University of Stavanger

Faculty of Science and Technology

MASTER'S THESIS

Study program/ Specialization: Societal Safety	Spring semester, 20..13 (Open) / Restricted access
Writer: Camilla Gjerde Ove	Camilla Gjerde Ove (Writer's signature)
Faculty supervisor: Ove Njå External supervisor(s): Morten Wenstad	
Title of thesis: Learning from training with the use of technical tools	
Credits (ECTS): 30	
Key words: Crisis Management Learning From training Technical solutions	Pages: 70 + enclosure: 4 Stavanger, 14.06.13 Date/year

Front page for master thesis
Faculty of Science and Technology
Decision made by the Dean October 30th 2009

Master's Thesis

Learning from training with the use of technical tools

A thesis within Societal Safety, by Camilla Gjerde Ove

14.06.2013

Summary

This is a study of learning from training with the use of technical tools. This paper is written as part of the BRIDGE project. The aim of the BRIDGE project is to develop technical and organisational solutions that can improve crisis and emergency management in the EU member states. The BRIDGE project consists of several Concept Cases. The focus in this thesis has been on a Concept Case called Training. A Norwegian company called Crisis Training AS (CTAS) is responsible for the Concept Case Training. CTAS have created a training solution called FRITS which consist of three technological tools for use during training. Two of the tools in this package have been studied, AKKA and MeTracker. The purpose of the thesis was to examine why training solutions assisted by technical tools increase the learning potential from training for personnel within the professional emergency network. And the conditions that need to be in place to achieve learning effects from training activities. Learning is not something that easily can be measured, it was therefore necessary to find some indicators for learning. Content, commitment and context was chosen as indicators. The content says something about what is learned. The commitment says something about how the learning happens and the context describes the conditions which make it possible to learn. In order to study the effects technical tools, for use during training, have on learning, two main sources was chosen; the military at Rena and the BRIDGE project. Links can be drawn from the technology at Rena to AKKA, one of the tools in FRITS. Both the technological solutions at Rena and AKKA offer opportunities to collect and store large amounts of data from exercises. This can be used further for learning purposes. It was found that the technology can influence the content of what is learned through detailed planning, collection of data from exercises and storing of data from previous exercises. The technology can also influence the other indicators for the individuals learning through activities surrounding the use of technology, for instance through preparation meetings, discussions and involvement in activities. The technology can increase the learning potential, but other conditions must also be in place. This is conditions the technology can facilitate, but the technology alone cannot provide the conditions. Focus on the individuals learning and allowing for involvement and contextual features in combination with the technology can provide good conditions for learning from training for the emergency response personnel.

Preface

This thesis marks the end of my master study within Societal Safety. I was included in the comprehensive research project, BRIDGE. Writing this thesis has been an exciting process. I have been in contact with many resourceful people and gotten insight in the innovative world of research. I have attended several meetings and conferences, travelled to Austria and within Norway.

I am grateful for being included in the project, not many get to spend their time planning exercises, viewing innovative technology and meeting resourceful people from all over Europe while writing their thesis. Writing this thesis has also been demanding, gaining insights in the complex world of research and understanding all aspects of the BRIDGE project has been challenging. One of the products studied in this thesis was still under development this have also been a challenge.

I would like to thank everyone who has contributed in this thesis. A special thanks to Morten Wenstad and Jan Erik Holen from Crisis Training AS for including me in their work, providing me with information regarding their products and for providing me with valuable feedback on the paper. I would also like to thank my faculty supervisor Ove Njå for providing me with academic support, and helpful comments. By encouraging me and asking critical me questions he has made me reflect on important aspects during the process of writing this thesis.

And last I would like to thank Magnus, my husband for providing me with useful feedback and support.

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1. Introduction

1.1 Background

On a regular basis society gets hit by a crisis, hurricane Sandy is an example off this. How the government handles the crisis; before, during and after the hurricane will have an impact on the consequences. Crisis management is extremely important because it influences the immediate as well as the long term effects of a social system (Rosenthal, Boin, & Comfort, 2001). Many lives were probably saved during Sandy, because the government, among other things, warned people in advance and arranged for evacuation.

Preparedness training has been recognized as an important tool in the preparation of a crisis, in most industrialised countries training is mandated by legislation and executive rules. Training for handling crisis has therefore become a natural part of most institutions in the society. It is an opportunity to test the preparedness plan and the exercise participants get the ability to practice in a controlled environment, so that they are capable to act in a better way if something unexpected should happen. Although training is fairly common, the focus is usually on the training activity itself; the planning of an exercise, necessary tools and effects, in addition to testing the skills of the participants. Learning is often something that is taken for granted. It is therefore interesting to study the learning effect training can have. How can we learn from training? What conditions needs to be in place to increase the possibility of learning?

All sorts of equipment has been developed to support the learning outcome of an exercise, for instance dummies for medical training, weapons for shooting practice, simulations for flight training and so on. These are all tools that are made to improve participant's individual skills. Tools for organising and controlling a training scenario are also under development in the BRIDGE project. It is assumed that these types of tools will have a positive effect on learning from training activities.

1.2 Objectives

To ensure that learning happens during training new methods might be needed. One way of doing this can be to adopt new technology to support all the phases when designing a training solution another way might be to use technology to gather observations during exercises. These are examples of technological solutions that are under development in the BRIDGE Project[1]. The purpose of the thesis is to examine technical tools and solutions that are created for use during training and study

[1] The BRIDGE Project is a research project which seeks to develop technical and organisational solutions that can improve crisis and emergency management within the European Union.

why these tools can influence the learning potential. Based on this the following main problem has been developed:

Why can training solutions supported by technical tools increase the learning potential from training for personnel within the professional emergency network? What conditions must be in place to achieve learning effects from training activities?

In order to answer the problem formulated above it is necessary to define learning and find a way learning can be measured. In addition it will be necessary to use theory on how training should be conducted to achieve the best learning results. It will also be necessary to study the technical solutions in BRIDGE and the effects they have or can have.

1.3 BRIDGE/CTAS

1.3.1 The BRIDGE Project

This thesis is written as a part of the research project BRIDGE. The aim of the project is to increase the safety of citizens by developing technical and organisational solutions that can improve crisis and emergency management in the EU member states. One of the main focus areas in the project is on how cooperation among different agencies and organisations can be made more effective.

This is a large project which consists of different cross disciplinary academics, technology researchers and developers, domain experts and end-user representatives. The companies involved are from different European countries, and meetings are held on a regular basis. Actors from Norway are SINTEF, Crisis Training AS and RAKOS (BRIDGE, 2012).

An important collaborating partner in this thesis is Crisis Training AS (CTAS) which develops optimal learning and training methodology supported by technical tools for use during training (CTAS, 2012). This company is involved in the BRIDGE project through the development of training solutions.

Another collaborating partner is RAKOS (Regional Centre for Emergency Medical Research and Development). RAKOS is a centre of competence at the Stavanger University Hospital. They are working for better coordination and collaboration between the community health system, with the General Physicians, the A&E departments at the hospitals and the ambulance services (including cars, helicopters and boats). RAKOS is also involved in the BRIDGE project, with an end-user perspective of the tools.

The figure underneath illustrate the extent of the BRIDGE project. The project consists of several Concept Cases which are under development. Through the project, several tools for use under

emergencies will be developed in addition to training solutions. There is a wide spectre of tools which are being developed in the project, for instance a Master table, an electronic Triage tool, a rescue application and a training methodology tool. The Concepts Cases are presented at different demonstrations, a total number of four demonstrations will be held during the time of the project, two demonstrations have already been carried out. The first one was held in September 2012. The purpose of this demonstration was to see how fire-fighters could include some of the BRIDGE concepts in their work under realistic conditions. The second demonstration (demo 2) was held in April 2013, this was a demonstration of the bridge concepts which allowed for feedback from a selection of end-users. At the demonstration a situation of a large scale emergency was presented and the focus was on visualisation and interaction. The third demonstration will be held in September 2013 and is a full-scale exercise which focuses upon multi-agencies collaboration. Demo 2 and demo 3 will have the same scenario, which is a terrorist attack with shooting and explosions in Risavika harbour, in Sola. The fourth demonstration is a large-scale emergency scenario involving a chemical disaster at a virtual facility called "ExploChemco"; this will be an integrated exercise which will present the final result of the BRIDGE project.

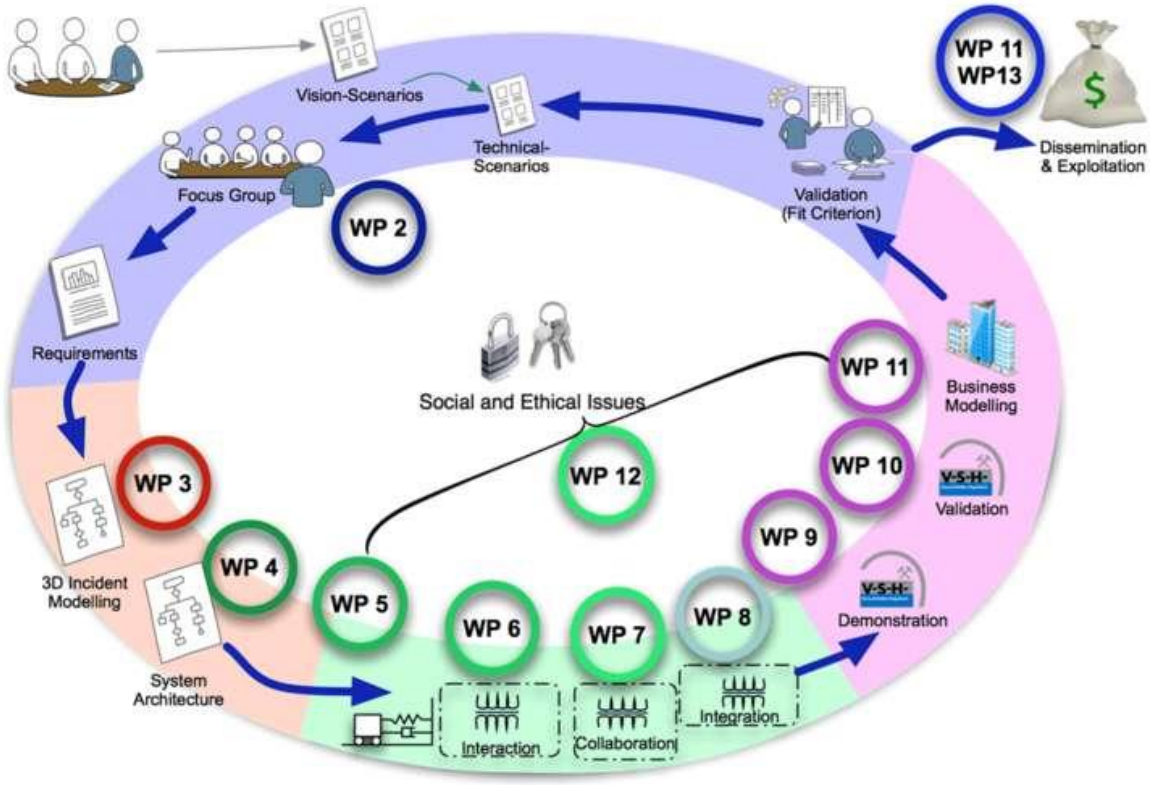

Figure 1: The extent of the BRIDGE project (Illustration: BRIDGE)

1.3.2 Concept Case Training

There are several concept cases within the BRIDGE project. The Concept Case Training is in focus in this thesis. This solution has gotten the name FRITS which stand for First Responders Integrated Training System. CTAS is responsible for this concept case. FRITS consists of several tools, were the final version of FRITS will function as a tool-box allowing for scenario-based training in a fully controlled environment. The purpose of FRITS is to develop learning and training methodology which is supported by integrated sub-systems to improve the quality of emergency response and crisis management between agencies and at different levels of authority. Tools in FRITS can be used on different types of training this include; live-training[2], virtual training [3]and constructive training[4].

CTAS has developed a learning and training process which functions as the basis of FRITS. The process consists of five phases necessary when designing a training solution; Analyse, Plan, Execute, Evaluate and Lessons learned. See figure 2. Information regarding the phases in the learning and training process is based upon information provided by CTAS.

The following example will be used to elaborate the phases in the learning and training model. Interaction and communication amongst the emergency services have gotten a lot of attention in Norway since the terrorist attack on the 22nd of July 2011. This can be a starting point for planning an exercise. In this example one assumes that it has been decided that the emergency service are going to train on an emergency scenario. A committee of planners has been formed with representatives from the medical emergency services, the police force, the fire department, the civil defence and volunteer organisations. They are responsible for planning this exercise based on the overall goal to train on interaction and communication.

[2] Live-training is training conducted in real time in the field where participants use real equipment and do their tasks like they would in a normal situation

[3] Virtual training is way of training which involves real people operating in a virtually simulated environment. Games can be an example of this.

[4] Constructive Training is a form of virtual training which allows for simulated people to operate in a simulated environment. Real people provide inputs to the scenario, but are not involved in deciding the outcome. This enables staff to perform their operational tasks in an unconstrained exercise environment.

Figure 2: CTAS Learning and Training Methodology (CTAS)

With this as a starting point one should begin the initial analysis. The first thing the planners should review is relevant emergency plans. The different departments most likely have different plans these should be considered and important aspects of the plans can be selected for testing during the exercise. Further the planners should gather and discuss experiences from their day by day work and previous exercises. The intent while using tools in FRITS is that these experiences already have been collected and are ready to be retrieved when planning new exercises. The different departments can therefor retrieve documentation from previous exercises and use this as basis for further discussions. By doing this one can ensure that important learning points are considered when planning this exercise. After this the planners should conduct a training need analysis. The purpose of this point is to reveal necessary training areas. In this process the exercise participants skills and abilities should be considered as well as other areas were improvement is needed. Based on the steps above the planners should be able to form training objectives. At this point a distinction should be made; is the purpose to learn something or test the process. Based on this distinction different procedures should be followed. If the purpose of the exercise is to learn something the exercise participants should be involved in a greater extent than if the purpose is to test plans and procedures. In this example it was decided that the purpose of the exercise was to learn something. This means that the exercise participants should be involved. Information letters to the exercise participants should be formulated and arrangements for preparing activities should be considered. The objectives of the exercise can

for instance be to improve communication procedures and interactions amongst the different agencies, to request assistance from the civil defence and to make contact with a nearby municipality. These objectives can be broken down into smaller elements and questions for use during the exercise. Once the objectives are formulated and agreed upon the planners should consider the need for supporting elements. It can be necessary with specific equipment or assistance from other agencies. This can for instance be necessary emergency vehicles, evacuation support by the civil defence, different props, like dummies and vehicles in addition to markers and observers. The purpose of this point is to clarify the need for resources on an early stage and consider the cost attached to involving certain resources in the exercise. In the analysing phase it is also necessary to define the process for evaluation. The planners need to consider the evaluation process in the analysing phase because then the conditions necessary for the evaluation can be planned for. For instance if detailed information regarding certain areas during the exercise is necessary then one can ensure that these areas are properly documented by placing cameras and assigning observers to this areas.

The next phase is *planning*, in this phase the planners should consider the exercise at a more detailed level. First one should define a training scenario on the basis of what was discovered in the analysing phase. In this case the scenario must fit with the goals of all the involved agencies. A relevant scenario can be an explosion in the city centre with an unknown origin. This scenario will require communication and interaction amongst the agencies and create uncertainties since they do not know if the explosion was a result of a criminal act or an accident. An explosion in the city centre will also lead to mass causalities which facilitates the involvement of the civil defence. At this point the planners should also determine type of exercise, virtual, constructive or live, or a combination of them. In this example it was decided that a live exercise should be conducted. After these elements have been agreed upon an execution plan should be formulated. This plan should describe what happens, where and when. The next activity in the planning phase is securing resources, at this point the planners know what kind of resources they will require during the exercise. It is therefore important to make arrangements with observers, markers, exercise participants and agencies. This scenario will require multiple markers and observers. To increase their performance during the exercise it will be necessary to arrange for preparing activities. Making arrangements early in the process can ensure enough resources and allow for preparation. Based on the results from the training need analysis preparing activities for the exercise participants may also be necessary. For better communication amongst the agencies it might be necessary to discuss communication procedures before the exercise. This allows for preparation and involvement which can improve the participants' performance during the exercise.

