MULTI-USER SYSTEM FOR TRAINING AND EVALUATION OF ENVIRONMENTAL EMERGENCY MANAGEMENT RESPONSE - MUSTER[1]

Verner Andersen & Henning B. Andersen
Risoe National Laboratory
Systems Analysis Dept.
4000 Roskilde Denmark
Voice: 46 77 46 77
Fax: 46 75 51 70
E-mail: verner@risoe.dk & hba@risoe.dk

ABSTRACT

The efficiency with which complex, large-scale organisations respond to emergencies and critical situations depends crucially on the co-ordination of actions and communication among decision makers. However, decision makers have typically few opportunities to train distributed crisis management under artificial, yet realistic conditions; and at the same time, real emergencies occur fortunately so relatively infrequently that few decision makers have a chance of establishing a useful real-life experience of crisis management. There is therefore a need for having available realistic and flexible multi-user training environments in which co-ordinated response to crises or emergencies may be trained.

At the same time, a flexible training environment supporting tactical training of co-ordinated emergency response can be used as a platform on the basis of which not only emergency response capability can be evaluated but also different procedures and practices and even control systems may be assessed before they are put into real use.

In order to identify requirements to, develop specifications of and finally produce a prototype of a flexible training and evaluation environment, a two-year project, MUSTER: 'Multi-User System for Training and Evaluation of Environmental Emergency Response' was started in 1993 and is now approaching its completion by mid-95. The project, which is supported by the ENVIRONMENT programme of the Commission of the European Union and which comprises nine partners in four countries, has selected railways and port areas as its two target applications.

INTRODUCTION

MUSTER - Multi-User System for Training and Evaluation of environmental Response, is a training system especially dedicated to improve the co-ordination of efforts of decision makers in emergency management. The project was initiated in 1993 and planned for two years; it includes nine participants from four different European countries, and it is partially funded by CEC.

Even though experience is the most efficient way to train how to handle difficult situations, the real world is not necessarily the best teacher; partly due to the low frequency with which specific emergency situations arise, and partly due to the risk in provoking dangerous situations just in order to build up the experience necessary for maintaining a high and effective preparedness for possible future hazardous events.

So, due to the fortunate low frequency of major emergency situations, training of emergency management organisations is of vital importance in order to minimise the consequences of catastrophic events. The entire emergency management organisation coping with large emergency situations is normally built up by various units like fire brigades, police forces, civil defence, hospitals, etc., and the skills to be trained exist mainly on three different levels: the skill of the individuals in each of these units, the efficiency of each unit per sey, and finally, the co-ordinated performance of the units in order to obtain the optimal emergency management and efficiency.

The individual skill as well as the separate efficiency of each organisational unit are effectively trained inside each unit by frequent exercises and drills, and their

[1] This work is partially supported by CEC Environment Programme, proj. PL 910675

optimisation is not the goal of the training supported by MUSTER.

The Objectives Of MUSTER

The goal of MUSTER is to develop advanced and efficient means of supporting the co-operative training among the various units forming the complete emergency management organisation. One way of carrying out co-operative training is full scale exercises, i.e. exercises in which all aspects of emergency response are carried out physically. Only the physical process of the emergency, the fire, the explosions, etc. is not present.

Full scale exercises are the most realistic training set-up in order to train all aspects of a co-ordinated emergency response: technical and physical skills including the technical and physical co-ordination, management and communication including the managerial co-ordination, and the state of initial preparedness. Figure 1 indicates a full scale training exercise with the emergency management resources represented partly at the site of the emergency and partly in remote command centres. The resources in a full scale exercise are normally the same as those involved in a real emergency situation, and this may easily add up to a huge amount of people. This is, therefore, typically an extremely expensive form of training, and even more, a form which is difficult to control in detail. Thus, it is often infeasible to pause or revert in case the evolution does not follow the line planned in advance in order to convey the most efficient training in relation to the objectives of the training session.

