THE DISCOVER PROJECT
DEVELOPING INDUSTRIAL COMPETENCES THROUGH VIRTUAL ENVIRONMENTS

Lisbeth Hansson

MARINTEK, P.O.Box 4125 Valentinlyst, N-7450 Trondheim, Norway

Lisbeth.Hansson@marintek.sintef.no

Keywords: Team training, Virtual environment, Simulations

Abstract

The DISCOVER project will investigate the capabilities of networked virtual environments to develop the competences of teams of individuals working in the Oil and Gas and Maritime sectors. Two real-time training and assessment simulations will be developed to function over company intranets and ultimately the WWW. The networked simulations being developed will focus on Incident Management Team training.

The DISCOVER project seeks to develop and test simulations which can allow such distributed teams of individuals to be trained and assessed. The main advantage is that team training in crises management can be performed far more frequent resulting in improved safety.

The proposed paper will present full aims of the project and discuss the methodologies and technologies employed. The DISCOVER system including a theory module, an administration tool and the two simulators, will be presented by describing a real training situation. The main focus in this paper will be to describe the type of training and the target groups for the training system.

The co-funded EC project will come to an end in October 2001 after three years of development. It has been co-ordinated by MARINTEK and the 12 partners include training centers, research institutes and software developers. Norwegian partners are Telenor, DNV, Statoil and MARINTEK. The other countries involved are Denmark, Finland, the United Kingdom and Germany.

Introduction

Effective safety-critical training in the maritime and offshore domains is crucially important. Disasters such as that which overtook the Piper Alpha oil platform in the North Sea in the 1980s, the loss of the ferry "Estonia" during a Baltic crossing and most recently the sinking of a Greek ferry "Express Samina" all highlight the need for team-based training in such high-level skills as situational awareness, decision making and leadership.

Whatever the domain, the undertaking is often almost prohibitively expensive, since trainees are co-located at a specialist training sites for several days at a time, or in the case of the offshore industry, hugely complex disaster simulations which are created *in situ* involving the coordination of large numbers of personnel and multiple agencies. DISCOVER will provide a virtual reality based series of collaborative training simulations, which could dramatically reduce the need for senior mariners and offshore workers to have to attend courses or run quite so many expensive exercises. It is envisaged that while the system will be made available at existing training centres, it will also be used offshore or on board ships more frequently.

For acceptance by the training community to be a realistic possibility, the technology must be grounded in current policy and practice, have real utility for those involved and stakeholders are playing a significant part in the design of the system. Industry institutions validating training provision will review the DISCOVER simulation within a complete training concept, not in isolation.

Background

Oil and gas companies and shipping companies are subject to heavy regulatory pressure designed to protect people, company assets and the environment. Traditionally, within the oil and gas and shipping sectors, employees have to participate in incident management exercises at training centers and participate in drills on board vessels or on offshore installations. Both are costly to run and usually logistically difficult to organise due to the shift/voyage nature of employment patterns.

Currently available computer based training (CBT) is given in simulation centres or by remote training using courses with CD-ROM and multimedia. The practising on board plays also a fundamental role especially in incident management training. Although these methods are useful they have limitations for flexible training. Multimedia uses videoclips which means that interactivity is poor and onboard training easily leads to routine without motivation.

The DISCOVER project investigate benefits and limitations for multi-user collaborative virtual reality (VR) based simulations for training in the maritime and offshore exploration industries by designing, testing and evaluating two multi-participant industrial simulations.

Project objectives

The objectives of the project are to design, develop and validate collaborative virtual reality based simulations for training and assessing teams operating in the maritime

and offshore exploration and production sectors. More specifically, the project focuses on the management of emergencies on ships or offshore installations, and thus such skills as situational awareness, communication, decision making, leadership and teamwork.