The next phase is *Execute*, in this phase the training scenario will be played out. Before the exercise can be played out it will be necessary to establish the training area. At this point equipment will be placed at the scene this can for instance be a damaged car, markers, a fire source and elements which represents a broken building. In addition it can be necessary to place recording equipment and ensure that there is a wireless internet connection at the scene. It can also be necessary to assign observers to specific areas. After the area is established the exercise is initiated on the basis of the execution plan and the scenario is played out. Materials for use during the evaluation phase will be collected during the exercise using different methods depending on type of exercise and defined evaluation process. After the exercise is completed the area needs to be cleared, equipment need to be removed and markers needs to be transferred.

After the exercise has been completed and the area has been cleared the *evaluation* phase begins. At this point data collected from the exercise should be sorted and analysed. There might be gaps in the data foundation or uncertainties that needs to be clarified this can be done with the observers assistance. After this initial analysis one should evaluate the data against training objectives. How was the performance of the exercise participants in relation to the objectives for the exercise? This provides the foundation for the evaluation where one discuss both positive and negative findings from the exercise. The evaluation process will vary depending on type of exercise and type of goals established for the exercise. In this example an evaluation meeting was held after the exercise where results from the exercise were presented. Different processes are required depending on if the goals are related to one specific agency or if they are related to cooperation amongst agencies. Since this was an exercise where interaction was important all the agencies was gathered and the goals of the exercise was discussed against the results provided by the observers. The final step in this phase is certification. This is an optional activity which could be used after individuals have completed the exercise as a part of a larger training program. The emergency workers might be required to attend a certain amount of exercises during a year. Certifications might be necessary to prove attendance during the exercise.

The last phase in this model is *lessons learned*. The purpose of this phase is to transfer experiences from the exercise to the organisation, for instance changes in daily operation or changes in plans. The results from the example might suggest that the performance of the exercise participants was good, but not in accordance to the plans. This can point to weaknesses in the plan and facilitate changes in them.

This learning and training process function as the basis for the training solution FRITS. To ensure that training is conducted in a proper way technical tools have been developed. FRITS is a package

consisting of three tools; MeTracker, AKKA and a virtual training tool. The first two phases Analyse and Plan can be conducted using the MeTracker program. The planners in the example above could use MeTracker to guide them through the phases and documentation as basis for decision making in the two phases can be implemented in the program. The Executing and Evaluation phase can be conducted using AKKA. AKKA can be used to gather information in the form of written text, pictures and video recordings. This can be used further in the evaluation phase where the results are presented to the exercise participants. Lessons learned are supported by both MeTracker and AKKA. Results from AKKA can be processed and implemented in MeTracker for further storing. The virtual training tool supports this package by offering virtual training solutions. Currently CTAS is testing a virtual training tool called VBS2. The three tools will be elaborated in the following.

MeTracker is short for Methodology Tracker and is a program that CTAS is developing. The program is called MeTracker because it gives the user information about their progress in their step by step planning, execution and evaluation of an exercise. MeTracker tracks the training process by using the five phases of learning and training methodology; analyse, plan, execute, evaluate and lessons learned. After one phase has been completed the progress will be visible for all the planners. When using the program the planners will know how much work is left. The MeTracker program will be the focal point of interaction throughout the entire process to collect and store relevant information in one database. The program is used as a planning and management tool by guiding the user through the different phases. The end- product after completing the two first phases is documentation for the execution of the exercise. This includes among others, training objectives, a description of the scenario, information relevant to managing the exercise and information about the exercise participants. Relevant information can be implemented in AKKA. During the exercise observations are gathered using AKKA. The observations can then automatically be generated to a report supporting the evaluation process. Experiences and feedback collected with AKKA can further be stored in MeTracker. Gradually a large foundation of experiences from a number of previous exercises can be built up. This also includes data implemented from the first phases, as well as training objectives. Relevant data from earlier exercises can then be gathered and used as input when designing a new exercise. This can simplify the process of designing a training scenario since data implemented in previous exercises may be relevant for new exercises. The program allows for different templates to be generated, for instance an information letter with exercises goals to the participants or a standardised evaluation report. In the example above could an information letter be generated to the participants using the templates in MeTracker, since the purpose of the exercise was to learn. The structure of MeTracker can be seen in the figure below.

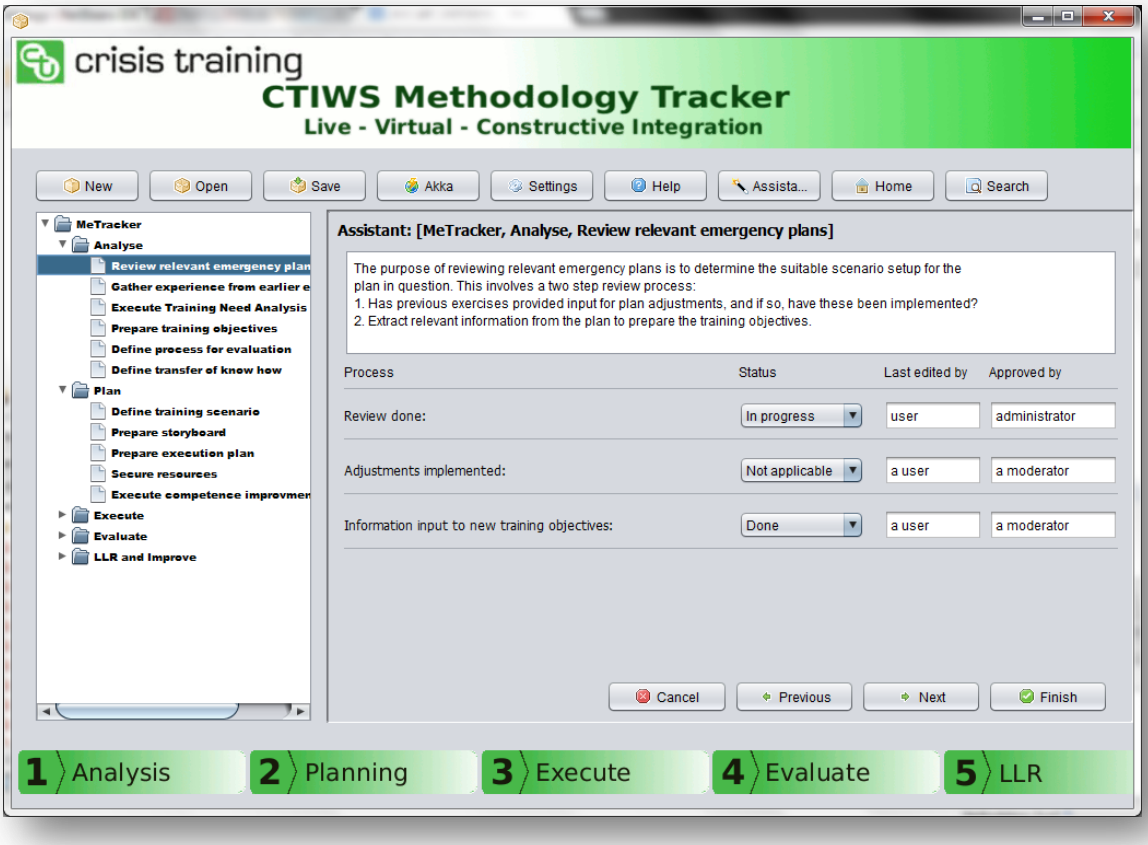

Figure 3: Structure of MeTracker (Illustration: CTAS)

AKKA is a tool mostly used in live-training, the tool allows for distributed observation and analysis in real time. AKKA is a tool which can gather and handle large amounts of information. The AKKA solution consists of a web portal where the objectives for a specific task, for instance an exercise are defined. The tools contribution to the FRITS solution is as mentioned above in the Execution and Evaluation phase. Based on the objectives created through the process in MeTracker reporting templates consisting of observation questions are created and uploaded to the web- portal. This web-portal will automatically synchronise with connecting Pad's (android clients). Observers and instructors access the observation questions through their Pad by logging in with a unique ID linked to their specific role during the exercise. Observers in the example above could use AKKA to register their observations during the exercise. In addition to the observations questions other documentation may also be uploaded in the web-portal, for instance plans and procedures. This can be used by the observers to check procedures and provide feedback on the behaviour of the exercise participants. Everything uploaded in the web-portal is available on the Pad. AKKA has a fairly standard layout with common icons like save and refresh. Writing the observations in the program is

fairly easy, questions are answered with simple Yes/No check boxes, and boxes for written observations and comments are available below. It is also possible to include a photo in the observation by taking a picture with the Pad. The structure of AKKA is illustrated below. Typically observers will carry a Pad and use the Pad to register observations, take pictures, video recordings and write comments. These recordings are sent directly to the web portal, this allows for viewing and analysing of data in real time. The personnel in the field can also receive information through the web portal this can contribute to situational awareness. The collection process is automatic since observations are registered electronically. Processing the data can be done during the exercise and right after. Usually one will be able to process the data in an hour. This allows for data to be presented during the evaluation meeting right after the exercise. Both positive and negative feedback are registered, which allows for thorough feedback (Saab, 2013). By implementing experiences from AKKA in MeTracker one can ensure that data is taken into consideration when planning new exercises. AKKA was created by Saab.

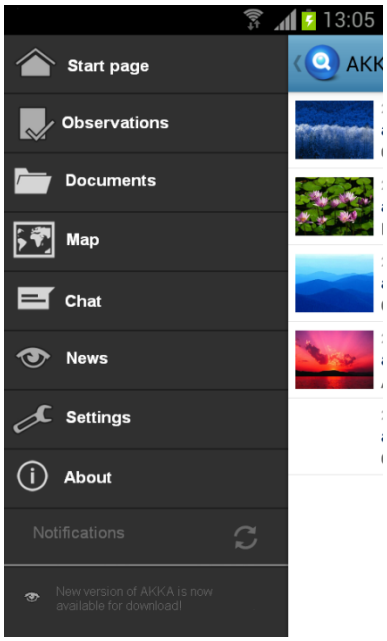

Figure 4: Structure of AKKA (Illustration: CTAS)

CTAS has tested the Virtual Game Engine*, Virtual Battlespace 2* (VBS2). VBS2 is a program that allows for virtual training and simulations. Both individual and collective training can be conducted, and the program can simulate real-world systems. CTAS is using this program as a part of the training solution in FRITS. They are creating real life scenarios by modelling the infrastructure of real places like Risavika Harbour and Sola Airport. Different scenarios can be executed and the trainees get the ability to train in familiar surroundings. The purpose is to make scenarios as realistic as possible. The tool can be used as preparation for an exercise, for instance as preparation for a full-scale exercise.

Simulations of the scenario could be created and the exercise participants could use the tool to play their real life part. Two simulation pictures from Sola airport created with VBS2 are shown underneath (Figure 5 and 6). The program allows for operating in a first person perspective, several actors can operate different virtual figures in the scenario and perform their task simultaneously. In addition to this observers can view the scenario from a bird eye perspective and inject event variations and resources. Some figures can be controlled by virtual intelligence while others are controlled by trainees. The program is developed by Bohemia interactive simulations (Bohemia, 2011). This tool as a part of the FRITS solution is still under development, it was therefore not possible to study this program while in use. For that reason in combination with time limitations it was decided that this tool should not be studied any further.

Figure 5: Simulation in VBS2 (CTAS)

Figure 6: Simulation in VBS2 (CTAS)

The FRITS solution offer technological solution which can ensure that the steps in the learning and training model are followed. MeTracker can be used in the Analysing and Planning phase and AKKA can be used to gather information during the exercise which again can be used in the Evaluation phase. Important lessons revealed though the collected data can be implemented in MeTracker, thus a circle of learning and training is created. The intent is that information gathered from the process of designing a training scenario, during the scenario and after the scenario will ensure a better data foundation. This can contribute to more targeted training and ensure that previous experiences are taken into consideration. Virtual training supports this solution by offering simulations which allows for practice in a virtual environment.

2. Theoretical framework

In this chapter a selection of theories will be described. The major goal in this paper is to show links or connections between training, technology and learning. The main problem consists of two comprehensive terms; learning and training. A definition of learning is necessary because the objective of this thesis is to study why technical tools in use during training can increase the learning potential. To be able to answer the main problem learning needs to be operationalized. A model for learning in emergency response work will be presented and this model will be used to study learning from training activities while using technology.

A description of training concepts will be presented in addition to theory on training methodology. The concepts are described because some of the concepts may have different meaning depending situation and context and some concepts are defined to clarify their meaning. Both theories on learning and theories on training methodology will be used to study the conditions which need to be in place to achieve learning effects from training activities.

2.1 Learning

Learning is a difficult term because it can have a wide spectre of meaning. There are many theories on learning, and individuals may learn in different ways. Learning is something that happens all the time; one learns how to deal with different situations while it happens. Norms in a group, language, behaviour, how to preform different tasks are some examples. Some authors talk about single- and double circuit learning, where the single circuit learning process is characterised by a change in behaviour as a result of a mistake or a poor result. In this process some learning has taken place, the change in behaviour represents learning. The double circuit learning process is more complex, as a result of a mistake or poor results over time one starts to question why the actions don't lead to the desired outcome. One looks beyond the behaviour and at the goals. Is it possible that the goal behind the action is not the goal one wants to achieve? The main difference between single circuit and double circuit learning is the reflection beyond own actions (Jacobsen & Thorsvik, 2007). Learning can by this definition be seen as change in behaviour.

Braut and Njå (2010)suggest a wider definition of learning which also involves confirmation of existing knowledge and achieving a deeper comprehension of emergency response. They define learning as; "*processes related to establishing new knowledge aiming to implement changes to, gaining deeper comprehension of and/or confirming the basis for, current apprehensions and practices" (Braut & Njå, 2010, p. 10)*. This definition implies that learning is not just change in behaviour it also includes processes that confirm existing knowledge and processes of achieving a better understanding.

Two views of learning has gradually been developed; an individual cognitive approach and a sociocultural approach. The traditional view is the individual cognitive approach, were individual mental abilities are in focus. This view sees learning as something that the individual must acquire and implies that learning is the activity where the brain is filled with new information or new skills. The knowledge is seen as something which is assembled in our minds, and the knowledge belongs to the individual. The sociocultural approach views learning as practice. In this definition the focus has shifted from having knowledge to knowing. Followers of this view says that learning cannot be considered separately from the context were it takes place. The learner is seen as an active participator in certain kinds of activities rather than someone who is accumulating private skills (Sfard, 1998). Both views of learning have been criticised, the individual cognitive approach for not considering important social aspects of learning and the sociocultural approach for not considering individual abilities. For that reason Sfard (1998) suggests a combination of the two approaches.

Sommer, Braut, and Njå (2013) have developed a model for learning in emergency response work. The model was developed on the basis of a combination of the individual cognitive approach and the sociocultural approach to learning. Both individual mental abilities and social aspects are included in this model. In this model the wide definition of learning as change, confirmation and/ or deeper comprehension is used. The model consists of four parts, see figure 7. The starting point for understanding learning is the person, the persons learning is influenced by three conditions; content, commitment and context.

Content; for learning to happen there have to be something to learn, like the use of equipment, specific skills, certain behaviour or how to understand or interpret situations. This is abilities or knowledge that the individual are supposed to learn. The content can be both practical and theoretical knowledge.

Commitment; mental or physical activity by the individual is crucial for learning to happen. In addition to involvement in work related activities through active participation and interaction. They need to experience that a change is necessary and want to learn.

Context; certain conditions needs to be in place to allow learning to happen. Learning happens in an environment and through interaction with other people. Contextual factors like interpersonal relationships, cultural elements, social climate and practice will therefore influence the learning outcome. To ensure sharing of experiences and stories of failure one is dependent on an environment characterised by trust and openness.

