten fikk han O2 og Ringer 500ml IV. Ambulansen kom til sykehuset 30 minutter etter skaden. Det er 30 min etter skaden just nu.
	K:	((snakker høyt om sin interaksjon))Nu høgerklikker jeg på ..nei nå forsvant han. Jeg vil nå ha info fra amb personalen om om om
	Ukjent:	Det var det.
	K:	((til ukjent)) Det var det jeg fikk nå, OK.
	K:	Det var det som hadde hendt under transporten.
02:00	K:	A/AS ta kontroll over luftveiene
	KS:	Jeg forsøker å sette IV
02:25	K:	Har dere sett han bevege et ben eller arm? Nei.?
	A:	Slik jeg forstår det har han nå egenresp, og puster godt OK BT og saturasjon
	K:	Han er altså bevisstløs . Og det innebærer en hodeskade. Bevisstløs Vi må skaffe en oversikt over nevrologsisk status.
	T:	Tutor fråger, er han bevisstløs? Se på vital signs.
	K:	..unless sedated...
	KS	jeg får ikke inn IV nål
	K	Hva menes med det?
3:38		
	T	det menes som i det virkelige liv tar det mer enn 3 sek

	K:	Ok, han nu level of c er at han er medveten.
	T:	Han er conscious ja, men han sløj
	K:	Han er sløj , just det..da har vi inte indikasjon før intubasjon just nu, utan jeg vill ha kontroll over luftvegen.
	A:	Ja
	K:	Hva heter det, narkoslege og narkossyster eh tar kontroll over luftvegen och setter på nakkekrage det har han ikke heller
	T:	Datorprogrammet har ingen halskrage, gå videre..
	K:	Han skal ha syrgas med reservoar, och As skal monitorerer saturasjon, Jag vill at hon skal sette en nål.
	KS:	Det går ikke å få inn en nål
	K:	Da gjør vi ett forsøk til så tar vi frem den intraossøse nålen
04:30	K:	En nål til
4:45	A:	Han må ha hatt en nål
	T:	Den har ramlet ut
05:00	K:	Oppsummerer
	AS:	Får mer drypp
6:00	A:	Lett tachycard
	K:	ikke mere væske, ned med dråpetakt
6:19	KS:	HB 110
06:34	K:	litt lavt, kan ha blødning
	K:	Fortsetter US -luftvei OK?
7:07	A:	Ja
	K:	Forsøker å se nærmere på pas: - ser blåmerker
7:50	T:	gå nærmere (oppfordrer kirurgen)
	K:	Han har blåmerker, ber KS om å sjekke v.side
	KS:	rtg?
	K:	god ide
	KS.	Blå på venstre side også
	K:	Vil ha rtg chest
9:35	KS:	leser svar på rtg ..vanskelig å se
	K:	ser på rtg bilde
10:31	K:	Kan ha indre blødning
10:37	AS:	Anestesilege?
	A:	Anestesilegen er her ja
	AS:	Vi får vel gjøre klar til intubasjon, hvis vi skal gjøre mere nå?
	A:	Ja, den er vel klar til? Så jeg er helt enig i det.
	T:	Det er korrekt, det er klar til. Så når dere trykker på det så blir det gjort
11:00	K:	Ok, anestesilege, synes du det er på tide å intubere nå?
	A:	Ja, du skal vel legge et thoraxdren vil jeg tro?
	K:	Thoraxdren....... skal jeg legge inn
	A:	Da intuberer vi.
	K:	Ja, da gjør vi det, da intuberer vi
	A:	Vi må vel nesten legge ham i anestesi, i og med at han er våken
	AS:	Ja, jeg har medisinene klare
	A:	Ja, han er såpass...
11:15	K:	Vent! Narkos .. akut.. Narkoselege, Hva har han for GCS, hva er hans nevrologiske funksjon? Har du sett ham røre på noe ben?
	A:	Jeg har ikke sett ham røre seg i det hele tatt, og skulle akkurat til å

