Training of Medical Teams On-site for Individual and Coordinated Response in Emergency Management

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Abstract

A system for training of coordination and cooperation of decision-makers in emergency management has been under construction for some time. A first prototype of the system was developed in the MUSTER* system, and presented at a former TIEMS conference. The system is being developed modularly, with one module for each of the sub-organisations involved in the complete preparedness: Fire brigade, Police, Medical team, Civil Defence, etc. All these modules will in the end be integrated on a common integration platform, either into a full-fledged system covering all aspects of training for the complete preparedness, or for creating a dedicated system for specific training set-ups for specific groups of trainees. The first module completed as a commercial system, 'Training of medical teams on site,' will be presented and demonstrated.

1. Introduction

In order to maintain the skill once perceived during previous education, it is important--and even mandatory--to carry out training sessions, especially related to situations that may be unique as compared to the daily routine. This applies to critical situations experienced by operators normally working in controlled environments, but who occasionally, though rarely, find themselves in the middle of a critical situation. However, even though the individual training in order to maintain the basic skills is of utmost importance, it is just as important for persons acting as part of a team to be trained as part of a team.

The idea and the benefit of this kind of training is well-known and practiced at Risø by the training systems developed and put into operation.

This idea has actually been utilised for training set-ups for air pilots trained in the cockpit, for the crew on the bridge on board large ships, and for the railway maintenance teams taking care of the technical maintenance of the railways and related signals for high-speed trains. The concept has been formalised in detail by Merritt and Helmreich[1] in the development of CRM, which initially indicated 'Cockpit Resource Management.' However, later, when the idea was expanded to the complete crew on the plane including the cabin crew, the same acronym changed its meaning to 'Crew Resource Management.'

The detailed training following this idea has, however, to be adjusted to the specific domain in which it is applied, and it was adjusted by Risø in co-operation with Robert Helmreich for the specific domains referred to above as BRM (Bridge Resource Management) and TRM (Train Resource Management), respectively. In fact, the training set-up needed to be adjusted not only due to the domain, but, most importantly, it had to be adjusted in relation to various cultures--e.g. professional culture, national culture, and organisational culture.

In the training system discussed in this paper, the same idea has been transferred to the domain of emergency management in general, by approaching the complete emergency management organisation dealing with various emergencies. This could incorporate transport accidents resulting in a great number of immediate casualties, or the same kind of accidents including the spill of toxic materials from turned-over trucks or railway tank wagons in densely populated areas. Or it could be related to industrial accidents or natural catastrophes likewise with the risk of a great number of lives. In these situations, a coordinated action of the forces involved in the emergency management and relief operation is of utmost importance, and the normally experienced skill of the individual units is far from sufficient, if they are not capable of acting together in a coordinated and cooperative way.

2. The Training System

The most efficient way of learning how to handle a critical situation and to maintain the obtained skill is by frequent managing of real-life situations. Fortunately, such situations occur rarely, and provoking dangerous situations of the kind needed (in order to build up the experience necessary for maintaining preparedness for possible future hazardous events) is not desirable due to the risk of starting an event in which the consequences are not initially controllable. The next best means of efficient learning and maintenance of learning is by full-scale exercises, in which the technical and human resources are the same as for a real situation, but the role of victims is played by

figurants; furthermore, the fire, explosions, or release of toxic material are lacking, and replaced by a supervisor giving instruction about the kinds of events the trainees are facing. However, this kind of training is extremely time- and resource-consuming as well as costly.

Therefore, the desirability of a computerised training system, in which not only the events, but also the environments may be simulated and presented to the trainee in a way as realistic as possible, has been highly expressed by the people responsible for the training of emergency managers. The realism of such a training system lies in a common interactive scenario, in which actions taken by one of the acting participants will influence the scenario and be reflected in the presentation of the scenario to all of the other acting participants, as in a real-life situation. Likewise, the presentation to each of the trainees must be specific for each type of participant, and adapted to the specific situation in which this person is presently acting. Consequently, the system described here is being developed modularly with specific modules developed for the training of fire fighters, police forces, civil defence people, and medical doctors all working together at the site of the accident.

A prototype of a system called MUSTER[2], Multi User System for Training of Emergency Response, has been demonstrated at a previous TIEMS conference. This prototype demonstrated the idea of coordinated training. However, as mentioned above, the final system will be built in modular form, and individual modules are now being developed to the level of commercialisation. Each module may be used for training of the individual unit assuming the attitude of the other units, or--following the real goal of the system--they may be integrated on a common platform for the mutual coordinated training of all the units. The first of these, the module for pre-hospital training of medical doctors at the site of the accidents, will be demonstrated during the conference.