The DISCOVER simulations being built are intended to be offered as complementary services to the traditional simulations exercises not as replacement services. The simulations are intended to:

- offer better opportunities for more varied assessments - ultimately with the aim of reducing risk by minimising the opportunity for human error
- provide cheaper, more flexible and regular training and assessment provision
- be installation or vessel specific
- provide a competence assurance "audit trail" for companies to track employees performance assessments

The DISCOVER system

The DISCOVER system consists of the two simulators, one designed for maritime use with a 3D model from a passenger vessel and the other for the oil and gas sector, based on a 3D model of an offshore installation in the North Sea. For demonstration purposes only parts of the ship and the offshore installation have been modelled. Virtual persons called avatars represent the trainees in the virtual environment. The functionality of the simulations is demonstrated by means of short training scenarios.

In the future the modular DISCOVER system will have the possibility of combining a number of 3D models and scenarios to support all required training scenarios.

In order to provide a more complete training programme for crisis management, the DISCOVER system also includes an on-line theory module on crisis management which users will be asked to complete before starting training on the simulators. We are also building an administration system where trainees can register, the tutor can plan new training exercises and assessors can post-evaluate the training.

The DISCOVER simulations have been designed to run on PCs and the administration of the exercises can be made over the WWW. The figure describes how this distributed training can take place. The idea of using a virtual environment in this distributed simulation is to "set the scene" in a way that the participants get a feeling of being in the same environment. Figure 1 gives an impression of the training situation using DISCOVER.
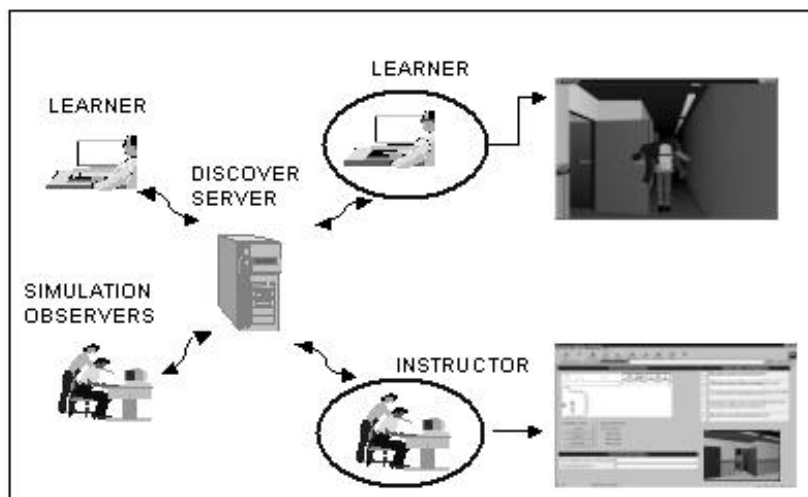
Figure 1 Illustration of the training situation using DISCOVER

Target groups

The target groups for training provided by these simulations comprise all personnel whose job descriptions indicate that they have a significant role to play in the process of managing a potentially dangerous incident.

These target individuals are:

- In the maritime sector persons employed in passenger carrying shipping companies - ferry or cruise
- In the offshore sector persons employed in hydrocarbon exploration and production companies and engaged in the extraction of hydrocarbon

The companies are trying to find ways of ensuring that they have the right people in the right positions with the necessary competence to take the right decisions at the right times. It is not just important that employees provided with these facilities and systems can operate them effectively and safely at all times - many companies relay upon their employees to make decisions that can have an effect upon the profitability of the business. In order to be able to make the right decisions at the right times, employees need to manage the situation by obtaining and communicate information in a clear and timely manner.

The primary performance concerns associated with managing these processes therefore concerns the consistent ability of personnel to:

- communicate clearly, concisely and effectively
- make the right decisions in a timely and orderly manner

The DISCOVER training objectives are based on standards of competence. These objectives state that participants should be able to filter important information and communicate it concisely, carry out procedures in line with best practice and relevant

to the appropriate decision making process. They should also elicit the desired response or actions from staff and remain outwards calm.