		spørre Johan, altså tutor om det samme. Jeg ville jo i den situasjonen ..
	T:	Han rør seg.
	A:	Han rører seg, ja
	K:	Han beveger alle sine ben?
	T:	Ja
	T:	Men han er sløj, han er altså conscious men sløj
	A:	Ja riktig
	K:	Ja just det han er minst en RLS 2, med andre ord
	T:	Ja
	K:	Ok, Og han beveger alle sine ben
	A:	Han har vært lett tachycard, men eller stabil etter han kom inn. Så jeg tror vi velger å innlede med vanlig anestesi, altså Fentanyl, Thiopenthone, Succinylcholine. Da velger jeg det, og så intuberer vi
	KS:	Legger på et varmt teppe, ettersom han er veldig kald.
	K:	Jeg takker for det.
12:30	K:	Venter på intubasjon skal bli ferdig
13:12	K:	Gjør klar for thoraxden på hø
	KS:	OK
	AS:	Kanskje mer væske?
	A:	Ja, sjekker
	AS:	Kateter?
	A:	Ja, og ventrikkelsonde
	K:	Ferdig med intubasjon?
	A:	Ja vi er det, pas er stabil
	AS:	Kateter er startet
15:28	KS;	Klar med thoraxdren
16:00	A:	Ferdig med intubasjon
16:35	K:	(oppsummerer)
	K:	Jobber med Thoraxdren
	AS:	A?
	A:	Ja
	AS:	Vil du legge inn arteriekran?
	A:	Ja, men jeg leter etter mulighet
	K:	Nei, det får dere ikke gjøre. Det lar dere være.. Jeg vil ikke arteriekateter på akuttrommet.
	A:	javel
	AS:	beskjed mottatt
18:25	K:	Når vi er ferdig gjør vi secondary survey
18:55	K:	Forbered CT av skallen
19:12	AS	Blodgass? (spør A direkte)
	A:	Ja
19:43	K:	Thoraxdren lagt, hø
	A:	Stiger i frekvens synker i trykk
20:35	K	Ser på hodet, starter sec survey, går gjennom det hele med tutor
23:00	A:	Stiger i frekvens/synker i trykk
	AS:	HB er 9
24:35	K:	palperer abdomen
25:20	K:	leser palp res

	K:	(fortsetter sec survey)
	AS	Blod er opphengt (til A)
26:00	K:	Oppsummerer, bestemmer seg for lavage, stabil gåt til CT, ustabil til OP.
	K:	KS forbered til OP
	K:	Sjekk om klart til laparotomy
	A:	Klart
29:51	K:	Da starter vi
32:00		((Ferdig))

APPENDIX

J. Log files

Team 4, log file

00:00:00	NONE	applikasjonen
00:00:01	ANESTESISYKEPLEIER	Default Position
00:00:02	KIRURG	Default Position
00:00:04	ANESTESISYKEPLEIER	Default Position
00:00:09	SYKEPLEIER	Default Position
00:00:09	ANESTESISYKEPLEIER	Default Position
00:00:15	ANESTESILEGE	Default Position
00:00:47	ANESTESILEGE	vital signs, level of consciousness
00:01:13	ANESTESILEGE	vital signs, respirationrate
00:01:23	ANESTESILEGE	vital signs, level of consciousness
00:01:35	KIRURG	Intravenous cannula
00:03:05	ANESTESISYKEPLEIER	Default Position
00:03:11	KIRURG	arm
00:03:35	ANESTESILEGE	vital signs, level of consciousness
00:03:37	KIRURG	arm
00:03:41	ANESTESILEGE	vital signs, skincolour
00:03:45	ANESTESILEGE	vital signs, peripheral temperature
00:03:48	ANESTESILEGE	vital signs, capillary refill
00:04:05	ANESTESISYKEPLEIER	Ringer 1000 ml
00:04:28	KIRURG	Chest x-ray
00:04:50	KIRURG	Default Position
00:05:13	KIRURG	full size
00:05:17	KIRURG	full size
00:05:19	ANESTESISYKEPLEIER	HB
00:05:22	ANESTESISYKEPLEIER	Leukocytes
00:05:25	ANESTESISYKEPLEIER	HB
00:05:30	KIRURG	rapport-knapp
00:06:22	KIRURG	vital signs, level of consciousness
00:06:37	KIRURG	vital signs, skincolour
00:06:41	KIRURG	vital signs, capillary refill
00:06:52	KIRURG	HB
00:06:56	KIRURG	Leukocytes
00:06:59	KIRURG	Arterial blood gas
00:07:14	KIRURG	Peritoneal lavage
00:09:02	ANESTESISYKEPLEIER	Electrolytes
00:09:13	ANESTESISYKEPLEIER	Leukocytes
00:09:59	KIRURG	Laparatomy
00:10:35	ANESTESILEGE	General anaesthesia, Fentanyl/Thiopentone/Succinylcholine
00:10:37	ANESTESISYKEPLEIER	Ringer 1000 ml
00:11:15	ANESTESISYKEPLEIER	HB
00:11:27	SYKEPLEIER	HB
00:11:41	SYKEPLEIER	Colloid, 500 ml
00:11:47	ANESTESISYKEPLEIER	Colloid, 500 ml
00:13:51	SYKEPLEIER	Default Position
00:14:05	ANESTESILEGE	Intubation