3. Pre-hospital Training

The medical module was chosen as the initial module to be developed. First, the medical domain wanted to have a module rapidly developed for use not only as an integrated version for coordination with other units in the emergency situation, but also as a medical stand-alone system for training of team performance among coordinating doctors, triage doctors, and treating doctors. Furthermore, the module has been developed also to be utilised for individual training of first medical care in the field, having available only the resources brought to the site in a medical bag.

Figure 1 illustrates a scenario that indicates the various roles of medical doctors in an emergency situation. The coordinating doctor is acting as the link between the emergency situation represented by the commander in charge, normally the chief of the fire brigade, and the medical team. He reveals the

situation and reports to the triage doctors the approximate number of casualties and the type of injuries the medical team will be facing. Moreover, he has contact with the various hospitals that may be involved in the emergency situation, and he is updated concerning their expertise and capacity. The triage doctors receive the casualties and prioritise them in various groups in accordance with need for expeditious medical care. Based on this, the treating doctors give the necessary treatment for stabilising the casualties, and prepare them for the succeeding transport to the hospital selected as the optimal one for each specific victim.

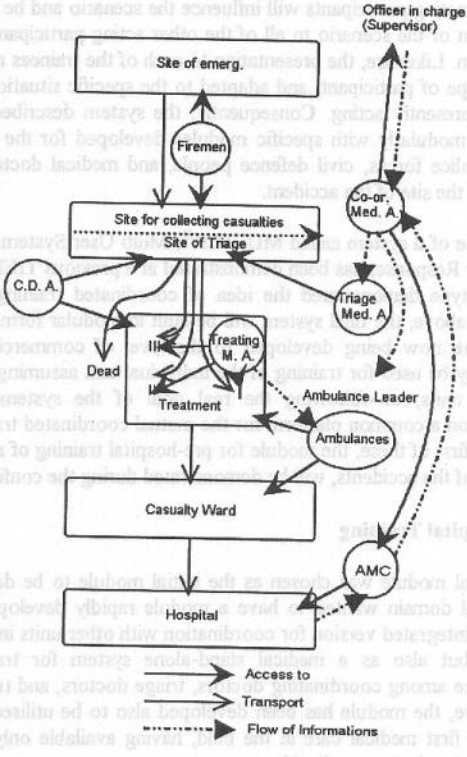

Figure 1, Schematic presentation of the organisational structure of the medical doctors at the site of the emergency (Abbreviations used in the figure: Co-or. Med. A., Co-ordinating Medical Agent; C.D.A., Civil Defence Agents; AMC, Acute Medical Co-ordination).

Second, the medical domain needs the on-site training due to the fact that this working area is unfamiliar to medical doctors as compared with the other units involved in the emergency management, including fire fighters, police officers, and civil defence people. For these people the field operation is common working ground, whereas for medical doctors, the common working ground is at the hospitals in the emergency ward, where all needed equipment and a full back-up of nurses are directly available. Furthermore, it is important for medical doctors to train for the role of being part of a team, where only effective coordination will secure total efficient performance. In contrast to this, in the normal working conditions of medical doctors, they have the full authority for prioritising the tasks to be fulfilled on behalf of themselves and their surroundings. Finally, training sessions including tough and stressing events may change the unrealistic opinion of medical doctors concerning their personal capabilities as demonstrated in figure 2[3].

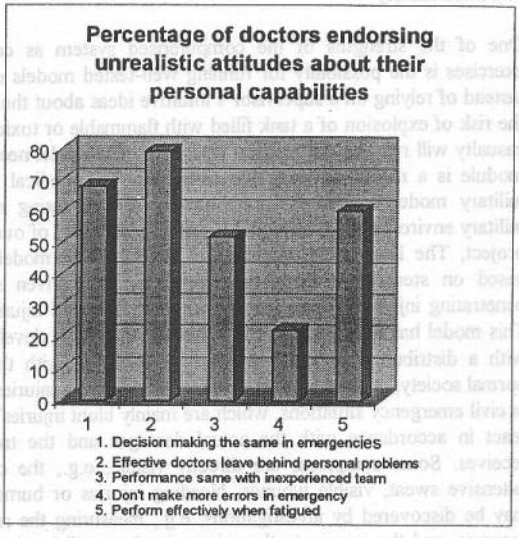

Figure 2, Attitude of medical doctors as related to personal capabilities

Previously, the medical domain in Denmark has achieved training by one to two yearly full-scale field exercises, in which about twenty newly educated doctors are trained for on-site performance during emergency management. These sessions are extremely expensive and leave no room for additional training or maintaining the skill once achieved. Consequently, the group of medical doctors having up-to-date skill concerning the on-site efforts for coping with an