In order to overcome the drawbacks of full scale training, training systems like MUSTER are used. The support offered by MUSTER embraces the phases of planning, execution, and evaluation. Similarly, the objectives of MUSTER are threefold:

- to support trainers or "drill supervisors" in the planning phase - by offering an authoring environment - in developing training scenarios based on specific training needs, the possible vulnerable objects, and the available resources, human as well as technical;
- to support the supervisor and his aides during the execution of a training scenario, by offering a simulation of the emergency environments giving the

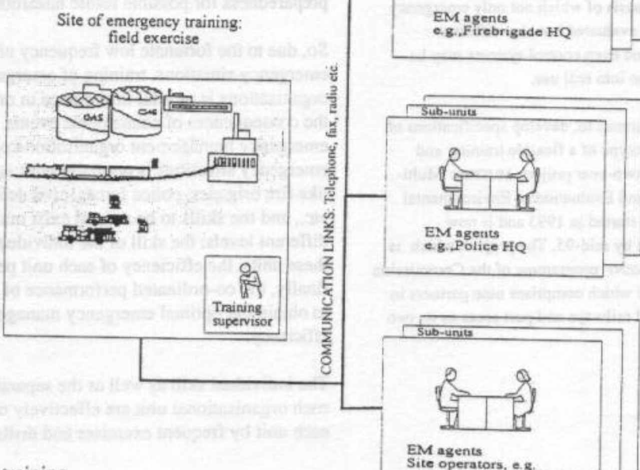

Figure 1 Full scale training

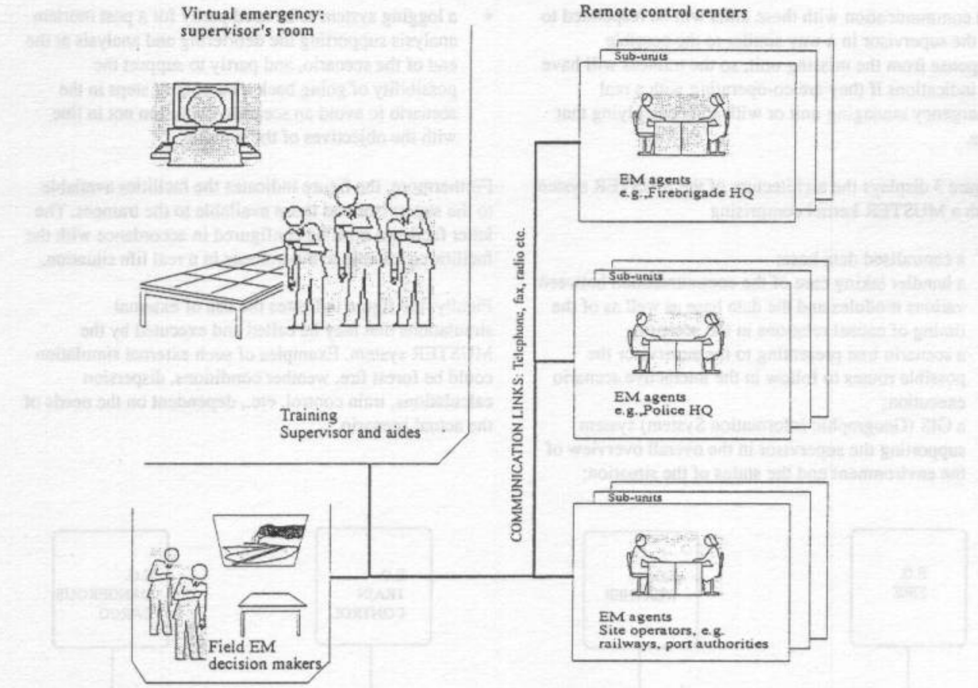

Figure 2 Simulated environments

supervisor the best possible overview of the situation, the events automatically or manually carried into effect, and the actions of the trainees; furthermore, to support the presentation of the actual situation to the trainees in a plausible way as compared with the visual impression they would have in a real life situation;

- to support the supervisor in the debriefing or evaluation phase by allowing him to review and present in an easy way specific situations selected during the scenario execution.

Figure 2 shows the simulated emergency situation with the decision makers situated partly in a training location giving presentations of the scenario as mentioned above, and partly located in the remote command centres in the same way as for a real emergency situation.