00:14:40	ANESTESISYKEPLEIER	Foley catheter
00:14:58	KIRURG	Default Position
00:15:05	KIRURG	Pelvic x-ray
00:15:51	KIRURG	rapport-knapp
00:16:00	KIRURG	full size
00:16:25	ANESTESISYKEPLEIER	vital signs, peripheral temperature
00:16:33	ANESTESISYKEPLEIER	vital signs, skincolour
00:16:40	ANESTESISYKEPLEIER	vital signs, peripheral temperature
00:17:09	KIRURG	Head CT
00:18:01	ANESTESISYKEPLEIER	Default Position
00:18:17	ANESTESISYKEPLEIER	Default Position
00:18:30	ANESTESILEGE	Arterial blood gas
00:18:53	ANESTESISYKEPLEIER	HB
00:19:48	ANESTESISYKEPLEIER	Arterial blood gas
00:20:00	KIRURG	Femur x-ray
00:20:31	ANESTESISYKEPLEIER	vital signs, peripheral temperature
00:20:35	KIRURG	Default Position
00:20:44	KIRURG	rapport-knapp
00:20:46	KIRURG	full size
00:24:17	ANESTESISYKEPLEIER	HB
00:24:20	ANESTESISYKEPLEIER	Leukocytes
00:24:23	ANESTESISYKEPLEIER	Platelets
00:24:27	ANESTESISYKEPLEIER	Electrolytes
00:24:31	ANESTESISYKEPLEIER	Arterial blood gas
00:24:45	ANESTESISYKEPLEIER	vital signs, level of consciousness
00:24:49	ANESTESISYKEPLEIER	vital signs, respirationrate
00:24:54	ANESTESISYKEPLEIER	vital signs, capillary refill
00:28:55	ANESTESILEGE	Arterial blood gas
00:29:04	ANESTESILEGE	HB
00:29:10	ANESTESILEGE	Platelets
00:29:15	ANESTESILEGE	Electrolytes
00:29:23	ANESTESILEGE	vital signs, peripheral temperature
00:29:27	ANESTESILEGE	vital signs, skincolour
00:29:31	ANESTESILEGE	vital signs, capillary refill
00:29:36	ANESTESILEGE	vital signs, respirationrate
00:30:02	ANESTESILEGE	Palpation
00:30:19	ANESTESILEGE	Default Position
00:37:28	ANESTESISYKEPLEIER	Default Position
00:39:35	KIRURG	Default Position
00:42:53	ANESTESISYKEPLEIER	Default Position
00:44:31	ANESTESISYKEPLEIER	Arterial blood gas
00:45:16	ANESTESISYKEPLEIER	vital signs, peripheral temperature
00:48:35	ANESTESISYKEPLEIER	Thoraic drainage
00:59:22	KIRURG	Neck x-ray