emergency situation is a dynamically changing group of about twenty persons, as the number educated in each session is more or less equal to the number losing their skill do to lack of follow-up training or of handling real-life situations. However, the field exercises may not be replaced by the computerised training system; but this system, presenting a simulated environment to the trainees, may be an excellent complement to the field exercise and may even be utilised for testing scenarios and for preparing in detail the field exercises. This may secure the most efficient spending of means for these very expensive exercises. Furthermore, the computerised training system will include (for a very reduced cost as compared to the field exercises) frequent training sessions for a great number of medical doctors, partly as a primary training session, and partly as a follow-up training session for maintenance of skill.

4. Functionality

One of the strengths of the computerised system as compared with field exercises is the possibility for running well-tested models of the environments instead of relying on a supervisor's intuitive ideas about the escalation of a fire, the risk of explosion of a tank filled with flammable or toxic material, or how a casualty will react to the medical treatment. The model needed for the medical module is a model covering the casualties. The medical module relies on a military model created for casualties contrived during a battle within the military environment. This model is developed by one of our cooperators in the project, The Danish Defence Health Services. The model describes patients based on stereotypic male, human beings of a given size and age with penetrating injuries, which are the normally obtained injuries on a battlefield. This model has in the MUSTER system been further developed into a patient with a distribution in age and sex in accordance with the distribution in a normal society, and the injuries are now including the injuries normally obtained in civil emergency situations, which are mainly blunt injuries[4]. The casualty will react in accordance with the actual damages and the treatment he or she receives. Some symptoms are directly visible, e.g., the colour of the skin, extensive sweat, visible wounds, bleeding injuries or burns. Other symptoms may be discovered by investigations, e.g., measuring the respiration or blood pressure, and the answer to these investigations will be shown in textual form on the screen after a delay corresponding to the time the same kind of investigation would take in real life. To ease the investigations concerning hidden injuries, it is possible to undress the casualty by parts or in complete; but each type of operation will, besides taking time, also need a person to perform the action. This could be the medical doctor himself, or he may ask a supporting nurse or helper to do the action, if one is available.

Likewise, the MUSTER training system is based on a training system developed for the military area by another cooperator of the project, The

Danish Defence Research Establishment[5]. This training system is developed for training of medical doctors as individuals in a pre-hospital phase based on military injuries. Besides a lot of additional functionalities, mainly suggested by the 'Office of Hospital Emergency Planning,' the MUSTER system has been developed as a network-based distributed system for training of the coordinated action of a group of individuals, even though the training of single individuals is still at hand.

5. Technical Functionality

The MUSTER system is a very flexible training system, where training scenarios may be built from scratch by the end-users and stored in a database. Alternatively, from this database, other previously stored scenarios may be selected for setting up a training session. Likewise, new training scenarios may be easily developed by combining existing scenarios in the way most suitable for supporting the exact emergency situations the training is aimed for. Figure 3 shows the general architecture of MUSTER.

When a scenario has been built or selected, the supervisor will secure that all trainees are logged on to the training session, and that each of them has defined the role they are going to fill out during the session, e.g. coordinating doctor, triage doctor, treating doctor, the commander in charge, or maybe a journalist asking persistent questions. Hereafter, the supervisor may start the scenario, and he has the possibility to pause it if he feels that important questions or acts have to be urgently discussed currently instead of during the subsequent debriefing, and then restart the session. During the pause, the scenario clock has been stopped as well, to avoid the possibility that the casualties are getting worse or have died during the time of discussion. Likewise, the supervisor may speed up or slow down the scenario time in case he finds that a given part of the session could be speeded without spoiling the scenario, or if he finds that the trainees may need more time to cope with a complicated situation, respectively. Moreover, the supervisor has the ability to follow the scenario execution by monitoring the conversation and acts of the trainees, the resources used, and the conditions of the casualties.