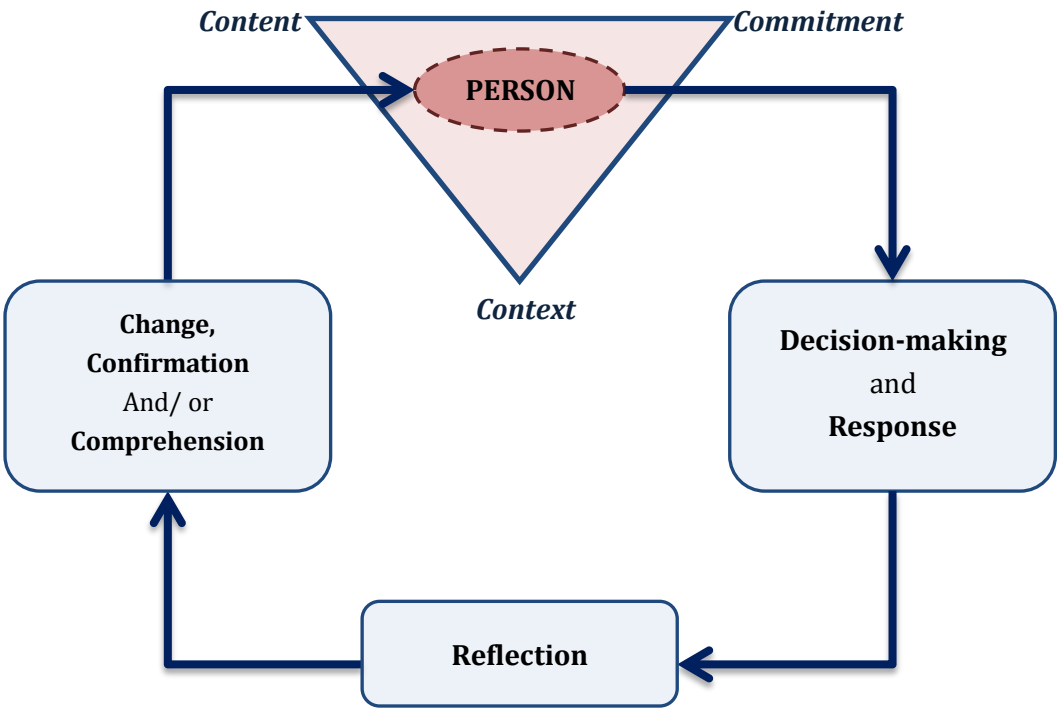

Figure 7: Learning in emergency response work (Sommer et al., 2013)

The second part of this model is decision-making and response. This part represents the individuals' performance in an emergency situation. This involves both real events and training situations. The emergency workers behaviour and response is a result of decisions they make which again influence the outcome of the situation. The next part of the model is reflection. Reflection has an important role when it comes to learning, for learning to happen one need to reflect on own performance and abilities. To be able to learn one need to actively interpret situations and experience how the behaviour results in positive or negative outcomes. Exchange of information amongst individuals is also important.

The final part of the model is change, conformation and/or comprehension. A need for *change* can be revealed as a result of reflections and discussions after an incident. The changes can for instance be in structures, behaviours or working methods. If an incident is handled well there might not be a need for change. This does not mean that learning does not happen. Experiences from the incident can confirm that the proper behaviour was performed. This *confirmation* is an important element in learning. Even if incidents do not lead to change or provide conformation some learning can happen in the form of *comprehension* of existing knowledge. Comprehensive knowledge about response work may in many situations be crucial for a successful response. For instance comprehensive knowledge about response work can make the emergency workers handle unknown situations better

since they may have experiences with similar situation and knowledge which can support their actions (Sommer et al., 2013).

Learning can be operationalized through the elements *content*, *commitment* and *context*. The content describes what is learned, for instance skills or knowledge. How learning happens is described by the commitment, for instance bodily activity and interaction. The context describe the conditions which makes it possible for learning, for instance through relationships or by using existing knowledge within the organisation (Sommer et al., 2013).

2.2 Training terminology

In this section training terminology will be described, and certain terms will be defined. More detailed theory on training will be described in the next chapter, Training methodology.

The words; *training*, *exercise* and *simulations* are used intermittent by different authors and have different meaning depending on how one use the words. For instance the word simulation is often used instead of training in many European countries and exercise can be seen as a form of training. In this thesis Perry's (2004) definitions on training and exercise will be used, where training is seen as a more overall term used on educational activities and an exercise is seen as an operational test. Thus an exercise is only a part of the training. The term *simulation* can be used in different contexts and describe different aspects, all sorts of exercise scenarios can be seen as a simulations, in addition to virtual games, virtual illustrations and so on. A common feature of simulations is that they have a source in reality; they imitate part of the reality (Borodzicz, 2005).

Exercise scenarios are created so that one can practice in a safe environment, it can be viewed as a constructed opportunity to test a plan. One gets the ability to see how protocols and equipment work and can use this to evaluate the plan. The plan can be seen as a product of the planning process and is therefore the connection between the disaster planning and the disaster response. When preparing a plan one conduct an analysis of needs that arise, actions which could be undertaken and necessary resources to support the necessary actions. Disaster exercises can serve a variety of functions. One of the most critical functions is detecting difficulties in executing the strategies and tactics proposed by the plan in addition to detecting operational failures or weaknesses (Perry, 2004). There are several ways to conduct a training session which require more or less resources. Exercise scenarios can be divided into three main types; Table-top exercises, Functional exercises and Full-scale exercises. The following descriptions of these is based on Peterson and Perry (1999).

A *table top exercise* is an exercise typically done at the table where the participants are presented with a simulated event. The participants usually have different roles and are supposed to provide a

solution to the problem that arises. Typically they provide a verbal response where they describe actions they would initiate as response to different demands. Controllers monitor the participant's response and in some situations they inject event variations or crisis into the exercise process.

A *functional exercise* has a higher level of complexity than the table-top exercise. In a functional exercise one selects parts of a disaster response plan and conducts a test. This type of exercise is usually done in real-time in the field with operational personnel executing their functions using appropriate equipment. This type of exercise can be seen as a limited full-scale exercise.

A *full-scale exercise* is the most complex form of exercise. It involves testing of a major part of the disaster response plan. The exercise is conducted in real-time in the field where multiple response agencies participate. The exercise has a high level of realism and requires many resources; a full staff of controllers, props and actors.

2.3 Training methodology

A training session can be conducted in many ways, the amount of resources necessary and the degree of reality varies depending on the desired learning outcome. Despite the large variety of training scenario's some recommendations for training can still be made. Vogel-Walcutt, Fiorella and Malone (2013) has conducted a study of training strategies for military training using grounded theory, they have developed a framework of pre-training strategies, during-training strategies and post-training strategies. This chapter is based upon their classification of training phases. Vogel-Walcutt et al. (2013) have a more traditional way of learning where the abilities of the teachers are in focus and the trainees are supposed to learn from the teachers efforts. This view of learning differs from the view by Sommer et al. (2013) which focuses more on the individuals learning abilities. The strategies by Vogel-Walcutt et al. (2013) can still be used to say something about useful considerations in the pre- training, during training and post- training phase. These considerations can be used to support elements of the individuals learning.

Pre-training phase

A training session is designed by trainers. Their competence and abilities will have a large influence on the outcome of the training session. It is therefore important that the trainers have a basic understanding of what the participants do on a regular basis and that they are in a position to relate the training to the participants needs (Bennett, 2010). The trainers can be a group of people with different backgrounds who work together in designing an exercise as in the example used when describing the learning and training process. Considerations regarding their abilities might be necessary before the group is formed.

Early in the pre-training phase one should determine what the necessary training areas are. In order to do that it is necessary to identify relevant plans to be tested (Bennett, 2010). Further it is important to determine the prior knowledge of the trainees so that the exercise can be designed on the basis of their needs. An analysis of needs and expectations from both the users and the stakeholders is necessary because both parts need to be included on an early stage. Involvement of both parts will make them take the exercise more seriously and help put the exercise on the agenda (t Hart, 2002).

One of the first things that should be done when planning an exercise is defining goals, the goals will provide the framework for the exercise. The goals should be clear, specific and realistic. It can be useful to include the exercise participants when determining goals because they might have different views on necessary training objectives than the people who are planning the exercise (Vogel-Walcutt et al., 2013). By including the participants in the process of determining goals they are involved in the process which can influence the exercise participants' commitment in addition to influence on the content. Influence on learning points can be crucial when it comes to learning because if the participants' don't find the training areas as relevant the probability of learning decreases (Sommer et al., 2013). One should define both overall goals and more specific goals. On the basis of these goals one will be able to develop specific observation questions which can be used during training. For instance can a list of observation questions be implemented in AKKA and used by the observers in preparation for and during the exercise. Further planning of the exercise should revolve around a way to achieve the goals. Focus on the goals prior to the exercise can help motivate the exercise participants to concentrate on the most relevant material during training and select appropriate learning strategies that will assist in achieving those goals (Vogel-Walcutt et al., 2013). The elements mentioned above can be considered and determined in MeTracker's Analyse phase.

After the goals are set, one should define an incident which fits with the training goals. This corresponds with the planning phase in MeTracker. Based on the chosen incident, one should consider relevant agencies to include in the exercise (Bennett, 2010). The incident should not be predictable; pre- planned exercises with only a limited range of scenarios can easily appear uninteresting to the participants and lead to an automated process (t Hart, 2002). The exercise scenario represents part of the context were the learning happens. A training scenario should appear relevant and interesting to the participants, if the scenario is regarded as too unlikely then the exercise might lose some of its credibility, and if the exercise is too familiar one risks that the participants lose interest and perform their tasks without reflection. There is a fine line between the two, the exercise should not be too tough, but it should not be too friendly either (t Hart, 2002).

Another important step is to choose instructors. An instructor has an important role in controlling the exercise and in giving feedback to the participants. It is therefore important that the instructor is experienced and dedicated in helping the participants achieve the goals (Bennett, 2010). In the pre-training phase experienced instructors can be used to activate the participant's prior knowledge before they are being presented with new materials. More importantly they can help the exercise participants in integrating their existing knowledge with newly presented material (Vogel-Walcutt et al., 2013). One should also spend some time on finding observers and markers. The observers skills in noticing critical events will influence what is discussed during the evaluation which again can have an effect on what is learned (Løvik, 2010). Securing resources is also an element in MeTracker's planning phase.

The next step should be to describe and define key terms of training material; this will provide the exercise participants with background information on important facts and concepts. When presenting key terms in the pre-training phase the participants get the ability to integrate new knowledge with existing knowledge before the exercise. This means that they can focus upon the more complex relationship between those facts and concepts during training, instead of spending time on figuring out what the terms means. The tasks in the pre-training phase are meant to help the participants focus upon relevant materials, activate existing knowledge and provide them with relevant background information. The learning outcome from these tasks will vary depending on the level of expertise the exercise participants have. Experienced participants will probably have a deeper understanding of the training situation and might not need the same amount of information as the inexperienced need. It is therefore important to adjust the tasks in the pre-training phase to prior knowledge of the participants (Vogel-Walcutt et al., 2013). This corresponds to the competence improvement activities in the planning phase in MeTracker.

During- training

The during- training strategies by Vogel-Walcutt et al. (2013) has a strong focus on the instructors abilities. How they should act during training in order to teach the participants something. This can be used by the planners to arrange for this type of conditions however it will be just important to consider the trainees abilities and motivation for learning, like contextual elements, involvement in activities and influence on learning points.

In the executing phase of an exercise there are several factors which should be taken into consideration. Vogel-Walcutt et al. (2013) use three sub-categories to describe different strategies for use during training; information presentation, providing guidance and practice. To be able to provide the necessary support during training one is dependent on experienced instructors to follow

and guide the participants. The instructor needs to know about different training strategies and have experience in using them. They should provide feedback during the exercise, this can be done through time-outs, where they identify crucial decisions or events and discuss actions or thoughts. It is also necessary with observers; an observer should take notes during the exercise and be prepared to offer honest and frank evaluation of the exercise. An observer can also provide feedback and inform the instructor about crucial events (Bennett, 2010). AKKA is a tool which allows for this type of feedback. AKKA provides the instructors and observers with tangible observation questions which they will be able to answer during the exercise. The questions offer a way of standardising feedback from the observers and can make sure that observations are made in accordance with specific goals. The tool also allows for feedback during the exercise, information regarding the scenario can be sent to the participants through AKKA.

An important factor the instructor needs to consider is how the training materials are presented. Different methods like combining oral and visual information, personalizing the information, using signals and animations can help the exercise participants understanding of the exercise goals and tasks. AKKA can be used to gather different data from the exercise, for instance pictures and videos. This can be of assistance when preparing data for presentation. Guidance is proven to be another important factor when it comes to the learning potential from training sessions. By providing, examples, hints, immediate feedback and explanatory feedback one can guide the participants through the exercise (Vogel-Walcutt et al., 2013).

Allowing for the participants to practice different skills on an individual basis can help them prepare for a larger exercise. In addition to this it can be useful to allow for several smaller training sessions over time (Vogel-Walcutt et al., 2013).

Post-training

It is important to give all the phases in the training session sufficient amount of time, the analysis and evaluation is equally important as the exercise. The results of the exercise should reflect the training goals. After the exercise a debriefing should be conducted, this can be a brief oral review right after the exercise followed by a review meeting a couple of days later. The time and date of the review meeting should be clearly expressed, and all the exercise participants should be invited to attend the meeting. When deciding on a date one should allow for sufficient amount of time so that the participants get the ability to reflect on the exercise. All the participants should get the opportunity to ask questions, and strategies, tactics and decisions that were made during the exercise should be

explained. Written reviews by the observers and instructors are important in the evaluation of the exercise. They should therefore provide open, honest and fair feedback from the exercise. Their written reviews can be used as a checklist for the discussion during the debriefing meeting. If AKKA is used during the exercise can the list of observation questions function as a check-list and data collected with AKKA can be presented to the participants. The purpose of the meeting is to allow for honest assessment of everyone involved in the exercise not to make individuals or groups look bad. Leaders of the review should make it clear that the actions discussed during the meetings should not be taken personally (Bennett, 2010). The instructor should provide a summary of the participant's performance, it is important to include corrective and explanatory feedback, in addition to suggestions for performance improvement. Both good and bad decisions should be discussed, and the discussion should follow the exercise time-line. It can be useful to ask the participants to reflect on their own actions and suggest areas that need improving. The participants will most likely have noticed some of the same areas of improvement as the instructor, and they will more easily accept the information if they are the ones who are suggesting it. It can also be useful to assess the participants through testing. Through testing the participants get practice in receiving information from the long-term memory which strengthens the materials memory trace. This is useful because it is the same retrieval practice that is necessary when solving real-life problems (Vogel-Walcutt et al., 2013).

3. Research design

3.1 Research method

In this thesis a study of technical tools for use during training has been conducted. The main objective was to study the effects these tools have on learning. The study has been conducted using two main sources; the military at Rena and the BRIDGE project. Results from this study are based upon observations, interviews and literature study.

The main problem of this thesis was as follows;

Why can training solutions supported by technical tools increase the learning potential from training for personnel within the professional emergency network? What conditions must be in place to achieve learning effects from training activities?

This problem is twofold; first it seeks to answer why learning increases with the use of technological solutions. Second it seeks to describe necessary conditions which need to be in place to achieve learning effects.

On the basis of the research questions a qualitative research method has been selected. The reason for this was the nature of the research questions which seeks to provide in-depth data regarding the technology's potential and effects on learning. Since most of the products are still in the developing phase, experiences from individuals and in-depth interviews with them was seen as more useful than large amounts of quantitative data.

The technological solutions within the BRIDGE project are under development. To be able to say something about experiences regarding technological solutions during training a study at Rena was conducted. They have years of experience with technological solutions for use during training and experiences from Rena can say something about what kind of results one could expect from other technical solutions.

One of products, MeTracker, which was studied in the BRIDGE project, was not ready to be tested. This was a challenge when working on this thesis. Since the product was incomplete, actual results on learning could not be studied. The focus when studying this product was on the potential the solution could have. During demo 2 experiences and feedback regarding both MeTracker and AKKA were recorded, followed by interviews with some end-users afterwards. Results regarding this product express how the product can work based on information provided by the developer, CTAS.

The AKKA tool was tested during an exercise in the Hell tunnel in Trondheim. This exercise was followed and provided important feedback regarding how this tool can support training activities. This exercise was an opportunity to study the effects the technology can have on learning. A challenge when observing this exercise was that the technology only had a small role in the exercise and the whole planning process was not followed.