Team 5, log file

00:00:00	NONE	applikasjonen
00:00:17	ANESTESISYKEPLEIER	Default Position
00:00:28	ANESTESISYKEPLEIER	Default Position
00:00:32	ANESTESISYKEPLEIER	Default Position
00:00:39	ANESTESILEGE	Default Position
00:00:45	KIRURG	ambulansemannen
00:01:21	ANESTESILEGE	vital signs, level of consciousness
00:01:26	ANESTESILEGE	vital signs, respirationrate
00:01:33	KIRURG	Default Position
00:01:45	SYKEPLEIER	Default Position
00:01:59	ANESTESISYKEPLEIER	Intravenous cannula
00:02:24	KIRURG	vital signs, level of consciousness
00:02:29	KIRURG	vital signs, level of consciousness
00:02:33	KIRURG	vital signs, respirationrate
00:02:33	SYKEPLEIER	HB
00:02:49	SYKEPLEIER	Electrolytes
00:02:50	ANESTESILEGE	HB
00:02:57	ANESTESILEGE	Arterial blood gas
00:03:04	ANESTESILEGE	Electrolytes
00:03:37	ANESTESILEGE	vital signs, level of consciousness
00:03:44	ANESTESILEGE	vital signs, respirationrate
00:03:46	ANESTESILEGE	vital signs, skincolour
00:03:48	ANESTESILEGE	vital signs, peripheral temperature
00:03:51	ANESTESILEGE	vital signs, capillary refill
00:03:57	ANESTESISYKEPLEIER	arm
00:03:57	KIRURG	vital signs, skincolour
00:04:01	KIRURG	vital signs, peripheral temperature
00:04:03	KIRURG	vital signs, capillary refill
00:04:13	SYKEPLEIER	vital signs, skincolour
00:04:21	SYKEPLEIER	vital signs, peripheral temperature
00:05:07	SYKEPLEIER	vital signs, skincolour
00:05:10	ANESTESISYKEPLEIER	vital signs, skincolour
00:05:11	SYKEPLEIER	vital signs, capillary refill
00:05:16	SYKEPLEIER	vital signs, level of consciousness
00:05:24	KIRURG	Palpation
00:05:57	ANESTESISYKEPLEIER	vital signs, level of consciousness
00:06:48	KIRURG	Pelvic x-ray
00:07:00	ANESTESISYKEPLEIER	vital signs, capillary refill
00:07:45	KIRURG	rapport-knapp
00:08:02	KIRURG	Chest x-ray
00:08:13	ANESTESISYKEPLEIER	NaCl transfusion 1000 ml
00:08:13	SYKEPLEIER	HB
00:08:34	ANESTESISYKEPLEIER	vital signs, respirationrate
00:08:36	SYKEPLEIER	Ringer 1000 ml
00:08:47	ANESTESISYKEPLEIER	vital signs, level of consciousness

00:08:48	ANESTESILEGE	vital signs, level of consciousness
00:08:51	ANESTESILEGE	vital signs, capillary refill
00:08:52	ANESTESISYKEPLEIER	vital signs, peripheral temperature
00:08:53	ANESTESILEGE	vital signs, peripheral temperature
00:08:54	KIRURG	rapport-knapp
00:08:55	ANESTESILEGE	vital signs, skincolour
00:08:57	ANESTESILEGE	vital signs, respirationrate
00:09:22	ANESTESILEGE	HB
00:09:24	ANESTESILEGE	Platelets
00:09:32	ANESTESILEGE	Electrolytes
00:09:57	ANESTESISYKEPLEIER	vital signs, respirationrate
00:10:01	ANESTESISYKEPLEIER	vital signs, capillary refill
00:10:11	ANESTESISYKEPLEIER	vital signs, level of consciousness
00:10:20	KIRURG	Neck x-ray
00:10:56	ANESTESILEGE	vital signs, level of consciousness
00:10:59	ANESTESILEGE	vital signs, respirationrate
00:11:01	ANESTESILEGE	vital signs, skincolour
00:11:05	ANESTESILEGE	vital signs, peripheral temperature
00:11:06	SYKEPLEIER	HB
00:11:17	ANESTESISYKEPLEIER	vital signs, skincolour
00:11:17	SYKEPLEIER	vital signs, respirationrate
00:11:24	SYKEPLEIER	vital signs, skincolour
00:11:51	ANESTESISYKEPLEIER	vital signs, respirationrate
00:11:52	KIRURG	rapport-knapp
00:11:53	SYKEPLEIER	vital signs, skincolour
00:11:58	ANESTESISYKEPLEIER	vital signs, peripheral temperature
00:11:59	KIRURG	Laparatomy
00:12:10	ANESTESILEGE	Default Position
00:12:19	ANESTESILEGE	Default Position
00:12:35	ANESTESISYKEPLEIER	General anaesthesia, Fentanyl/Thiopentone/Succinylcholine
00:13:39	SYKEPLEIER	HB
00:13:44	SYKEPLEIER	HB
00:14:25	ANESTESILEGE	vital signs, level of consciousness
00:14:30	ANESTESILEGE	vital signs, respirationrate
00:14:32	ANESTESILEGE	vital signs, skincolour
00:14:34	ANESTESILEGE	vital signs, peripheral temperature
00:14:37	ANESTESILEGE	vital signs, capillary refill
00:14:41	ANESTESISYKEPLEIER	Intubation
00:14:45	SYKEPLEIER	vital signs, level of consciousness
00:14:58	SYKEPLEIER	vital signs, respirationrate
00:15:09	KIRURG	vital signs, respirationrate
00:15:12	KIRURG	vital signs, level of consciousness
00:15:13	SYKEPLEIER	vital signs, level of consciousness
00:15:24	ANESTESILEGE	vital signs, level of consciousness
00:15:24	ANESTESISYKEPLEIER	vital signs, level of consciousness
00:15:32	ANESTESISYKEPLEIER	vital signs, respirationrate
00:15:41	ANESTESISYKEPLEIER	vital signs, capillary refill