One objective of the simulation of the emergency is to present to the training supervisor the virtual world in the best possible way in order to support his overall view of the situation, and to update him continuously about all events and actions taken either automatically by the system in accordance with the scenario planning, by the supervisor himself in accordance with the scenario planning or initialised due to the wish of changing the current stress of the scenario, or by the trainees in response to the scenario. Another objective of the simulation is to present to the trainee part of the virtual world in accordance with the information they would have had in a similar real life situation and based on which they must build their own mental model of the complete scenario.

Besides the ability to control the training scenario in high details by using the training environments, this will moreover allow training of a selected part of the emergency managing units by letting the role of the remaining parts be taken by the supervisor or his aids.

All communication with these units will be responded to by the supervisor in a way similar to the possible response from the missing unit; so the trainees will have no indications if they are co-operating with a real emergency managing unit or with someone plying that role.

Figure 3 displays the architecture of the MUSTER system with a MUSTER kernel comprising

- a centralised data base;
- a handler taking care of the communication between various modules and the data base as well as of the timing of causal relations in the scenario;
- a scenario tree presenting to the supervisor the possible routes to follow in the interactive scenario execution;
- a GIS (Geographic Information System) system supporting the supervisor in the overall overview of the environment and the status of the situation;
- a logging system to be used partly for a post mortem analysis supporting the debriefing and analysis at the end of the scenario, and partly to support the possibility of going back a number of steps in the scenario to avoid an scenario evolution not in line with the objectives of the training.

Furthermore, the figure indicates the facilities available to the supervisor and those available to the trainees. The latter facilities must be configured in accordance with the facilities available to the trainees in a real life situation.

Finally, the figure indicates the use of external simulations that may be called and executed by the MUSTER system. Examples of such external simulation could be forest fire, weather conditions, dispersion calculations, train control, etc., dependent on the needs of the actual scenario.