3.2 Data collection

The data collection process started with a visit at Rena military camp. Two different training solutions were presented; one solution for live- training and one for constructive training. Informal interviews were conducted with the guide and individuals from each of the departments. During the visit arrangements regarding follow-up interviews were made. Two follow-up interviews were conducted over mail with representatives from each of the departments, one of them was with the leader of the constructive training department and this was the same individual who also was interviewed during the visit at Rena. The other one had the role as an instructor in the live- training department. These sources were chosen because they had in-depth information and experience with the training solutions. Interviews with individuals who have trained with the different solutions could have been beneficial for a more versatile description of the solutions at Rena. One could expect that the leaders and individuals who work with the solutions in their everyday work is more positive to the training solutions than the individuals actually train in the solution. Because of time limitations interviews with trainees was not conducted.

Results from a report from the Norwegian Defence University College (Krigsskolen) were also used. This report was developed on the basis of a large study of the constructive training solution at Rena and is based upon observation during training and interviews with approximately 100 individuals.

The BRIDGE project has been followed since November 2012. Experiences have been gathered at two conferences, one in Klagenfurt and one in Stavanger (demo 2), and during an exercise in the Hell tunnel in Trondheim. Information was collected through conversations with representatives from the project, through two different BRIDGE online databases and through observations and interviews.

Two semi- structured interviews were conducted with end user representatives after demo 2. These two was chosen because they attended the presentations and were experienced individuals who could say something about how the technology could function in their organisations. More interviews could have ensured a wider perspective on the solutions. However opinions and feedback from the end- users made during demo 2 was recorded this contributed to feedback on several aspect relevant to this thesis and provided a more versatile picture than the interviews alone.

Planning meetings for the exercise in Risavika Harbour has also been followed. In the planning committee, representatives from the police force, the fire department, the medical emergency service, the civil defence and volunteer organisations has been present. This group is planning the exercise where the BRIDGE tools will be tested in September, and representatives from this group were also present at Demo 2. The two interviews from demo 2 were with individuals from this group.

As a part of the BRIDGE project the exercise in the Hell tunnel in Trondheim was followed. Observations were made during an educational preparation meeting on the day before the exercise, during the exercise and during the following evaluation meeting. The focus of observation was the observers, how they received the information regarding the technology and how they used the technology. A list of specific observation areas had been developed in advance. This list can be found in the appendix. During the exercise two observers were observed while using the technology and observations was also made of observers without the tool. Semi- structured interviews was conducted with four observers over the phone. Two of the interviews were with individuals, and the last one was a group interview with two observers. The informants were chosen because of their unique experience with use of technology during the exercise. One of the informants used the technology during the exercise, one of them had the ability to use the technology and the last two attended preparing activities but did not have the ability to use the technology. One observer who used the technology during the exercise was not available for interview. This individual could have provided more insights on how the technology functioned during the exercise. The interviews were of informal nature, an interview guide had been developed in advance, however this was not strictly followed. The intent during the interviews was to get in-depth answers regarding their experience. For list of interviews see the table 1.

	Unstructured	Semi structured
Rena		
Guide	Questions face- face	
Leader of constructive training division	Questions face- face	Interview via mail
Leader of live-training division	Questions face-face	
Instructor in Excon (live-training)		Interview via mail
BRIDGE: Hell		
Observer		Interview via telephone
Observer		Interview via telephone
Two observers		Group interview via telephone
BRIDGE: Demo 2		
Participant at demo 2		Interview face- face
Participant at demo 2		Interview face- face

Table 1: List of interviews

The basis for the semi- structured interviews was interview guides which had been developed in advance. The interview guides can be found in the appendix (note that observation lists and interview guides are in Norwegian). During the interview they were asked to elaborate certain opinions and follow-up questions were asked.

3.3 Data analysis

The main problem in this thesis was to explain why training solutions assisted by technical tools can improve the learning potential for personnel within the emergency network. And to describe the conditions that need to be in place to achieve learning effects from training activities. In order to do that it was necessary to find some indicators which could be used to measure learning. Learning is a continuous process, it was not possible to measure change in behaviour or other exact results on learning during this study. In order to do that it would be necessary with multiple studies where changes from one situation to another were studied. This was not an option. The model by Sommer et al. (2013) has been used as basis for studying learning, and the elements content, commitment

and context was used as indicators for the individuals learning. These elements were further broken down into concrete elements. In a training situation elements are related to the content conditions which allows for a better understanding of the situation; like concrete information regarding the individuals specific skills and behaviour, how things are connected and explanations regarding the chain of events. Elements related to the commitment are conditions which allows for involvement in mental and physical activities, active participation and interaction. Elements related to the context in are conditions that allows for interpersonal relationships, sharing of experiences and open discussions. The technology's influence on learning during training is analysed based upon the following table.

Content	Allowing for feedback regarding the individuals specific skills
	Allowing for feedback regarding the individuals behaviour
	Allowing for explanatory feedback on how things are connected
	Allowing for feedback through multiple sources
Commitment	Allowing for involvement in preparing activities
	Allowing for mental and physical activities before, during and after training
	Allowing for interactions and discussions before, during and after training
	Allowing for active participation before, during and after training
Context	Allowing for interpersonal relationships
	Allowing for sharing of experience and stories of failure
	Allowing for open discussions regarding the use of results from the technology
	Allowing for an open and trusting environment

Table 2: Elements of learning

The focus when studying the technology was on the differences the technology provided in relation to the non-technological alternative. These differences were studied further against the three indicators for learning.

3.4 Validity and reliability

The results from the study at Rena may be influence by the selection of informants. A more differentiated picture of the solution could have been described had the trainees also been interviewed. This is a limitation with this paper. The informants at Rena were chosen because they had long experience with the solution and could provide in-depth information regarding how the solutions work. This is information participants would not be able to provide in the same extent. The follow-up interviews with the individuals from Rena were sent via mail, this can have influence the

answers they provided since it requires more efforts of the informants to formulate written answers. It was therefore decided to limit the follow-up questions to nine questions. By sending questions over mail one also lose the ability to ask for elaborations, however the informants provided detailed answers and they were open for answering more questions over mail.

The results from demo 2 are to some degree of hypothetical nature. The solution is under development and actual effects on learning could not be studied. How the solution work is described based upon information on how the solution can, and is planned to, work. A study of the complete solution will most likely provide different results than what has been discovered in this paper. The results can only say something about the potential the technology can have, not how it actual work. Two interviews were conducted after demo 2, to ensure the validity of the responses more interviews could have been conducted. The comments made by the end-users during the demonstration were recorded and a summary of their comments can be found in the results chapter. During the presentation of AKKA and MeTracker they made several comments, it is therefore assumed that the combination of feedback during the demonstration with interviews after the demonstration provides an adequate picture of their opinions of the technological solutions.

4. Analysis and results

In this chapter results from studies at Rena, Hell and demo 2 will be presented and analysed. The results will be analysed on the basis of on the main problem and theories on learning and training.

4.1 Rena

A study of Rena was conducted because they have fully developed training solutions assisted by different technical tools. Experiences from Rena are important because it says something about how technological solutions can work and what effects the technology has.

The military at Rena have a solution for live training and different solutions for virtual or constructive training. *The live-training solution* consists of technological equipment for use during and after training. They train under realistic conditions in a large forest within the military camp. Up to 800 people can train at the same time. Equipment they normally would use, like wests, helmets, rifles, armoured vehicles and rocket launchers are altered or replaced so that a scenario can be executed without the use of sharp bullets. The helmets and wests are equipped with a GPS tracker and sensors which receive signals through Bluetooth. The rifles are real; a laser with a receiver is attached on the tip of the rifle. The rocket launchers are replications, but the size and weight is the same as a real one. The armoured vehicles are also real and they are also equipped with sensors. The exercise is monitored by observers and instructors in the field, in addition to remote monitoring by operators in a control room (referred to as Excon). As many as nine people can operate in Excon at the same time; they follow the exercise through a computer program called ExPERT, which shows the position of the exercise participants and the armoured vehicles on a map. The operators in Excon can also inject event variations. The computer also shows injured people in the scenario. In addition to following the participants on the computer screen they can also listen to radio communication. The operators in Excon communicate with instructors and observers in the field; they inform the operators in Excon about critical events, when doing so the operators in Excon can take screen shots of the situation which can be used in during action reviews (DAR) or after action reviews (AAR). The time of the screen shot is also noted automatically in the radio log so that it can easily be retrieved for AAR. After the exercise they have an AAR where they use information gathered during the exercise. The technology allows for skill training on an individual basis as well as strategic training on higher levels.

The training solution assisted by technical tools facilitates feedback and analysis which would not be possible without the technology. First of all it allows them to view recordings from the exercise this can show/explain what the situation was at a given time. Recordings from the radio enable them to learn communication procedures and understand each other and military terminology better.

Shooting accuracy can be evaluated by using information gathered with the technology. This information can say something about were the hit was and if the individual makes typical mistakes. Immediate feedback regarding these areas provides them according to a representative from this department with a steeper learning curve. Note that this is the opinion of one of the leaders at Rena and this has not been confirmed in this study. Collection of visual and oral information is important because it contributes to diversity in data sources. According to Vogel-Walcutt et al. (2013) is information presentation important when it comes to understanding the materials which are presented. The technology allows for visual information and animations this can be combined with oral information from the radio in addition to oral feedback from the observers. The technology also allows for updated feedback during the exercise, since the operators in Excon have an overview of the entire exercise can they provide the instructors in the field with updated information which can be discussed in DAR. This allows for process feedback where critical decisions and actions can be discussed once they are made. This is important because it says something about why things happened instead of just discussing consequences afterwards. This provides them with a better understanding regarding their choice of actions (Bennett, 2010). The technology can support the instructors in providing guidance during the exercise, updated information can be communicated to the participants and the instructors can steer the exercise based upon progress in the scenario.

Rena also has a solution for *constructive training*. This solution has some of the same technological elements as the live-training solution however they use simulations instead of staff in the field. The solution is called SLT which stand for staff and leader training. This solution allows for training on decision making, testing of different strategies and training in a variety of scenarios. The solution can function as a table-top exercise were different strategies are tested and scenarios are played out. People can monitor and control the scenario from a computer while others make decisions based on information provided over the radio. Typically two teams play against each other, each team may consist of only a few individuals. They control a whole virtual battalion and other virtual resources. This allows them to be creative and test out strategies they normally would not dare to use in a real life situation. They said that this way of training is extremely efficient and provide the opportunity to train on decision making and leadership. It was however pointed out that they lacked something when it came to learning from experiences.

Constructive training provides opportunities for learning and development which is not supported by other solutions. It provides a more efficient way of training than one would achieve without constructive training. Training through virtual simulations allows them to see structures and direct

consequences of actions more clearly. This provides them with insight as to how things are connected and provides them with a deeper understanding of the conditions they are working under. The training activities happen in the virtual world this means that the degree of reality is lower than one would expect in a live- training situation. According to Sommer et al. (2013) training activities should be conducted under the same conditions as one would expect in a real life situation. This type of constructive training cannot replace live- training, since some factors cannot be replicated in the virtual world. However the solution can with benefit supplement other training methods. An informant from this department expressed that realistic simulation contributes to a better understanding of the environment they are working in. Since they are operating in similar surroundings and meet some of the same challenges as in a real life situation. Data is collected in the same way as the live-training solution, with recordings of the virtual battalion's position and radio recordings. This is used in AAR and facilitates sharing of experience and failure stories. This is elements which influence the context were the learning happens. Constructive training also allows for repeated practice, if mistakes are done one can just start over again. This would not be possible under other conditions for instance if one were to train in the woods. Allowing for practice is according the Vogel-Walcutt et al. (2013) an important strategy when it comes to learning skills. Focusing on skills during practice can shift the focus during training from a practical skill based point of view to a more overall view. Practice can also influence the commitment since the people who are practicing actively participates in activities. This form of involvement can make them experience that the old way of doing things might not be the best way and that a change might be needed. The training activities can also be repeated more often than regular training activities, this allows for a deeper understanding or overlearning, which is according to Braut and Njå's (2013) definition a form of learning. Learning by their definition includes comprehension and confirmation as well as change in structures and behaviour. The content of learning will be influenced in the same way as mentioned in the live training case through data collected with the technology.

An informant from the constructive training department claimed that the same results might be achieved using other method, however not as efficient and it would cost a lot more. If one only had a month to train one would not be able to achieve the same goals without simulations. When asked about improvement potential he said that they lacked something regarding goals. For a more targeted and efficient training they should formulate specific goals before the exercise. This is in accordance with theory on learning and training. The goals function as the framework of the exercise and influence the content of what is learned. He also said that technological development could provide an even more efficient way of training.

The constructive training solution has been studied by the Norwegian Defence University College, which resulted in a report by Skarpaas and Kristiansen (2010). Based on their studies they made some recommendations regarding how these exercises should be conducted for optimal learning effects.

The *framework* surrounding the training was pointed at as one of the factors which could improve the learning outcome from training. Factors to consider when planning an exercise are the physical environment, use of time and professionals. This is elements which they found could influence the learning outcome. The *context* of the training should also be considered. The scenario which the training is built upon should be based on concrete goals, and the trainees should be involved in the process of establishing goals. *Learning episodes* should be addressed in a larger extent. The learning episodes can be actions and episodes which naturally occurred during training, the reflection around these episodes should be done when they happen not afterwards. Smaller episodes can say something about structural features, leader abilities, cooperation and culture. If this is not addressed during training they might be forgotten before the AAR. They also found that there should be training *procedures* that address the follow- up work regarding areas of improvement identified during training. Elements are usually revealed during AAR however one normally fails to follow- up and make the proper changes. Clear procedures can ensure that these experiences are used further.

To summarise some of the findings from Rena a table have been developed. This table lists some of the differences between training solutions assisted by technical tools and the non-technological alternative.

	Advantage over non-technological solutions	Disadvantages	Non- technological alternative
Rena Live Training			
Recording of radio	Recording as basis for procedural communication training	Large data quantities is stored can be time consuming to analyse the data	Manual recording by observers
GPS tracking and recording	Monitoring in real time and accurate visual feedback	Large data quantities is stored can be time consuming to analyse the data	Manual recording by observers (No live update)
Live Participants status	Immediate update of wounded and dead and monitoring in real time		Manual recording by observers (No live update)
Immediate feedback from operator to observer to participant	Feedback based on overview of the entire exercise		Limited without live recordings
Shooting accuracy measuring	Feedback regarding accuracy		Can be measured at shooting range separately
Screenshots of critical events (also marked in radio log)	Data from critical events which can easily be retrieved for AAR		Manual recording by observers
Rena Constructive Training			
Recording of radio	Recording as basis for procedural communication training	Large data quantities is stored can be time consuming to analyse the data	Manual recording by observers during table top exercise or live training
Virtual tracking of resources and recording	Accurate visual feedback	Large data quantities is stored can be time consuming to analyse the data	Manual tracking and recording during live training
Volume training	Can train more often since the cost of virtual training is low	Repeated training can lead to an automated process	Repeated table top exercises or live training
Realistic simulation	Familiarise with working environment through simulations	Can never replicate the environment completely	Real life training
Multiple tries in case of failures	Little costs associated with repeated attempts		Repeated table top exercises or live training

Table 3: Results from Rena

4.2 BRIDGE/ CTAS

The solutions at Rena can be compared to the BRIDGE solution, even though it is separate solutions with different technology there are some common features. The technology at Rena allows for collection of large amounts of data as foundation for After Action Reviews. AKKA have some of the same features, where one can record data from exercises using different sources (written comments, pictures, video recordings and positions) and present this information to the exercise participants during the evaluation meeting. Rena's solution with process feedback during the exercise can be compared to AKKA's solution where information can be sent to the exercise participants. Some of the same results most likely can be achieved using AKKA as with the solutions at Rena. The main difference is that Rena is a military facility with a top-down structure, the exercise participants are controlled in a larger degree than what one would expect in the civil world.

As a part of the BRIDGE project two events was followed; the exercise in the Hell tunnel and the second BRIDGE demonstration, demo 2. Results from these two events are described in this chapter.

4.2.1 Training in Hell

On the 10th of April an exercise in the Hell-tunnel in Trondheim was conducted. This was a full-scale emergency scenario which involved fire in a truck inside the tunnel. Representatives from the police force, the fire department and the medical emergency service were involved as well as the civil defence, Trondheim municipality and Statens Vegvesen. The scenario involved a school bus with students from secondary school who were driving through the tunnel during the time of the fire. Some of the students had smoke poisoning symptoms.