DISCOVER is fundamentally about communication skills rather than just operating objects such as fire extinguishers.

Learning strategy

The DISCOVER learning strategy uses simulations of actual events, where the individuals play different crew or staff roles. The simulations are based on real life events and are designed to be flexible enough to allow tutors to refine the situation to suit the skill level of the individual. The scenarios to be used will be analysed in advance and a range of observable affective decisions and communications will be produced for each of the individuals and each of the teams.

Currently the formal assessment of competence is conducted through the observation of exercises. The DISCOVER product will allow the formal assessment of candidates to be conducted more rigorously. This will be achieved by measuring and recording relevant system parameters and overt interactive behaviours. Assessment is in-built, and tutors constantly endeavour to assess the affect of instruction on the learner and modify the exercise to give the appropriate level of stress.

During the exercises each tutor is continually assessing what the team is doing both on an individual and collective level. By use of a question and answer technique learners may be prompted to consider different methods or strategies. Some learners are used as observers for each team and may be prompted by the tutors to make particular note of the actions or communication to illustrate interesting learning points.

The debrief focuses on the observers assessment of the actions and decisions taken and individuals own assessment of their actions and decision. Within the debrief session the team assessors provide a peer assessment of what went well during the exercise and what they felt could be improved upon. Individuals are then called upon to comment and reflect on their and the group performance. Peer assessment allows for a more flexible and reflective approach. Individuals with similar qualifications by different working background can have a different outlook and approach to a problem, which allows for transfer of ideas and problem solving techniques.

Tutors act to facilitate the self-assessment and peer assessment process and indicate how effective certain actions were, and what can be done to improve individuals effectiveness. The tutors set the tone of the training and assessment. For it to be most effective, the students should be able to make and learn from mistakes in a safe environment.

The DISCOVER system will be built on the above strategies by providing the facilities to monitor the training exercises and assess the trainees' progress.

DISCOVER in daily use?

Training using the DISCOVER system must satisfy a number of competing constraints. Firstly, it must fit into the current training provision at the project partner sites. Training at these sites is known to work, is trusted by their respective industrial clients and cannot be radically rewritten or re-organised.

The last part of this paper describes how the partners in DISCOVER see the use of the system within current and anticipated training schemes. Scenario examples are included.

Maritime training institutes view on DISCOVER

In general, DISCOVER simulations should provide scenarios that will allow participants to cope with all levels of crises management in compartments inside the ship. To make an attractive offer to shipping companies and other clients, the DISCOVER simulation approach should take into consideration the clients' specific requirements for safety management training of their staff. The training should be implemented in virtual environments meeting the realities in the most possible (customised) way with respect to international/national/company rules.

Existing (traditional) simulations capabilities permit interaction in a very realistic way with the environment on the bridge and in a minor - but very realistic - way with the environment outside the ship. Engine simulators have succeeded in recreating the same "sense of reality" in engine control room as well as the interaction with the different areas of the ships with a high degree of reality. Nevertheless DISCOVER will close the gap for simulations for training providers to manage special emergencies such as fire on board various types of ships.

DISCOVER is expected to be integrated into existing courses, e.g. the current crisis management courses. This implies that DISCOVER will be used as an extension or supplement to the existing training, and not as a substitute for face to face interaction. Exercises would still be largely instructor controlled and manipulated for maximum training benefit.

The main advantage of virtual reality in teaching and learning will be the ability for teams to interact unpredictably with each other in realistic virtual environments. The simulations will increase realism of exercises in various areas including: passenger rescue during a fire, displacement of cargo in rough seas, find faults (e.g. leakage, fire, flooding etc).

The possibilities for the simulators to be accessed through distributed stations, will allow grater access and economies in terms of travel, accommodation etc. Another significant advantage of virtual reality will be capture and playback of actual assessment evidence.

Example on scenario from maritime sector

This example is an extract from a training scenario. A team of experienced first mates are being assessed as part of their company's programme to fast-track their promotion to master. They have been sent on a three day assessment course at a major maritime

training centre who have recently integrated the DISCOVER system into their training and assessment provision.