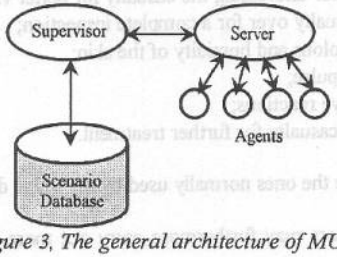

Figure 3, The general architecture of MUSTER

6. Scenario execution

When the supervisor has prepared a scenario and started the session for the trainees, they may experience the full sequence of events as for a real emergency situation. This begins in the initial phase--if so planned by the supervisor through the scenario--from the very minute where the alarm comes up, by gathering the full medical team and organising the transported into one or more cars, ensuring that nobody is left back at the hospital by accident. During the tour towards the emergency site, the trainee may discuss what they expect to encounter at the emergency site, and agree about their specific roles if this is not given beforehand by the supervisor. After arrival at the scene, they may carry on individually for their final site, depending on their role as coordinating doctor, triage doctor, or treating doctor for starting their medical tasks. The triage doctors and the treating doctors, who are the ones in most direct contact with the casualties, will have the same treating possibilities; however, the triage doctors ought to remain at the level sufficient for the prioritisation, whereas the treating doctors need to be more careful. However, offered all the same possibilities, the triage doctors are not guided to the correct level, and in a subsequent evaluation or debriefing it may be discussed whether the right level was obtained.

The trainees choose themselves if they want to have an overall view of the environment exposing the complete number of casualties, or if they want to approach a specific casualty for closer inspection. Figure 4 shows a graphical presentation of a close-up indicating a number of possible actions and highlighting specific features related to measurements and observations. Likewise, the figure indicates human and technical resources available to the 'doctor.'

Examples of potential actions to be taken by the doctors are:

- communication with the casualties making use of standardised questions, in case the casualty is able to communicate despite the injury;
- the possibility to zoom in on the casualty for better view of the damages;
- the possibility for undressing the casualty for better view of the damages;
- turning the casualty over for a complete inspection;
- checking the colour and humidity of the skin;
- measuring the pulse;
- checking the eye reactions;
- classifying the casualty for further treatment.

These features are the ones normally used by the triage doctors.

The treating doctors may furthermore carry out more detailed investigations, including:

- measuring the respiration by quality or frequency;
- measuring of blood pressure;
- checking the capillary response;

and they may carry out treatments such as:

- give morphine;
- attach a drip;
- add support;
- stabilise the casualty for transport to the hospital selected according to expertise, capacity, and distance.

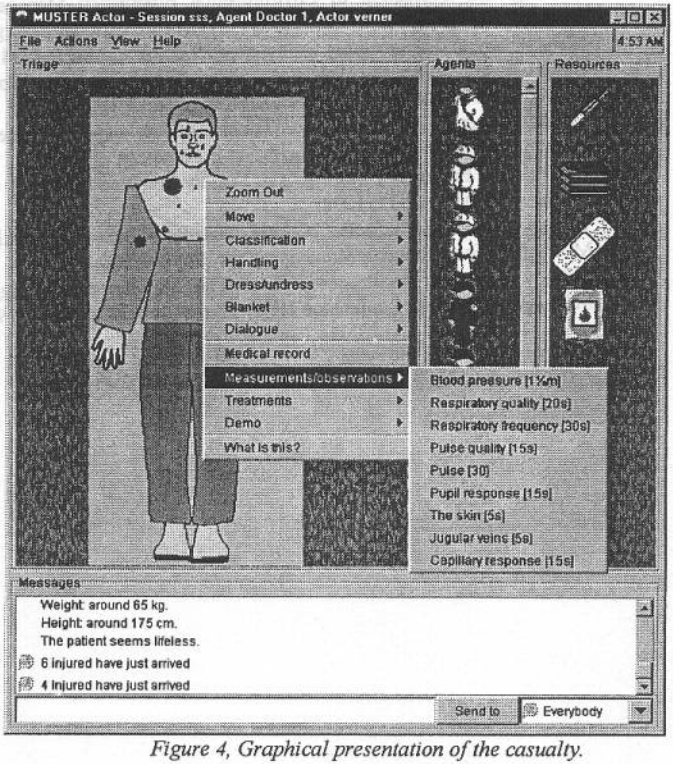

Figure 4, Graphical presentation of the casualty.

7. Conclusion

The training system has by now had a number of evaluation rounds, and is released as a commercial product, which is now put into use as a training system for the hospitals in Copenhagen.

8. References

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