Figure 8: Fire in the Hell-tunnel (Photo: Frank Lervik, Adresseavisen)

A controlled fire was started by the fire department before the exercise began using tires. This generated a lot of smoke which was visible from one side of the tunnel. Students from secondary school were markers. The observers were chosen representatives from their respective agency.

Three different gathering sites were established, there where one site at both ends of the tunnel in addition to a site at the end of an evacuation tunnel. Observers were present at all sites and they also followed their study objects to other sites. In addition observers were present at the AMK central at St.Olavs hospital.

Figure 9: Observers and trainees (Photo: Frank Lervik, Adresseavisen)

At the end of the exercise a crisis team was generated which embraced the victims and provided them with a warm place to stay, food and comfort.

Three main goals had been established for this exercise;

- To train on regional coordination between the emergency services
- Establishing centre for evacuees and next of kin
- Requesting assistance from the civil defence

The study of the exercise in Hell started with observations during an educational preparation meeting on the day before the exercise. The planning process before this point was not followed.

Exercise assisted by AKKA

Observers in this exercise were invited to use the AKKA tool during the exercise. Results presented in this section are based upon observations and interviews with observers. The table below shows important characteristics of the observers. In the following they will be referred to as O1, O2, O3, O4

and O5. O3 was not available for interview. Information about this individual is based upon observations and comments made during the exercise.

Observer number	Attended prep. meeting	Tested the technology at home	Used the technology during the exercise
O1	x	x	x
O2	x	x	
O3			x
O4 and O5	x		

Table 4: Characteristics of the observers

Pre-training

The technology had a direct impact on two elements in the pre- training phase of this exercise. The technology facilitated the arrangement of an educational preparation meeting in addition to the development of a list of observation questions. The educational preparation meeting was held to inform the observers about the technology and teach them how to use it. The list of observation questions were developed because it is necessary with a specific list of questions for AKKA to be useful during training. In the following, elements from the meeting will be elaborated, followed by elements relevant to the observation questions.

The educational preparation meeting was held the day before the exercise. At this meeting several individuals who had the role as observers the following day were present. This included representatives from the medical emergency service as well as a representative from the fire department. Exercise participants were not invited to this meeting. A total number of ten people attended the meeting. Five Pad's with AKKA installed were available for use during the exercise the following day and four representatives were chosen to use the tool during the exercise.

The meeting started with individual presentation of the meeting participants followed by a short walk-through of the exercise by the preparedness manager at St.Olavs hospital. He pointed out the importance of learning from training and asked about the observers expectations regarding the meeting. One of the first comments was expectations regarding the technology that it could be of help while observing the exercise. Other meeting participants seemed to agree with this comment. Focus on learning from management is important because it can influence how the observers view the exercise. The participants may take it more seriously if they find that the management takes it serious (t Hart, 2002). By asking the observers about their expectations he allowed for active participation. The observers were able to reflect on own expectations and respond, thus they were

mentally and physically involved, which are important elements of the commitment (Sommer et al., 2013).

The purpose of the meeting was to educate the observers in the technology. One hour was set aside to this purpose. Due to delays some time got lost and approximately 45 minutes were left to this purpose. The technology did not function as it should and a lot of time was lost due to technical difficulties. The observers were given Pad's to practice on, however the practice was limited because of the technical problems. The initial plan was to let the observers' use the technology on Pad's and get to know it. Since the technology functioned poorly the meeting ended with an overhead presentation of the program where they were shown what to do instead of them doing it themselves. Allowing for physical involvement is an important part of the commitment. Since the participants did not get the ability to use the program properly the commitment of the observers may have been affected in a negative direction.

Feedback from the observers was that the technology did not function during the meeting. O1 stated that the technology problems resulted in feelings of uncertainty regarding the technology. O2 said that the knowledge about the technology after the meeting was insufficient and he did not feel comfortable with the technology. Both O1 and O2 brought Pad's home so that they could test the technology on their own. This worked well for O1, by bringing the Pad home she got to use the technology and familiarise with the program on her own. Experiencing that the technology worked most likely had a positive effect on this person's commitment. O2 had some problems with the technology at home. There were some problems related to internet connection in addition to problems with logging in. The Pad did not have a mobile internet connection and this was something O2 was not aware of. Initially O2 had planned on using the technology, he stated that he tried during the educational meeting and at home, but the problem with logging in consisted. He had been told that the benefits with using AKKA was observations and analysis in real- time and since the Pad did not have a mobile internet connection he failed to see the benefits of using AKKA. Lack of practical experience with the equipment and not enough knowledge regarding how the technology works could have had a negative impact on this person's commitment.

Some motivation might have been lost as a consequence of poor communication and technological failures. However the observers seemed determined to learn how the technology worked and they did not give up despite being thrown out of the program repeatedly. O1 did not have much experience as an observer. She was determined to use the technology because it provided some support, the list of observation questions provided her with something tangible to base her observations on and the technology was seen a simple way of registering observations. Despite the

technological problems she tried to get a grip of the technology. O2 also tried the technology at home and his initial plan was to use the technology. O2 stated at several occasions during the interview that technological solutions could improve the learning outcome from training. His experiences were that they lacked a tool or solution which could be used to control an exercise, in addition to a tool which could be used to maintain experiences from exercises. O1 also expressed that technological solutions could improve the learning outcome from training given that the information gathered were analysed and used on subsequent occasions.

The list of observation question had an influence on the observers in preparation for and during the exercise. Both observers with technology and the ones without used the list to make observations during the exercise most of them also used it to prepare for the exercise. The list of observation questions was also on the agenda during the preparation meeting. The specific questions was discussed and clarified. This could have had an effect on what the observers registered during the exercise. During the discussion the observers interacted and shared experiences. This is important contextual features. By participating in the meeting they could form relationships and discuss important aspects of the exercise. The observers were asked if they believed that a similar list would have been developed had it not been for AKKA, they said that they usually do not use detailed checklists. O1 had tried to find similar lists from her agency to complement the list she had been given but she where unable to do so. O4 and O5 said that they had a short list of elements they should focus on during training however this list was not as detailed as the one that had been developed for AKKA.

During the interviews the observers were asked about their thoughts regarding the list of observation questions. In general they were positive to this list. O1 used the list as preparation for the exercise; she used some time on familiarising with the observation points and took some notes regarding what to look for. She said that by doing this she managed to reduce the stress during the exercise. This observer also provided the person who she was observing with the list so that this person had the ability to prepare. O2 also appreciated the list of observation questions. He only used the printed list of observation questions were he noted comments using pen and paper. He said that it was useful and could be used to steer the exercise. He did however comment that it could have been beneficial to spend more time on altering the questions to suite the exercise and the specific agency more. O2 also suggested that there should be more options directed at each questions (not just Yes/No) and that there perhaps should be sub-questions so that he did not have to write as much. Especially if he were to use AKKA, because he felt that it would take too long to write observations on the Pad. O4 and O5 also said that the observation questions could have been more

specific regarding each agency, but in general it was a good list. They expressed that it functioned as a way of standardising training and that it could be used to compare results between agencies. They also said that it could counteract guessing and assumptions regarding critical areas by the observers.

The list of observation questions provided them with specific questions regarding different aspects of the exercise. This allows for preparation for both the observers and the participants, this form of preparation is important because it can help them focus upon relevant material during the exercise (Vogel-Walcutt et al., 2013). The educational preparation meeting allowed for interaction and discussions which influenced the observers' commitment. This meeting can also have influenced contextual features like the forming of interpersonal relationships which can influence the conditions for learning.

The exercise participant was not included in the meeting, effects on their content, commitment and context can therefore not be expected. The exception is with the participants who were handed the list of observation questions before the exercise. This can have had an effect on their commitment by allowing for mental activities before the exercise.

During training

On the day of the exercise four out of five available Pads' with the AKKA program were in use. Only two of the observers who attended the educational preparation meeting used the technology. One of the observers chose not to use the technology during the exercise. And one Pad was given to an observer who only got a ten minute presentation of the technology on the day of the exercise. The last Pad was used by CTAS representatives. Two of the observers with Pad's (O1 and O3) were at the same site. These two were studied while they used the technology. The last observer with the technology was at a distant location and could therefore not be studied.

The technology had a small role when it came to the exercise. Only a small part of the observers present at this exercise were influenced by the technology, manly the individuals who used the tool during the exercise and individuals who used the observation list.

O1 and O3 were studied while they used the technology. Both of them used the technology during the entire exercise. O2 who had been given the opportunity to use the technology and were present at the preparation meeting chose not to use the technology. He said that the reason for this was that the technology did not work and that he did not feel comfortable with the technology. He did however use the list of observation questions to write down observations.

The two observers with Pad used the technology during the entire exercise. It was cold and they could not use normal gloves on the Pad so they got cold hands. Both of them made several entities in AKKA using the simple Yes/No check boxes in addition to notes in the observation box. O3 took pictures and seemed more comfortable with the technology then O1. Both O1 and O3 had experience with similar Pad's, but not with the specific program. O4 and O5 were asked if they would have used the technology given that they had that possibility. They said that they did not have that ability, but if they were to use it they would have needed more time to prepare and understand the technology. One of them said that he would not know what to do if the system stopped working and that the system seemed a bit unstable. They appreciated that the technology provided them with specific goals and said that it seemed like a good way to work as an observer. Both of them used the list of observation questions to register observations. They liked that the questions were specific and said that these questions prevented guessing and assumptions. They were planning on registering their observations in the AKKA online portal so their observations could be used together with the observations made with AKKA in the field. Both of them saw the potential in the technology and they are working on implementing Pad's in their daily work. They said that the limitations were with the humans not with the technology. Given proper training and a stable system they would use the technology. One of them also pointed out that it would have been useful with more Pad's, there were not enough Pad's to cover the entire need during the exercise. One of them also pointed out that AKKA could be useful during real events as well.

During the exercise both observers with Pad's and observers without were present. The main difference between the two methods was that some registered their findings directly in AKKA while others used pen and paper. The observers who used Pad's also used pen and paper. The observation process was pretty much the same for the observers with Pad's and the ones without, however there were some inequalities. AKKA contributed with a list of concrete observation questions, electronic registration of observations in real time and observation comments linked with pictures. This facilitated concrete and detailed feedback from the exercise. AKKA also allows for registration of both positive and negative feedback. In exercises without similar tools the observers often focus on negative aspects and neglects positive aspects when making notes for the evaluation report. The questions in AKKA were formulated in a way where YES means positive response and NO means negative response. Thus positive and negative feedback are recorded in the same extent. Positive feedback can lead to conformation of the actions made during the exercise or better comprehension of the situation. Confirmation on correct measures and better comprehension is also a form of learning (Sommer et al., 2013). Honest feedback from the observers can be crucial when it comes to learning from exercises since it has a direct impact on elements which are discussed after the

exercise. Both visual and written information are recorded this can contribute to a better understanding of the information which are presented. Confusions can be clarified by combining written notes with pictures or video recordings (Vogel-Walcutt et al., 2013). Thus it influences the content of learning for the exercise participants. Combining negative feedback with positive feedback can also influence how criticism is received. An individual who only receives negative feedback can easily shut down and reject the information which is presented. By combining negative and positive feedback one can prevent this kind of reaction (Vogel-Walcutt et al., 2013).

The new technology enabled some extra functions, but it also meant that the observers had more tools to carry. Both O1 and O3 carried a radio, pen, paper and Pad. Keeping taps on the gear might have disrupted them in their work. One of the questions the observers were asked during the interview was if the technology disrupted their work tasks. O1 said that taking notes while observing will distract them a little from their main task which is observing, however they would have taken notes regardless of the technology. She experienced the technology as useful because it provided her with something tangible to base her observations on and said that it was simple to just check of Yes/No in AKKA. She also said that she got used to it and that it became easier as time went.

In the field the equipment worked as it should. No problems with the equipment were noted. O3 who only had a little training used the technology without difficulties. A comment was made by O1 that it was not intuitive were one was in the hierarchical structure of the list of observation questions while in the process of writing an observation. She had to use the printed list of observation questions as a map to know where in the structure the observation were made.

The focus the observers got when they received the tool can have influenced their motivation. It was noted that two of the most active observers where the two who carried Pad's. They followed their objects closely even to different sites and O3 also took several pictures.

The technology facilitated standardised and concrete feedback from the observers. It allowed for notes to be taken in the field and pictures to be linked with the notes. Feedback collected with the technology can be used further in the post- training phase.

Post -training

After the exercise observers and exercise participants were gathered at Stav hotel for an evaluation meeting. Before this meeting a gathering of the observers who were present at the educational preparation took place. The initiative for this gathering was made by CTAS and the purpose of this gathering was to discuss the exercise on the basis of the observers' findings and data collected

through AKKA. The observers who made the observations were present and could explain more thoroughly what the observation was and what went good/bad during the exercise.

The evaluation meeting was fairly unstructured, the room was crowded and the acoustic was poor. The comments made during the meeting regarding the exercise were off shallow nature. Typical remarks were “It was a good exercise” or “pretty much the same as usual, the same improvement areas as earlier”. Everyone seemed tired and eager to go home. One of the leaders had on earlier occasions stated that the purpose of an exercise is to learn. However this individual was not present at the meeting. It did not seem like anyone were taking notes during the evaluation meeting. Results from AKKA were not presented. The technology had a small role in the post training phase and in in the exercise general. The discussion at the gathering before the evaluation was the basis for what was said by a representative from the medical emergency service at the evaluation meeting. His remarks were one of the most specific and critical remarks compared to remarks made by others earlier in the meeting. This was the only form of influence the technology seemed to have in the evaluation meeting.

The technology influenced the post training phase mainly through statistical support provided by the registered observations. These observations were discussed with the observers in the gathering before the evaluation meeting. The exercise participants were not present at this gathering. The technology had the greatest impact on the observers; they were the ones who used the technology, they participated in the gathering before the evaluation meeting and they had the opportunity to reflect on aspects of the exercise based upon registered observations in AKKA.

To summarise the technology’s influence during the exercise in Hell a table has been created, se figure 4. The table lists AKKA’s contribution in the three phases of training.

Phase	AKKA's contribution
Pre- Training	Facilitated educational preparation meeting
	Facilitated the development and discussion of the list of observation questions
During Training	Concrete list of observation questions
	Electronic registration of observations in real time
	Facilitated both positive and negative feedback
	Observation comments linked with pictures
Post- Training	Facilitated the gathering before the evaluation meeting
	Provided statistical support

Table 5: AKKA's contribution during the exercise in Hell

In the Pre- training phase AKKA influenced the exercise through the educational preparation meeting and the list of observation questions. This is elements which again influence the learning outcome for the observers and to some extent the participants, through influence on content, commitment and context. During training the technology facilitated registration of observations. This allowed for the observers to actively reflect on the participants' behaviour and register their findings. Thus the observers were mentally and physically involved which can influence their commitment. The technology offer elements which can improve the quality of the observations, this can further influence the content for the exercise participants. AKKA influenced the post- training phase mainly through the gathering before the evaluation meeting were the observers discussed the exercise based upon statistical support from AKKA and other thoughts and observations. Results from AKKA had little effect on the exercise participants in this phase as well. Through the activities facilitated by AKKA the observers participated in several meetings and interacted with each other. This seemed to have influenced the context were the learning happens and the commitment of the observers.

A table with a list of questions linked to the three indicators of learning has been developed. This table lists AKKA's contribution on important elements of the content, commitment and context for both observers and participants. See table 6.