The assessor and the controller (i.e. the individual running and configuring DISCOVER simulation to) are situated in a control room. The controller will act as the Chief engineer in the simulation and he will also control the development of the situation.

In another room two trainees representing the fire team leader and a member of the fire team are situated with one PC each, acting in the simulation with their own avatars.

Acting captain Smith and his bridge staff, first mate Kidd and helmsman Roger are located in a bridge simulator, first mate Kidd in front of a PC with the DISCOVER simulator. Captain Smith, is on a bridge simulator taking his ship into Europort. Figure 3 presents the exercise set-up.
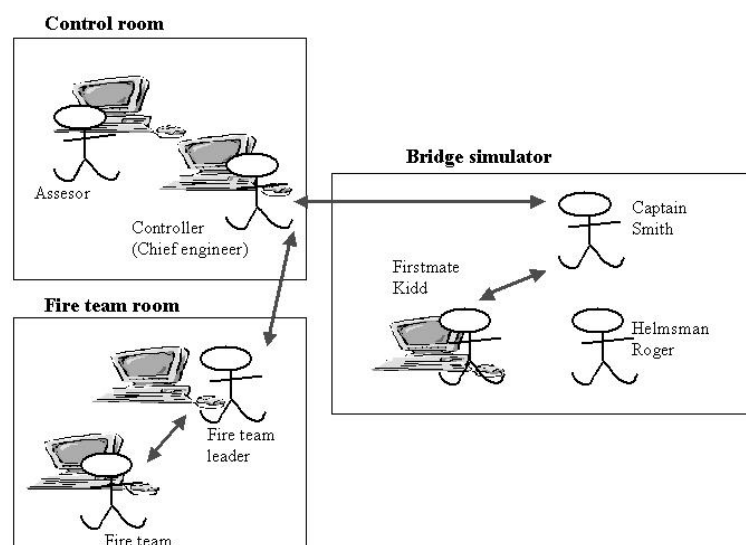

Figure 3 Scenario setting

The assessor has asked the controller to start a fire in a specific location within the virtual environment. Chief engineer (the controller) informs the captain about smoke alarm in a certain location.

The captain reports back and tells the chief engineer to send a man to check the situation. The chief engineer (the controller) phones the fire team leader and tells him to inspect the location. The fire team leader enters the DISCOVER simulator as an avatar and "walks" to the location were he can see smoke. He contacts the chief engineer by walkie talkie and reports about his findings, visual smoke and hot walls. The chief engineer orders the fire team leader to get a hose.

The controller sends a fire team to assist the team leader. The chief engineer informs the captain about the fire being confirmed at the reported location and that the fire team leader and the fire team are cooling the walls by a hose. The captain then asks one of his bridge staff, first mate Kidd, to check upon the situation. Kidd enters the DISCOVER simulator as an avatar. Kidd "walks" to the location and using virtual communication he asks the team leader for information. Kidd reports back to the captain "The fire is burning out of control. Suggest you release the CO_2 and contact shore for additional help".

Behind the scenes the assessor has been listening in to both the real and virtual communication from the control room and passing on his instruction to the controller.

Offshore companies view on DISCOVER

The offshore companies have indicated that the finished version of the DISCOVER environment will provide a useful training system for those working in the offshore industry. They anticipate that the finished product will be used in incident management training courses on the following basis:

- The course will last for 1 day.
- Will be delivered to those in the 1st, 2nd and 3nd line incident management teams, namely those in the control rooms, fire teams and onshore company teams.
- Will be used with 6-12 trainees.
- The system will replace some parts of existing training and will be used as an extention to complete others.
- The theory module will replace existing parts of theoretical course.
- The simulator will supplement the hands on course.
- The DISCOVER simulation will be used in four sessions each lasting 20 minutes.
- The theory module will be used as a prerequisite to the simulator. Students will need to pass on 80% of the criteria within the theory module prior to being given access to the simulator.
- DISCOVER simulation assessment will be carried out on two levels. The initial assessment will take place during the simulation and the other during the debriefing session - this is similar to the methods used in current courses.
- During use of the DISCOVER simulation the observer and simulator manager can call for "time outs" for assessment purposes.