00:15:47	ANESTESISYKEPLEIER	vital signs, skincolour
00:15:53	ANESTESISYKEPLEIER	vital signs, capillary refill
00:16:04	ANESTESILEGE	Peritoneal lavage
00:16:31	SYKEPLEIER	HB
00:16:34	KIRURG	HB
00:16:35	ANESTESILEGE	Default Position
00:16:36	ANESTESISYKEPLEIER	HB
00:16:38	ANESTESILEGE	Default Position
00:16:42	ANESTESISYKEPLEIER	Leukocytes
00:16:43	ANESTESILEGE	Default Position
00:16:44	ANESTESILEGE	Default Position
00:16:46	ANESTESISYKEPLEIER	Arterial blood gas
00:16:52	SYKEPLEIER	vital signs, skincolour
00:18:20	KIRURG	Default Position
00:19:10	ANESTESISYKEPLEIER	Default Position
00:19:17	ANESTESISYKEPLEIER	Default Position
00:19:42	ANESTESISYKEPLEIER	vital signs, respirationrate
00:19:45	ANESTESISYKEPLEIER	vital signs, peripheral temperature
00:19:49	ANESTESISYKEPLEIER	vital signs, capillary refill
00:19:55	ANESTESISYKEPLEIER	vital signs, respirationrate
00:20:00	ANESTESISYKEPLEIER	vital signs, peripheral temperature
00:20:13	ANESTESISYKEPLEIER	vital signs, capillary refill
00:20:40	ANESTESISYKEPLEIER	vital signs, level of consciousness
00:20:45	ANESTESISYKEPLEIER	vital signs, skincolour
00:22:30	KIRURG	Abdomen CT
00:23:08	KIRURG	Default Position
00:23:16	KIRURG	Chest x-ray
00:23:24	KIRURG	rapport-knapp
00:35:43	SYKEPLEIER	Foley catheter
00:43:33	SYKEPLEIER	vital signs, skincolour
00:43:41	SYKEPLEIER	vital signs, capillary refill
00:43:45	SYKEPLEIER	vital signs, peripheral temperature

Team 6, log file

00:00:00	NONE	startet	applikasjonen
00:00:22	ANESTESISYKEPLEIER	valgte	Default Position
00:00:37	ANESTESILEGE	valgte	Default Position
00:00:38	KIRURG	klikket	ambulansemannen
00:02:01	SYKEPLEIER	valgte	Intravenous cannula
00:02:19	ANESTESISYKEPLEIER	valgte	Default Position
00:02:46	KIRURG	valgte	vital signs, level of consciousness
00:03:10	ANESTESISYKEPLEIER	valgte	Default Position
00:04:17	SYKEPLEIER	klikket	arm
00:05:14	KIRURG	valgte	vital signs, skincolour
00:05:20	KIRURG	valgte	vital signs, respirationrate
00:05:20	SYKEPLEIER	valgte	HB
00:05:24	KIRURG	valgte	vital signs, capillary refill
00:05:27	ANESTESISYKEPLEIER	valgte	Ringer 1000 ml
00:06:01	ANESTESISYKEPLEIER	valgte	Ringer 1000 ml
00:06:34	SYKEPLEIER	valgte	Electrolytes
00:07:00	ANESTESISYKEPLEIER	valgte	Default Position
00:07:26	SYKEPLEIER	valgte	vital signs, respirationrate
00:07:34	SYKEPLEIER	valgte	vital signs, skincolour
00:08:16	ANESTESISYKEPLEIER	valgte	Default Position
00:08:38	ANESTESISYKEPLEIER	valgte	HB
00:09:00	KIRURG	valgte	Chest x-ray
00:09:02	SYKEPLEIER	valgte	Chest x-ray
00:09:20	SYKEPLEIER	klikket	rapport-knapp
00:09:21	ANESTESISYKEPLEIER	valgte	Default Position
00:09:24	ANESTESISYKEPLEIER	valgte	Default Position
00:09:47	KIRURG	klikket	full size
00:10:28	KIRURG	klikket	rapport-knapp
00:11:30	SYKEPLEIER	valgte	vital signs, respirationrate
00:11:33	SYKEPLEIER	valgte	vital signs, skincolour
00:11:38	SYKEPLEIER	valgte	vital signs, peripheral temperature
00:11:42	SYKEPLEIER	valgte	vital signs, capillary refill
00:11:58	KIRURG	klikket	full size
00:12:00	ANESTESISYKEPLEIER	valgte	General anaesthesia, Fentanyl/Thiopentone/Succinylcholine
00:12:02	ANESTESILEGE	valgte	General anaesthesia, Fentanyl/Thiopentone/Succinylcholine
00:12:30	ANESTESISYKEPLEIER	valgte	Default Position
00:13:01	ANESTESISYKEPLEIER	valgte	Default Position
00:13:57	ANESTESISYKEPLEIER	valgte	Default Position
00:14:33	ANESTESISYKEPLEIER	valgte	Foley catheter
00:15:14	ANESTESILEGE	valgte	Intubation
00:15:46	ANESTESISYKEPLEIER	valgte	Default Position
00:16:24	KIRURG	valgte	Thoraic drainage
00:18:06	SYKEPLEIER	valgte	vital signs, level of consciousness
00:18:12	SYKEPLEIER	valgte	vital signs, respirationrate
00:18:16	SYKEPLEIER	valgte	vital signs, skincolour