Phase	Indicator		Observer	Participant
Pre-Training	Content	Did the data collected for AKKA offer opportunities for clarifications and explanations?	Yes	No
		Did the data collected for AKKA allow for feedback related to the individuals' skills?	-	No
		Did the data collected for AKKA allow for feedback related to the individuals' specific behaviour?	-	No
	Commitment	Did AKKA facilitate involvement in mental activities?	Yes	Yes*
		Did AKKA facilitate involvement in physical activities?	Yes	No
		Did AKKA facilitate participation and interaction?	Yes	No
	Context	Did AKKA allow for sharing of experiences?	Yes	No
		Did AKKA facilitate an open and trusting environment?	No	No
		Did AKKA facilitate conditions for interpersonal relationships?	Yes	No
During-Training	Content	Did the data collected with AKKA offer opportunities for clarifications and explanations?	No	No
		Did the data collected with AKKA allow for feedback related to the individuals' skills?	-	No
		Did the data collected with AKKA allow for feedback related to the individuals' specific behaviour?	-	No
	Commitment	Did AKKA facilitate involvement in mental activities?	Yes	No
		Did AKKA facilitate involvement in physical activities?	Yes	No
		Did AKKA facilitate participation and interaction?	Yes	No
	Context	Did AKKA allow for sharing of experiences?	No	No
		Did AKKA facilitate an open and trusting environment?	No	No
		Did AKKA provide conditions for interpersonal relationships?	Yes	No
Post-Training	Content	Did the data collected with AKKA offer opportunities for clarifications and explanations?	Yes	No
		Did the data collected with AKKA allow for feedback related to the individuals' skills?	-	Yes
		Did the data collected with AKKA allow for feedback related to the individuals' specific behaviour?	-	Yes
	Commitment	Did AKKA facilitate involvement in mental activities?	Yes	No
		Did AKKA facilitate involvement in physical activities?	Yes	No
		Did AKKA facilitate participation and interaction?	Yes	No
	Context	Did AKKA allow for sharing of experiences?	Yes	No
		Did AKKA facilitate an open and trusting environment?	No	No
		Did AKKA provide conditions for interpersonal relationships?	Yes	No

Table 6: AKKA's contribution on indicators of learning

* AKKA facilitated involvement in mental activities for the participants who had been given the list of observation questions however several participants did not receive the list before the exercise.

By looking at the table one sees that the technology influenced the elements of learning for the exercise participants in a small degree. The technology can influence the participants' content in the post- training phase given that they receive the information. Otherwise the technology did not have a direct effect on the participants. The observers were influenced in a larger degree, especially in the pre- training and the post- training phase. Learning is a continuous process results on learning can therefore not be revealed after just one exercise, however it seemed like some of the conditions for learning was in place for the observers before, during and after the exercise in Hell.

4.2.2 Demo 2

This demonstration was held on the 24th of April. The BRIDGE concepts were presented to approximately 20 end-users. They were divided in three groups and were presented with different concepts cases. Each group got to see three concept cases. During the presentation of the concepts cases the end-users were allowed to ask questions and provide feedback regarding the solutions. At the end of the day and the following day interviews were conducted. One group got a presentation of the Concept Case Training, as part of this Concept Case three tools were presented; MeTracker, AKKA and VBS2. MeTracker and AKKA have been in focus during this study and results from these tools will be presented in the following. The results are based upon comments the end-users made during the demonstration and following interviews.

MeTracker

The demonstration of the Concept Case Training started with a presentation of MeTracker. This is a program which is under development and it was made clear that inputs from the end-users were appreciated. During the presentation of MeTracker, lots of comments were made regarding necessary needs and solutions. A comment was made regarding learning and testing of plans, and that there was a need for a distinction between the two early in the planning process. Most of the discussion revolved around what one should consider when planning an exercise, like available resources, establishing clear goals and other methodological elements. MeTracker is a program that can guide the user through the process of designing a training scenario, the basis for the steps in MeTracker is theory on training. Most of the comments made during the presentation verified the content in the phases. One of the end-users pointed out that it was important that the end product of MeTracker was a shortened version of the data implanted in the program. He said that one would use a lot of data in the analysing and planning phase of an exercise which would function as the basis for the decision making process, however this information would not be necessary during the exercise. He said that the end-result should only consist of documents directly relevant to the exercise for instance a list of observation questions. MeTracker should not only be a process of guiding one through the planning of an exercise, it should provide something tangible which can be

used further. Other end-user representatives seemed to agree with him. One end-user said that the most important information in MeTracker should be learning points which could be used to formulate training goals. One appreciated that the program allowed for people working together when they are physically at different locations. He said that it could save time and that it would make cooperation easier. One of the end-users pointed out that learning is not just something that happens during training. He said that teachers use 6 months to teach a subject. To believe that learning happens during an exercise is a little naïve. He said that a change in the way we view exercises might be necessary.

When comparing MeTracker to the non- technological alternative it was found that the program contributes to several aspects which are not supported by other solutions. The program allows for tracking of the process when designing a training solution. By using the program one can see how far one has gotten in the planning process and how much work is left. This can help monitor the progress of the planning process and be used as basis when assigning resources. Thus the program can function as a project management tool. This kind of automatic tracking will not be possible without the technology. After the phases Analyse and Plan have been completed, the program automatically generates documentation which can be used further in the Execution and Evaluation phase of the exercise. Through the process of completing the phases one also creates a document which can be used further. This can simplify the design process and save time since one doesn't have to spend time on developing the document. Information letters to exercise participants, observers and markers can also be generated through the program by using templates. This can assist in involving people in an earlier stage. If information letters are generated automatically the threshold for sending them might be lower. Involvement is as mentioned earlier an important part of learning. Involvement also allows for preparation which is according to Vogel-Walcutt et al. (2013) important because it can contribute to focus on more relevant areas during training. MeTracker offer a systematic way of preparing for an exercise where one can focus on one thing at a time. Important elements to consider when designing an exercise are listed and require focus from the planners. This can ensure that certain areas are attended to in the planning stage. This was supported by an end-user who said that MeTracker would allow for focus on one thing at a time. She felt that this could simplify the process of designing an exercise. A risk when using MeTracker is that elements which are not specified in the program are neglected. MeTracker also offer a standardised way of designing an exercise. This can allow for comparison of results from different exercises which again will make it easier to measure improvement from one exercise to another. This was also something that was appreciated by the end- users.

The program allows for storing of materials relevant to the design process, all documentation gathered in the analysing and planning phase can be stored in MeTracker and can easily be retrieved when necessary. This can simplify the process and save time since uncertainties can be clarified when they happen though documentation stored in MeTracker. Information gathered in MeTracker can also be stored and retrieved when planning new exercises. Certain areas in the planning phase will be the same for a variety of exercises in an organisation. Work conducted on previous exercises can be retrieved and used on new ones. This can save time and simplify some of the tasks in the planning phase. A risk when using previous work on new exercises is that the process becomes automated and the planners complete the steps in MeTracker with little reflection on the phases. This can limit the learning outcome for the planners (t Hart, 2002). Experiences and improvement areas from previous exercises can also be stored in MeTracker and used when planning new exercises. This can ensure that previous experiences are considered and contribute to focus on improvement areas during new exercises. This was supported by one of the end- users. He felt that they lacked something when it comes to learning from previous mistakes in the training solution they currently use. His experience was that mistakes made during an exercise was noted in the evaluation report and later forgotten. He said that usually the same mistakes were done over and over again unless someone took initiative and read the report before the new exercise was conducted. MeTracker can contribute to more focus on previous experience and mistakes since data regarding these areas are easily accessed in the program. MeTracker also allows for collaboration at distant locations. Data in MeTracker can be accessed through a web page this means that different individuals can work together on designing the exercise without being in the same room together. They can use the program to follow the process, make changes and add new elements to the exercise. Information regarding the exercise will be available to everyone who has access to the program. This was also something that the end-users pointed at as useful during the demonstration of MeTracker.

During following interviews the end-users were asked about possible challenges regarding the use of MeTracker. One of them said that a challenge would be to learn how to use the technology. New equipment is always a challenge and it is important that the people who are going to use it feel comfortable with it. She said that for MeTracker to be useful it must be used all the time, at small exercises as well as large ones. If the program is only used during large exercises one risk that the users must learn how to use it each time and then the technology will be more of a barrier than a tool. Economy might be another problem when it comes to using the technology. The emergency services do not have a lot of money and getting funding might not be easy. Both of them seemed to think that MeTracker could increase learning from exercises given the right circumstances.

MeTracker's contribution in comparison with the non-technological solution is listed in the table below. The table is based upon feedback during the demonstration, results from interviews and information regarding MeTracker provided by CTAS.

	Advantage over non-technological solutions	Disadvantages	Non technological alternative
BRIDGE MeTracker			
Standardising training	Makes it easier to compare results from other exercises	May not be compatible with non-standard exercises	A universal handbook or checklist on training can contribute to standardisation
Systematic review	A step by step walk-through of factors to consider when planning, executing and evaluating training. Focus on one thing at a time	The process is not always linear	A handbook or checklist on training
Tracks the process	Shows how far one has gotten in the process and how much work is left		
Storing of relevant documentation as basis for the planning process	All documentation stored electronically in one place, can easily be retrieved	Too much documentation can be stored in the program if not used properly	Manuel archiving
Generates documentation and templates automatically	Simplifies involvement of participants and work task related to creating documentation for use during the exercise	Can create more paperwork than necessary	Assembling documentation manually
Storing of experiences from previous exercises	Experiences from previous exercises can be retrieved when planning new exercises		Manuel archiving
Collaboration at distant locations	Can work together with people who are at distant locations, can save time and traveling costs	May loose something when not communicating face to face	Might not be possible without some sort of technology
Recycling	Work from previous exercises can be retrieved and used as basis when designing new training scenarios. Saves time	Risks that the process becomes too automated and learning is reduced	
Motivation	The tool can motivate planners to take the work on the training scenario more seriously		Motivation provided by other factors or people

Table 7: Comparison of MeTracker with the non-technological alternative

AKKA

The second program which was presented was AKKA. During the presentation lots of comments were made. One of them said that one should be careful in collecting and storing to much information, misunderstandings and misinterpretations of the information can lead to situations where incorrect measures are initiated. He said that one could risk too much focus on elements which are not connected. Another end- user said that if one takes pictures and notes during the exercise some of the misunderstandings could be avoided. The end-users had different opinions regarding how one should handle observations and feedback from exercises. One of them said that it was important to be careful when providing feedback to the exercise participants. Criticism could make the exercise participants shut down and reject the information. Another end- user said that it was important to provide direct and concrete feedback. The tangible data from AKKA could be of assistance. A third end- user said that criticism could be well received if the people who were receiving it had the ability to talk back. How feedback is presented is according to several authors ((Bennett, 2010),(Vogel-Walcutt et al., 2013) and (Løvik, 2010)) important, one should make it clear that actions discussed should not be taken personally and allow for open discussions regarding the chain of events and specific actions. One end-user said that learning is about trust and openness. People who see the technology as a threat will just shut down. It is therefore important that people trust the technology. One end- user pointed out that if the technology should be a useful tool it needs to be used all the time, in daily practice, otherwise the technology will be more of a liability than a useful tool. He said that experience with the equipment is important.

When comparing AKKA to the non-technological alternative it was found that the tool offers opportunities to collect and store data from exercises which would not be possible without technology. Through AKKA one can electronically register observations once they are made. This can ensure that details regarding the entire exercise are noted, not just elements which was remembered as significant by the observers after the exercise was completed. This was supported by one of the end-users who said that much information can be lost if the observers don't register their findings during the exercise. Observations are electronically registered with simple Yes/No checkboxes. This can simplify the tasks of the observers since they don't have to keep track on notes and they don't have to write as much as they would without the technology. The tool allows for feedback on a variety of areas in addition to registration of both positive and negative observations. Registration of both positive and negative observation can be of assistance when providing feedback to the exercise participants. They are more likely to be open for criticism if it is combined with positive feedback. AKKA provide the possibility to write detailed notes and take pictures, when information is gathered in a database this can contribute to a solid data foundation which can be

presented to people who did not participate in the exercise as well. Thus it facilitates sharing of information. This was also something that was appreciated by one of the end- users. She said that this is normally a challenge. Everyone who is working in the field needs to participate in the exercise, but that is not the reality. The report which is generated after the exercise is normally more of a summary. She said that it normally would be difficult for people who did not participate in the training activities to learn something from the exercise. By gathering information through AKKA one can influence the context were the learning happens and facilitate sharing of experiences, which according to Sommer et al. (2013) is an important part of learning. The data provided by AKKA can be a combination of written comments, pictures and video recordings. According to Vogel-Walcutt et al. (2013) this form of data combination can influence how the data is received and contribute to a better understanding of the information which is presented. This can be especially useful for individuals who did not participate in the actual exercise. Information collected with AKKA can also be stored electronically and function as learning points when planning a new exercise. This can facilitate a more targeted training solution where the focus in the next exercise is improvement from previous exercises. This was also something that was appreciated by one of the end- users. This end-users experience was that improvement areas discovered after an exercise often was forgotten and not considered when planning a new exercise. Plans and procedures can also be implemented in AKKA and accessed during the exercise. This can simplify the tasks of the observers since uncertainties regarding plans and procedures can be clarified when they are observing and proper feedback can then be provided to the exercise participants after the exercise is completed. AKKA can also be used to send information to the exercise participants during the exercise. This can contribute to a better understanding of the exercise for the exercise participants and it can be used to steer the exercise. This was something which was appreciated by one of the end-users during demo 2 (in addition to several of the observers during the exercise in Hell). As described in the chapter on the Hell exercise, AKKA facilitates the development of a list of observation questions in addition to an educational preparation meeting. This is elements which will be necessary in most training situation where AKKA is going to be used. A consequence of these two elements is increased focus on the tasks of the observers which again can motivate them in their jobs and ensure detailed feedback from the exercise.

The end-users were also asked if they believed that the data from AKKA would be used. Both of them said that it depended on the individual responsible for following up the exercise. It is important that this person is dedicated, that he processes the data and follow up areas where the performance was bad. One of them said that it is useful with predetermined goals, that using these predetermined goals would save time during the exercise and that it simplifies the process since the observations

are registered automatically. One of them said that a challenge would be to make the participants use the technology in the field. He had experience with observers who had a list of observation questions to use in the field, but most of them did not use it during the exercise. When the observers were asked about the list they spent a few minutes on crossing out observations and handed the list in. The other end- user said that one could meet some of the same challenges as with using MeTracker, learning to use the technology and using it frequently enough can present some problems.

AKKA's contribution in comparison with the non-technological solution is listed in the table below. This table is based upon results from both the exercise in Hell and demo 2, in addition to information provided by CTAS.

	Advantage over non-technological solutions	Disadvantages	Non technological alternative
BRIDGE AKKA			
Necessitates the development of a list of observation questions	Predetermined goals and observation questions simplifies the observation process	Areas not covered by the list of observation questions may be neglected	Development of observation questions by own initiative
Electronic registration of observation	Quick and easy registration of observations electronically	Can be more time consuming to write comments on a Pad than using pen and paper	Manual registration of observations
Registering of observations in real time	Analysis in real time	Requires an Internet connection	Observations are manually registered
Written observations combined with visual information	Both visual and written information are provided this can clarify uncertainties		Observations and visual information is recorded separately
Distribution of information to exercise participants electronically	Updated information can be sent to participants to steer the exercise	Requires an Internet connection	Manual feedback
Access to plans and procedures	Plans and procedures can be retrieved during training through AKKA		Bring printed copy's
Necessitates education in the technology or some kind of preparation	Increased focus on the tasks of the observers	Requires time and resources	
Both positive and negative feedback is recorded	Positive feedback is registered in the same extent as negative feedback through the observation questions		Instruct the observers in recording both good and bad comments
Storing of information from exercises	Information gathered can be used as learning points when planning new exercises and say something about typical mistakes and improvement areas		Manual storing of information
Data from the entire exercise is collected	Facilitates sharing of information with everyone involved as well as individuals who were not present during the exercise	The learning outcome is dependent on contextual features	Manual collection of information

Table 8: Comparison of AKKA with the non-technological alternative

5. Discussion

The objective of this thesis was to explain why technological tools for use during training can increase the learning potential for personnel within the professional emergency network. In the results chapter the technology's contribution in comparison with non- technological solutions have been presented. It was clear that the technology contributes with something extra compared to the non-technological solution. In this chapter these elements will be discussed against their influence on the three indicators of learning; content, commitment and context.

5.1 Rena

Rena has fully developed well-functioning training solutions. Experiences from Rena are important because it says something about the potential technological solutions may have. Representatives from both the live-training - and the constructive training department expressed that it would be difficult to achieve the same results without the technology.