In order for the training to be effective the offshore company has indicated that the theory module will play a vital part in the overall training package, primarily as a means of assessment prior to taking part in a DISCOVER simulation based scenario. This is further complemented by the use of the DISCOVER simulation as an adjunct to current training methods, where the critical aspects are the use of "real" scenarios and the implementation of an effective assessment structure. For example, the DISCOVER simulation should allow for pauses in the scenario to take place, typically so that observers and simulator manager can use this time to debrief and/or assess the participants.

Example of use in offshore

The offshore usage scenario has three main participants, John Ronaldsy, a recently appointed control room operator on the Statfjord C offshore installation, Ole Kristofffersen, the leader of the first aid team, and Einar Johansen, the leader of another installation's first fighting team. Both Ole and Einar have considerable experience in their posts, but all three staff have recently realised that it is some time since they undertook formal safety critical training and feel a need to brush up their skills. The company 's training officer has advised that such training is now available online from their home installations and the men individually decided to take advantage of the opportunity.

They first undertake a self-paced and automatically assessed theory module on best practice in incident management. This is available as an online workbook, and the three men work through the material in their "spare" time over a period of two weeks or so from terminals on the installation or onshore. The results of this are automatically logged in the company's training database, and on completion the men are e-mailed by the training officer to suggest that they take part in a real time online exercise in incident management which uses the DISCOVER 3D virtual environment. They feel that this would be the next best thing to practising on the real installation, and decide to take part.

Firstly, since this is the first time any of them has used software of this type, they undertake small scale familiarisation exercises, at first individually and then over the network with the other two team members. In this way they become accustomed to moving their avatars around the environment of the rig, interacting with objects and communication with each other via virtual walkie-talkies and telephones. Once all are comfortable with the VR system, a time and date is arranged for the full-scale exercise. This also involves a tutor at the training centre, and three simulation operators who play the roles of other personnel in the incident scenario and introduce events (such as fires, crashing helicopters..) into the environment. John, Ole and Einar adopt their own roles for this time's exercise, each working from separate terminals.

Once all participants are online, the incident starts with an incoming helicopter radioing that he is experiencing problems and is about to make an uncontrolled emergency landing. John, from his position in the "control room" (Figure 3) contacts all the necessary staff by virtual walkie-talkie including, Ole and Einar (the leaders of the first aid team and fire team) and the onshore 2nd line emergency response team, who all respond appropriately. The helicopter makes a crash landing, and as Ole and Einar "run" through the installation they can hear alarms sounding and see others moving quickly to emergency stations. On emerging on the helideck both men can see a number of injured passengers and fuel spilling from the helicopter. Einar makes a report to the control room and proceeds to direct his team by walkie-talkie.

Figure 3 The offshore control room

The scenario proceeds through escalating incidents directed by the tutor, who has a bird's eye view of the environment, and eventually a satisfactory solution is reached. After the scenario is concluded the three trainees and the tutor discuss the events and the trainee's responses in an audio-conference, completed by replays of selected sections of the action in the virtual environment. A run of a second scenario is arranged, this time with the team playing each other's roles.

Future plans for DISCOVER

In the future the modular DISCOVER system will give the possibility to combine a number of 3D models and scenarios to support all required training exercises. After a period with evaluation and further specification of the functionality, the DISCOVER system will be commercialised. New partners will be invited to participate in the next phase, which is planned to start in the end of 2001.

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Author: MSc Lisbeth Hansson has more than 15 years of experience within the areas of safety, reliability and safety training. She is employed in MARINTEK, division of Technical Operation, as a senior research Engineer.