00:19:21	ANESTESISYKEPLEIER	valgte	Arterial blood gas
00:19:27	ANESTESISYKEPLEIER	valgte	Default Position
00:19:38	ANESTESISYKEPLEIER	valgte	Arterial blood gas
00:19:44	ANESTESISYKEPLEIER	valgte	Default Position
00:23:45	SYKEPLEIER	valgte	HB
00:24:09	ANESTESISYKEPLEIER	valgte	HB
00:24:23	KIRURG	valgte	Palpation
00:24:58	ANESTESISYKEPLEIER	valgte	Platelets
00:25:08	SYKEPLEIER	valgte	Blood transfusion 1 unit
00:25:34	ANESTESISYKEPLEIER	valgte	Blood transfusion 1 unit
00:26:38	KIRURG	valgte	Peritoneal lavage
00:27:03	SYKEPLEIER	valgte	vital signs, respirationrate
00:27:18	SYKEPLEIER	valgte	Blood transfusion, 2 units
00:27:41	ANESTESISYKEPLEIER	valgte	Blood transfusion, 2 units
00:28:27	SYKEPLEIER	valgte	vital signs, peripheral temperature
00:29:51	KIRURG	valgte	Laparatomy
00:31:56	SYKEPLEIER	valgte	HB
00:32:03	ANESTESISYKEPLEIER	valgte	HB
00:32:07	ANESTESISYKEPLEIER	valgte	Arterial blood gas
00:49:40	SYKEPLEIER	valgte	Thoracotomy

APPENDIX

K. *Cultural acknowledgements*

Cultural acknowledgements:

The rationale for describing the tools used in the project:

1. It is easy and fun
2. It might have historical value (i.e fun)
3. It follows the concept of cultural artefacts and evolution in practice, by acknowledging the 'external cognition' the tools have provided.

Software:

OS: MS Windows XP Professional version 2002

The document:

MS Word 2000 for thesis dissertation (9.0.2720)
References by: EndNote 4.0.1
PDF's by: ps2pdf locally or http://ps2pdf.com
Images by: IrfanView 3.75, Paint 5.1, Paint Shop Pro 7.0, and
Smart Draw 6.11
Translation: Clue v3.3
Dictionary: www.dictionary.com; Merriam-Webster (http://m-w.com/)

The log-files

Compiled with: MS Excel 2000
Analysed, and graphed with: SPSS 11.0

The VHS tape

Transcripts of video: pen by Norflis and paper by Studia
Audio capture from VHS to mp3 by: SoundCapture v1.0
Audio transcripts with: Transana v1.20

Hardware:

Mainboard: MSI Micro-ATX MS-6378 with video card and LAN
Processor: AMD Duron 1.2 GHz
Memory: 256 MB SDRAM
Hard disk: Western Digital 80 GB
Monitor: ADI Microscan 5AP
Keyboard: Mitsumi
Mouse: Microsoft Port Compatible 2.1A

Website technology:
Citeseer   (http://citeseer.nj.nec.com/cs)
BIBSYS   (http://bibsys.no)
Google   (http://google.com)