Based on the study of the technology at Rena one could say that the technology contribute to more effective and targeted training. The technology contributes to tangible data regarding the exercise which can be used during- and after training. The technology also contributes to concrete feedback and can clarify uncertainties regarding the chain of events. Recordings from the radio can be used as basis for procedural training. Feedback regarding what the situation was at a given time, mistakes that were made, areas of improvement, accuracy and communication influence the content of what is learned. The degree of influence the feedback has depends on how relevant the feedback seems to the people who are learning (Sommer et al., 2013). The data can be considered to be relevant to the individuals who are training since it is directly linked to their behaviour during the exercise. Information gathered by the technology is also the basis for the data presented at the evaluation meeting (AAR). Concrete and honest observations according are to Bennett (2010) important to be able to provide relevant information for the AAR. The technology collects and stores information on all aspects of the exercise automatically. This provides a thorough data foundation and can lessen the burden on the observers. In addition to providing them with a large selection of different data sources which can be combined when presenting materials to the participants (oral, visual, animations, maps etc.).

The data collected during exercises are used during AAR where important aspects from the exercise are discussed in groups. This can be seen as the context where the learning happens. The technology's contribution to the context is through the data collected during the exercise. Conditions during AAR can influence what and how much is learned. The technology facilitates sharing of

information and stories of failure since large amounts of data are collected and discussed during AAR. The technology facilitates feedback in written, visual and oral form this can contribute to a better understanding of the materials which are presented (Vogel-Walcutt et al., 2013). The degree of influence this have on the context depends on the environment surrounding the learning process, it is important that the process is characterised by trust and openness. Otherwise one risks that the people who are supposed to learn simply rejects the information or withholds comments and experiences they made during the exercise. Both DAR and AAR can contribute to reflection, by using collected data the exercise participants are able to visualise the chain of events and are able to recall what happened and further discuss alternative solutions. As mentioned in the chapter on theory of learning is reflection an important part of the learning process (Jacobsen & Thorsvik, 2007) and (Sommer et al., 2013).

The exercise participants' commitment can be influence by participation in the training activities, during DAR and AAR. The degree of influence will vary depending on how actively they are involved. This is a military facility with a top-down structure. A reasonable assumption is that the instructors control what is learned and decide what the necessary training areas are without involving the participants. However the exercise participants are involved in realistic scenarios and are able to experience the consequences of insufficient behaviour. If they make a mistake during training they might be shot and are not able to participate in the exercise any further. One could therefor expect that they are committed. The technology allows for immediate feedback from the observers in Excon to the exercise participants, this can also influence the commitment of the participants since they receive feedback regarding their behaviour while they are doing it. Reflections on actions when they happen can be useful because it can provide insights on important aspects of their actions. If they are not able to reflect during training they might forget to do so afterwards. This was also something the report by Skarpaas and Kristiansen (2010) suggested could improve the learning outcome from the constructive training solution.

The live training solution when used correctly seems to lead to learning this was confirmed by several individuals at Rena. However it is not certain that the there is a direct link between technology and learning. The learning outcome might be just as dependent on instructors who guide the exercise participants, provide feedback and use information gathered with the technology. In addition to contextual features which allows for open discussions and sharing of experiences. At Rena they train on warfare, if they do not take the training seriously they risk severe consequences in a real life situation. This suggests that they are motivated and want to learn. Despite that they are not involved in the process of deciding relevant training areas and other activities which influence their

commitment. The technology contributes with important feedback regarding their actions and this is discussed in a group with other individuals who also want to learn. It seems like the conditions for learning at Rena are in place even though the technology only facilitates part of it.

Much of the same can be said with the constructive solution at Rena. Information gathered with the technology influence the content, and involvement in training activities influences the commitment. The technology provides the participants with scenarios and they play their role in the virtual world. In this solution the technology provides the training environment in addition to facilitate collection of information. The technology also allows for repeated tries in case of failures. The exercise participants can try over again until they get it right. This was something that was suggested by Vogel-Walcutt et al. (2013) as a useful way of preparing for an exercise. Realistic simulations allows for preparation in an environment similar to the environment they will be operating in during a real life situation. Through simulations the participants can experience strategies that work well and strategies that do not. This can influence their commitment and make them want to learn different strategies that work better. As the report of the SLT (constructive) solution suggests there are areas which need improvement (Skarpaas & Kristiansen, 2010). Most of the improvement areas are elements which should exist in a training solution whether one uses technology or not. For instance one of the suggested improvement areas was focus on the framework; the physical environment, the amount of time spent and use of professionals. These are contextual features which should be considered when planning and executing an exercise scenario. Another improvement area was the formulation of clear goals. These goals provide something tangible regarding areas of training. As the leader of SLT department said if we don't have goals we will not get better. The goals influence the content, thus also what is learned Sommer et al. (2013). Without goals there is not something specific for the individual to learn. The report also suggested that learning episodes should be dealt with when they happen. This can ensure that important aspects are reflected on and not forgotten. The last improvement areas the report suggested was to establish procedures that address the follow-up work and procedures for maintaining experiences. This is something that seems to be a challenge in most training situations. Experiences from former exercises are not used further.

Rena has well established technological solutions for use during training. They have years of experience, but there is still room for improvement. The technology supports learning to a certain degree, however there is need for human contributions. Contextual features seem to be difficult to create with the technology. The technology can facilitate meetings and provide information, but it cannot create a learning environment on its own. The challenge might be to integrate contextual features with the technological solution.

5.2 BRIDGE/CTAS

One could expect some of the same challenges in the BRIDGE solution as in the Rena solutions. Contextual elements and elements related to the individuals' commitment will be difficult to support using the technology alone. MeTracker might contribute to more consideration on surrounding elements like involvement of participants on an earlier stage, preparing activities and reviews of results from previous exercises. AKKA can contribute to increased focus on the tasks of the observers and involvement during training.

5.2.1 Training in Hell

AKKA had a small role during the exercise in Hell. Still it was found that AKKA provided contributions which would not be possible without the technology. The technology seemed to have the greatest impact on the observers who used the technology and the ones who were invited to the educational preparation meeting. The elements which seemed to have the greatest influence on the performance of the observers were activities surrounding the technology; the educational preparation meeting and the list of observation questions. The initiative with the educational preparation meeting, focus on the observers work and expectation in addition to involvement from management seemed to influence the observers performance in a positive direction. As the Olympics winner, Egil Søby (2013) said during a motivational seminar "Make Me Feel Important." Everyone wants to feel important. This provides us with motivation to act better. Focus on the observers' roles, expectations, involvement in activities before the exercise, being given technology to support their jobs probably made them feel like their contribution was important and provided them with motivation to perform their task as well as possible. This might be the reason why the observers who participated in the activities before the exercise appeared more active and involved in their roles then the ones who did not. They followed their study objects closely and seemed more certain regarding their roles. The same can be said about the observers who attended the meeting, but did not use AKKA during the exercise. The observers who were present at the educational preparation meeting appeared more dedicated than the ones who were not. The observers were also given the opportunity to prepare for the exercise using the list of observation questions this can also have influenced their performance during the exercise. Since the list of observation questions could be used to find relevant areas for them to focus on during the exercise. Involvement in activities is also an important part of learning. The observers were motivated and involved in both mental and physical activities before, during and after the exercise. They participated in preparing activities before the exercise, studied the exercise participants during the exercise and discussed the exercise participants' actions afterwards. During the activities related to the technology they seemed to reflect on several aspects through multiple discussions and they shared knowledge and experiences.

By doing this one could say that they created a context for learning. Reflection is an important part of the learning process. According to the model by Sommer et al. (2013) can the reflection process lead to change, confirmation and/ or comprehension, which are all elements of learning. The foundation for learning was in place for the observers. Their commitment was influenced by the focus on their tasks and by involving them in preparing activities, the context was influenced through discussions before and after the exercise and the content was influenced through the list of observation questions and data assembled during the exercise. A reasonable assumption is that they learned something from the exercise. When asked about learning they also confirmed this.

The exercise participants were not included in the activities AKKA facilitated. It is interesting that the people who are supposed to learn are the people who are least involved. The exercise participants could with benefit be involved in the same activities as the observers since involvement is an important part of learning. By being allowed to prepare they could focus on the relevant areas during training and reflect on own actions after training. Improvement areas will be better received with the individual if this person is the one who is suggesting Vogel-Walcutt et al. (2013). It will be difficult for exercise participants to suggest improvement areas if they are not aware of the areas they are evaluated on. By involving them in the educational preparation meeting the exercise participants could also familiarise with the technology. This could make them trust the technology which again makes them less likely to reject the information provided by AKKA.

The observed effect AKKA had on learning for the exercise participants was only indirect. The data collected with AKKA was not presented to the exercise participants during the evaluation meeting. Only a few of them were given the list of observation questions to prepare for the exercise, however this was only on the initiative of the observers. The effect AKKA had on the rest of them will probably vary depending on the information provided to them from the observers. The exercise participants may have been influences by the observers' commitment during and after the exercise. In addition data collected by AKKA can influence what is learned if the data from AKKA is presented to them.

The degree of involvement in activities surrounding the exercise points to a more traditional view of learning. The planners of the exercise made all the decisions regarding what the exercise participants were supposed to learn and how they were supposed to learn it. This is typical for class room situations where the teacher is supposed to learn the passive student something. Learning is in this view seen as something the individual acquire. Important social aspects of learning may be neglected in this view of learning. As described by Sommer and Njå (2011) sharing of experiences and involvement in activities can improve learning for emergency workers. These conditions did not seem to be in place for the exercise participants. Their role during this exercise was to show up, do their

job and attend the evaluation meeting. The observers evaluated the exercise participants' performance based upon what the planners said was important. Feedback during the evaluation meeting was of shallow nature and no one seemed to take notes. Learning based upon shallow comments during the meeting will probably be difficult. However the follow-up process and the evaluation report might influence the exercise participants learning. Information gathered with AKKA can be of assistance when developing this report and in the follow-up work. The degree of influence will depend on contextual factors and the individuals' commitment. One could say that AKKA provided motivation for the observers and facilitated concrete and specific feedback. The quality of the feedback was a result of the observers' efforts. Data collected by the observers during the exercise can be seen as the content of what is to be learned by the exercise participants. Detailed feedback on both positive and negative aspects of their actions can be important learning points for the exercise participants. The data can be seen as relevant for the exercise participants since it is concrete information on their behaviour during the exercise. Based on data provided by AKKA the exercise participants might learn something. However it is not certain that the exercise participants will assimilate the information provided by AKKA. Contextual features surrounding the aftermath of the exercise will influence what and how much is learned. How the information is presented, acceptance within the learning group and the individuals' commitment will influence the learning outcome. It cannot be taken for granted that the exercise participants learned something based upon information collected through AKKA. Involvement in activities before the exercise could have had a positive effect on the exercise participants in the same way as with the observers. This could increase the possibility of learning for the exercise participants. Involvement in activities after the exercise can also contribute to learning in a larger extent. That being said the exercise participants most likely learned something from the exercise. They were actively involved in the exercise and in the evaluation meeting. However how much of the learning the technology facilitated is uncertain.

The technology has a potential of doing much more than what was done in the field during this exercise. None of the observers used the technology's full potential during the exercise. This is probably a consequence of poor information in advance. O1 also could have taken pictures, and both of them could have looked up different procedures and perhaps added more comments. The technology also has a map function; due to technical difficulties it was not an option to use this function during this exercise. By using the technology's full potential one could expect more detailed and concrete feedback. This could influence how the feedback is received and contribute to a better understanding of the feedback for the exercise participants. However since the exercise participants were involved in such a small degree it is not certain that more detailed and concrete feedback would have had an effect on the exercise participants learning.

5.2.2 Demo 2

MeTracker

MeTracker is still under development and have never been used. The following discussion is therefore of hypothetical nature. How MeTracker can work is based upon information provided by CTAS. MeTracker provides a solution for designing a training scenario which is not supported by the solutions the medical emergency services use today. Most of the elements MeTracker facilitates can also be conducted without technology. One can work through the phases in MeTracker and manually create proper documentation. A handbook on training may have the same effects on standardising training as MeTracker have and one can plan an exercise systematically by using pre-planned steps. Relevant materials can also be gathered and stored manually. There is however not a solutions which integrates all these elements to one package.

MeTracker allows for systematic review of several phases necessary when designing a training scenario. This form of review can make the planners consider aspects of the scenario they might not would considered without the tool. For instance in MeTracker the process of evaluation will be considered in the Analysing phase, this can contribute to more focus on elements related to the evaluation early in the process and perhaps lead to a more coherent solution. Further this can contribute to increased focus on the evaluation process which again can ensure that experiences are shared and maintained after the exercise. By offering a standardised way of planning an exercise MeTracker also facilitates comparison of results. This can reveal reoccurring problems within the organisation. Storing of information from previous exercises can also contribute to finding reoccurring problems. End-users from demo 2 expressed that there usually was little correlation between exercises and that the same problems occurred over and over again. The same attitudes could be seen during the evaluation meeting after the exercise in the Hell tunnel, where they expressed that the improvement areas were pretty much the same as from previous exercises. Storing of documentation relevant to the design process from previous exercises can simplify the design process and increase the quality of the process. Since the planners can focus on new elements and don’t have to spend as much time on elements they have considered before. One can just find a similar exercise and use much of the same elements over again. A risk with doing this is that the process becomes automated and the planners use works on previous exercises without reflection. This can also counteract learning for the planners. The elements mentioned above will influence the quality of the design process thus also how the exercise is conducted. The content of what is learned during the exercise is related to the process before the exercise.

MeTracker generates documentation automatically through templates, for instance information letters or list of goals. This can increase the probability of involvement of the exercise participants earlier in the process since the letter is generated automatic the threshold for sending the letter to the participants will probably be lower. Thus MeTracker can have influence on the exercise participants' commitment. The planners' commitment can be influence simply by given them the program, since the gesture provides increased focus on the planners' tasks. The program facilitates automatic tracking of the design process this can motivate the planers to consider several aspects of training. It can also motivate them to use information collected during the exercise since the final phase in MeTracker is lessons learned. Maintaining and using experiences from exercises seems to be a reoccurring challenge in the training methods the emergency services use today.

The context can be influenced by MeTracker since the program allows for focus on learning through the phase lessons learned. This can contribute to an environment which focuses on learning. However other contextual features most likely will influence the setting in a larger degree. Trust, openness, social climate, structures within a group and interpersonal relationships are contextual features which have a large influence on what is learned.

This program was not studied in use and the interviews were with individuals who had gotten a presentation of the program not actually used it. It would be easier to say something about the learning potential had the program been fully developed. MeTracker is built for use by the planners, the program in itself does not allow for involvement of the exercise participants in a large degree. An information letter can be generated to them and preparing activities can be set in motion initiated by MeTracker, however the individual participant is not in focus. By using the program the planners can design good training scenarios where important considerations are made this can increase the quality of the scenario and again the exercise participants' possibility for learning. MeTracker is not a learning tool for the exercise participants but a means to create training scenarios. The effects MeTracker have on learning for the participant's seem to be indirect.

AKKA

AKKA is a tool which can gather detailed information during exercises. Most of the differences AKKA facilitates in relation to non-technological solutions will have an impact on the content of what is learned. Concrete and detailed feedback, registration in real time, combining written and visual information, registration of both positive and negative feedback, access to plans and procedures and the list of observation questions will influence the quality of the feedback from exercises. This can contribute to a better understanding of the materials which are presented and influence how well the information is received by the exercise participants. How the information is presented to the

exercise participants is important. It is not certain that the exercise participants will receive feedback from the exercise well. This was also discussed by the end-users during demo 2. When presenting information to the exercise participants it is necessary to consider different aspects of learning. The methods described by Vogel-Walcutt et al. (2013) regarding information presentation can be of assistance. However they seem to have a top-down view on learning, where the instructors are supposed to teach the exercise participants how things should be conducted without involving them. Sommer et al. (2013) has a different view on this where involvement in activities is seen as an important part of learning. It will be difficult to teach the exercise participants something if they find the information provided as irrelevant. By involving them more in the process they will be able to influence what is learned and one could expect that they receive the provided information better. Registration of observations in real time can also contribute to more concrete feedback and prevent loss of information. Much information may be lost if it is not noted when it is observed. Memories are not static they change over time, if observations are noted after the exercise is completed one could expect incomplete and perhaps incorrect feedback from the exercise. The registered observations are influences by what was registered during the event, information gathered after the event and the observers own perceptions of the event. To render observations correctly after time has passed can therefore be difficult (Olsen, 2012). The time available for the observers to be influenced by other factors is reduced when observations are registered in real time. One can therefore expect more accurate feedback regarding the exercise. A risk when assembling a lot of information from exercises electronically is that incorrect feedback can be recorded. This can for instance be a misunderstanding regarding the observation question or that one accidentally checks off the wrong box. Since data is analysed in real time one risk that these mistakes are not corrected and the results from the exercise point to a tendency which is incorrect. This can influence the content of learning in a negative way and lead to a situation where wrong measures are initiated. Data collected by AKKA can also be used when planning new exercises to make sure learning points are considered when planning new ones. The intent with the FRITS solution is that positive response and improvement areas are recorded with AKKA and after the data has been processed it will be implemented in MeTracker. This connection between the two programs might improve learning from training since the tendency is that previous experiences are not used further.

The commitment of the exercise participants can be influenced by involving them in certain activities and allowing for influence on the exercise. The exercise participants can be involved in the process of developing the list of observation questions, through meetings before and after the exercise in addition to participation in the actual exercise. Allowing for influence on elements of the exercise can make the exercise participants more open for learning. The exercise participants may have different

thoughts regarding necessary learning points and improvement areas then the planners do. If the exercise participants don't find the improvement areas and goals suggested by the planners as relevant they might not learn anything (Sommer et al., 2013). Involvement in activities before the exercise can make them see that improvement is necessary on certain areas. And involvement in training activities can make them experience elements of their practice that work well and elements that do not. This can motivate them to adjust their behaviour to more beneficial way of doing things, thus influence learning. AKKA can also be used by the instructors to guide the exercise participants. They can use the program to send relevant information to the exercise participants. This can contribute to the involvement by providing the participants with necessary information and pointing them in the right direction with respect to the goals of the exercise. AKKA facilitates some sort of preparation. However it seems that the factors which influence the individuals' commitment require a human touch. Creating an environment which allows for involvement and feedback cannot be done using a technological tool. The technology can be the reason why meetings are held, but conditions that allow for involvement and active participation requires individuals who create this type of environment. The effect AKKA has on the commitment seems to be only indirect. AKKA facilitates certain activities which again can influence the commitment.

Information collected with AKKA can also influence the context of learning. By collecting data one can contribute to sharing of experiences and stories of failure. The quality of the data will influence how the data is received by the exercise participants. By allowing for feedback on both positive and negative aspects and combining written and visual information one can create a better data foundation which can be presented to the exercise participants. However trust is an important part of the context, the exercise participants needs to trust the technology and feel secure in the environment for them to be able to discuss actions and experiences. A trusting and open environment can contribute to this (Sommer et al., 2013). If the exercise participants don't trust the technology they may reject data provided by it and the tool can lose some of its intended effect. This was also something one of the end-users pointed at as important. Learning happens within a context, acceptance within the learning group is crucial when it comes to the technology's influence on learning. For the tool to be useful one need to consider how the tool is implemented in the organisation and allow for open discussions regarding the tools use. This is something which needs to be considered before one starts to use the technology. The preparing activities AKKA necessitates can be of assistance when it comes to gaining the exercise participants trust. Involvement in a preparation meeting where the technology is presented and allowing for open discussions on the list of observation questions can make them feel more secure with respect to the technology. The preparing activities can also contribute to an environment where the individuals can learn from each

other through discussions and reflections within the group. Through these meetings and preparing activities one can achieve what Wenger (1998) calls communities of practice. He defines communities of practice as platforms were people come together because they share a common concern or passion for something. As a consequence they share knowledge and experiences which results in learning. It seemed like the observers from the exercise in the Hell formed a community of practice. Their common interest was to get good results from the exercise. Their community was created through several meetings initiated on the basis of AKKA and during interactions after the exercise. The same might be achieved with the exercise participants if they are included in similar activities. The technology can lay the foundation for this type of environment since it provides the exercise participants with an arena where they come together. However interpersonal relationships, social climate and structures within the group have a large influence on the context. The technology in itself has little influence on these elements.

AKKA can have a direct impact on the content, however it seems that the tool only have an indirect impact on the two other indicators for learning; the commitment and context. AKKA can influence the individuals motivation for learning and the environment where the learning happens, however certain conditions needs to be in place to allow for learning to happen. Providing the exercise participants with information collected with AKKA and expecting them to learn without focusing on the other aspects of learning might be farfetched.

The FRITS solution consists of both MeTracker and AKKA. When these two work together one could create conditions for learning first by designing a training solution which supports improvement by using previous experiences second by assembling data and creating a foundation with results from exercises. Both the programs influence the content of learning to some degree. By using the programs one could improve the quality of the training and the data foundation. This can facilitate influence on the other indicators of learning given the right conditions. It can for instance assist in involving the exercise participants in a larger extent through information letters and preparation meeting, thus influence their commitment. Together the programs can influence learning, however learning is also dependent on factors that the technology don't provide.

The studies of Rena, Hell and demo 2 suggest that the technology can have an influence on the learning potential from training for the professional emergency network. The technology facilitates certain elements which can contribute to learning. One of the main contributions is through the collection of data from exercises. This can contribute to data of better quality which can be presented to the exercise participants. The study of Rena suggested that the collection of data from exercises was one of the main sources to learning since the data was discussed in groups after the

exercise. AKKA can provide similar data as the technology at Rena by using AKKA one could therefore expect similar results as at Rena. However it depends on if the data is used and how it is used. Data from the exercise in Hell had been gathered and were available for sharing during the evaluation meeting, but it was not shared with the exercise participants. In this case the data was not used because AKKA had a small role during the exercise and the majority of the participants were not affected by the tool. However it is clear that the conditions surrounding the exercises have an influence on what and how much is learned. Results from the exercise in Hell suggested that involvement in activities, allowing for discussions and interpersonal relationships enabled the observers to share experiences and can have motivated them to perform their tasks better during the exercise. This illustrates the importance of considering the other elements of the individuals learning; context and commitment. This can also be important elements to consider for the third BRIDGE demonstration. Involving both participants and observers in a larger degree, allowing for influence on learning points, allowing for open discussions and focus on learning can influence the learning potential in a positive direction. During the exercise in Hell the observers expressed that too little time was set aside to education in the technology. This is also a lesson for the third demonstration. Allowing for practice on using AKKA can make the users feel more secure regarding the tool and therefor also increase the probability for them to use it. Observers also expressed that there was not enough available Pad's. By using more Pad's one can collect data from a larger spectre of the exercise. This can make the data from AKKA appear relevant to a larger number of participants and provide a better data foundation from the exercise. During the exercise in Hell the technology had a small role, use of technology was not planned for and elements of CTAS learning and training process had not been considered. This can be important elements to consider for demo 3, creating an integrated solution were the use of technology is planned for and set aside more time for preparing activities. During demo 3 it can also be useful to study MeTracker more closely while in use. This can provide more accurate results on the effects the program can have on learning. The integrated FRITS solution consisting of both AKKA and MeTracker can contribute to increased focus on previous experiences. This can have an indirect effect on what is learned by the participants.

6. Conclusion

The studies of Rena, the exercise in Hell and demo 2 confirmed that the technology contributes with something extra during training. The technology can make the planning of exercises more efficient, assist in collecting information and contribute to a better data foundation from exercises. The data collected does not in itself increase learning, but it can be used for better feedback during evaluation which again can increase the learning potential. The extra contribution the technology provides has an effect on what is learned. The technology does not have a direct impact on the commitment and the context of learning, but it can influence activities which again influence these elements. It was found that the technology may influence the commitment of the observers since the technology promotes preparing activities which allows for involvement. Preparation meetings may also influence the context since it allows for interactions and discussions within a group. Studies of the exercise in Hell show that the observers' commitment and the context were influenced in a positive way through all the activities AKKA promotes. Technology can improve the learning potential from training, but other conditions for leaning need to be in place and will influence the realisation of the learning potential. Focus on the individuals learning, allowing for influence on learning points, allowing for involvement and focus on contextual features in combination with the technology can provide good conditions for learning for the emergency response personnel. With this in place technology can increase the learning potential from training activities.

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APPENDIX

Appendix 1. Rena: Oppfølgingsspørsmål

Virtuell trening

Jeg sender deg noen oppfølgingsspørsmål som jeg håper du kan ta deg tid til å svare på. Svarene vil benyttes anonymt i min masteroppgave som omhandler læring ved hjelp av teknologiske virkemidler under øvelser.

1. Hva vil du si er de positive sidene ved virtuell trening kontra trening uten bruk av virtuelle løsninger?
2. Hva vil du si er de negative sidene?
3. Hvilke ferdighetsområde opplever du at man kan forbedre seg mest i ved hjelp av virtuell trening kontra tilsvarende øvelser uten disse virkemidlene?
4. Hvordan ville treningen blitt gjennomført dersom dere ikke hadde mulighet til å trene i et virtuelt miljø? Ville det vært mulig å oppnå de samme resultatene ved denne metoden?
5. Hvilke tilbakemeldinger har du fått fra de som øver vedrørende denne treningsformen?
6. Er det noe du kunne tenke deg å endre på i forhold til metoden som benyttes i virtuell trening nå?
7. I hvilken grad blir during action review (DAR) og after action review (AAR) benyttet ved virtuell trening og hvordan gjennomføres evt. dette?
8. Hvis DAR og AAR gjennomføres hvor viktig mener du at dette er med tanke på læringsutbyttet?
9. I hvilken grad tror du at teknologiske virkemidler kan øke læringsutbyttet for *individer* før, under og etter øvelser? Teknologiske virkemidler brukes her som en samlebetegnelse på teknologisk utstyr som kan brukes som assistanse i øvelser. Her inngår virtuelle treningsløsninger i tillegg til annet utstyr f.eks. videoopptak, lydopptak etc.

Live trening

Svarene du kommer med vil bli benyttet anonymt i min masteroppgave som omhandler læring ved hjelp av teknologiske virkemidler under øvelser. Jeg har fått en omvisning på Rena og sett mye av utstyret dere benytter.

1. Hva vil du si er de positive sidene ved å bruke teknologisk utstyr til å samle inn informasjon i en øvingssituasjon? (tenker da informasjon i from av GPS- koordinater, samband, bilder og annen informasjon fra ExPERT).
2. Hva vil du si er de negative sidene?
3. Opplever du at informasjon innhentet ved hjelp av teknologiske virkemidler bidrar til økt læringsutbytte hos de som trener?
4. Tror du at det samme læringsutbyttet kunne blitt oppnådd ved å trene uten dette utstyret?
5. Hvilke ferdighetsområder opplever du at man forbedrer seg mest i ved hjelp av informasjon innhentet under øvelsen?
6. Er det noe du kunne tenke deg å endre på i forhold til metoden som benyttes til trening nå?
7. Hvilke tilbakemeldinger har du fått fra de som øver vedrørende denne treningsformen?
8. Hvordan vil en during action review (DAR) og en after action review (AAR) gjennomføres? Hva slags informasjon vil normalt bli tatt i bruk?
9. Hvor viktig mener du at DAR og AAR er med tanke på læringsutbyttet fra øvelser?

Appendix 2. Øvelse Hell: Observasjonsmoment

Under opplæringen:

- Hvordan blir informasjon om øvelsen og teknologien presentert?
- Hvordan forholder observatørene seg til AKKA-teknologien?
- Hvordan tas teknologien i bruk?
- Hvor brukervennlig fremstår teknologien?

AKKA-teknologiens påvirkning på observatører

- Bidrar teknologien med noe nytt?
- Bruker observatørene til å styre deltakerne under øvelsen?
- Virker det som om arbeidsoppgavene deres blir enklere ved hjelp av teknologi?
- Virker teknologien forstyrrende på dem?
- Blir informasjon som kan brukes til evalueringen registrert?
- Ble teknologiens fulle potensial utnyttet?

Etter øvelsen

- Hva er de umiddelbare tilbakemeldingene?
- I hvor stor grad har AKKA-teknologien plukket opp sentrale hendelser fra øvelsen?
- Fremstår det som om teknologien har bidratt til at elementer blir påpekt som ikke hadde vært synlige uten teknologi?
- Hvordan fungerer teknologien? Får en frem den informasjonen en ønsker?
- Hvordan blir informasjonen benyttet under evalueringen?
- Forstyrrer teknologien på noen måte under evalueringen?
- Virker det som om observatørene tar til seg informasjon og reflekterer over øvelsen på bakgrunn av informasjon innhentet gjennom teknologi?
- I hvilken grad fører informasjon innhentet vha. teknologi til diskusjon, refleksjon og samtaler mellom observatørene?
- Bidro teknologien til at noen av øvingsmålene ble oppfylt?

Appendix 3. Øvelse Hell: Intervjuguide

1. Hvordan opplevde du informasjonen som ble gitt på møtet før øvelsen?
2. Hvordan opplevde du at teknologien fungerte på dette møtet?
3. Har du erfaringer med bruk av tilsvarende teknologi (nettbrett, pad, andriod telefon)?
4. Hva syns du om Excel arket med observasjonsspørsmål som ble delt ut?
5. Tror du at et tilsvarende ark hadde blitt utarbeidet dersom AKKA ikke hadde vært i bruk under øvelsen?
6. Hadde du fått de samme observasjonene uten listen med observasjonsspørsmål?
7. Hvorfor valgte du å (ikke) bruke Pad under øvelsen?
8. Hvordan opplevde du at teknologien fungerte?
9. Opplevde du at arbeidsoppgavene dine ble enklere ved å ta i bruk AKKA?
10. Opplevde du at teknologien var forstyrrende på noen måter under øvelsen?
11. Tror du at teknologiske løsninger kan føre til økt læringsutbytte fra øvelser, f. eks informasjon innhentet gjennom teknologi? Ser du noe nytte av teknologi under øvelser?
12. Tror du at AKKA kan føre til økt læring?
13. Hva tror du kan være med å øke læringsutbyttet fra øvelser?
14. Tror du at info innhentet vha. AKKA kan føre til at personen du observerte lærer noe mer?
15. I hvilken grad påvirket teknologien din rolle som observatør?
16. I hvilken grad opplevde du at teknologien bidro til diskusjon og refleksjon ***etter*** øvelsen?
17. Hva mener du at kunne vært gjort annerledes for å øke læringsutbyttet fra øvelsen?
18. Hva syns du om øvelsen?
19. Tror du at dine erfaringer fra denne øvelsen vil føre til at du gjør noe annerledes ved fremtidige hendelser?
20. Er det noe du vil legge til angående øvelsen eller teknologien?

Appendix 4. Demo 2: Intervjuguide

1. Hvordan opplevde du informasjonen som ble gitt under demonstrasjonen av treningsløsningen?

2. Hva syns du om MeTracker?

3. På hvilken måte tror du at MeTracker kan støtte dere i planleggingen, utførselen og evalueringen av en øvelse?

4. Opplever du at MeTracker bidrar med noe nytt i forhold til måten dere planlegger øvelser nå?

5. Tror du at et slikt verktøy kan føre til økt læring av øvelser?

6. Hvilke positive effekter tror du MeTracker kan føre til?

7. Hvilke utfordringer tror du MeTracker kan møte under bruk?

8. Hva syns du om AKKA- løsningen?

9. Er dette et verktøy som kan støtte dere i planleggingen, utførselen og evalueringen av en øvelse?

10. Er dette et verktøy du tror du kunne benyttet f.eks. dersom du var observatør/kontrollør? Tror du at det er lett å bruke?

11. Tror du at AKKA føre til økt læring (refleksjon, diskusjon, endring i atferd)??

12. Hvilke positive effekter tror du AKKA kan føre til?

13. Hvilke utfordringer tror du AKKA kan møte under bruk?

14. Hva skal til for å få gode observasjoner under øvelser?

15. Hva må til for å oppnå læringseffekt fra en observasjon?

16. Hva mener du er viktigst å fokusere på for å få best mulig læringsutbytte av øvelser?

17. Tror du at teknologiske løsninger kan føre til økt læringsutbytte fra øvelser, f. eks informasjon innhentet gjennom teknologi? Ser du noe nytte av teknologi under øvelser?

18. Hva tror du kan være med å øke læringsutbyttet fra øvelser?

19. Er det noe du vil legge til angående øvelsen eller teknologien?