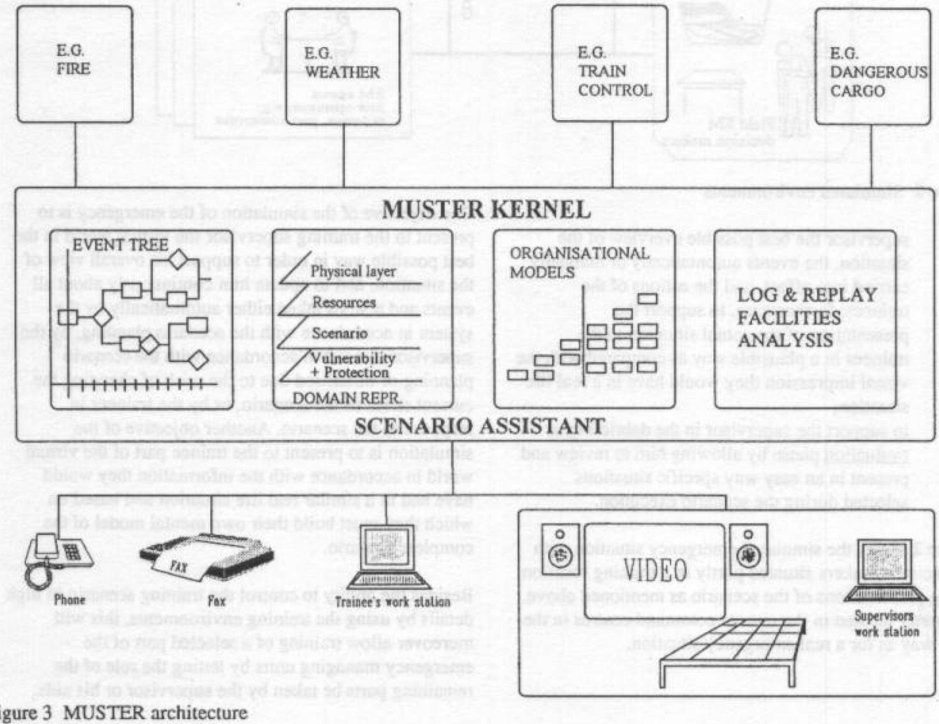

Figure 3 MUSTER architecture

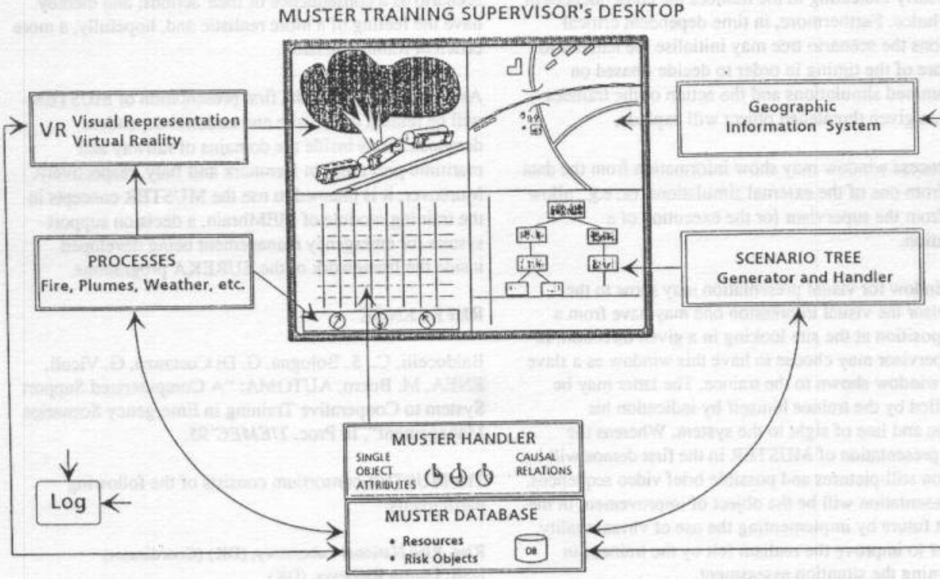

Figure 4 Supervisor's desktop

Based on the MUSTER kernel and the choice of external simulations, a large variety of scenarios may be fulfilled by the use of MUSTER. However, the first phase of demonstrations of MUSTER scenarios will be limited to two domains:

- one is the railway domain based on a fictive accident at the Danish railway comprising derailed tank wagons of which one is leaking toxic materials to be dispersed in the environments, and another one is jeopardised to explosion due to a nearby fire;
- the other is the port domain based on a real accident in 1982 in the port of Genoa comprising an explosion in an oil tanker with the implications of emptying the port area for other tankers jeopardised to the same destination. (see Balducelli et al.)

Figure 4 indicates the supervisor's desktop that will show at least four different views of the situation presented either on one screen as shown on the figure or on a couple of screens.

The GIS system will be performed using MapInfo, and it will probably have its own screen of presentation. It will present the overall view of the scenery, showing the environment, the scene of action including the threatened object and the resources available for the rescuing process. In case of fire the GIS system will show isocurves of temperatures to indicate the area in which rescuing people may or may not act. Likewise, in case of release of toxic materials, the GIS system will show isocurves of the concentration of the toxic cloud in order to indicate the risk of victims and consequently the order in which they should be rescued; and furthermore, the isocurves will indicate the need of protective equipment for the rescuing personnel. Moreover, in relation to the window of visual presentation the GIS window will indicate the line of sight of the decision maker at the site with subsequently consequences for the information to be shown for the trainee.

The scenario tree will support the supervisor during the execution of the planned scenario as well from the point of view of reminding him of his own choices at a given time of the scenario as from the point of view of indicating reasonable choices of the trainees in specific critical situations. In order to have realistic scenarios, the MUSTER system is an interactive system; so, these choices will influence the evolution of the scenario in a way clearly indicating to the trainees the consequences of their choice. Furthermore, in time dependent critical situations the scenario tree may initialise the handler to take care of the timing in order to decide - based on programmed simulations and the action of the trainees - if, e.g., a given threatened object will explode.

The process window may show information from the data base, from one of the external simulations, or, e.g., allow input from the supervisor for the execution of a simulation.

The window for visual presentation may show to the supervisor the visual impression one may have from a given position at the site looking in a given direction; or the supervisor may choose to have this window as a slave of the window shown to the trainee. The latter may be controlled by the trainee himself by indication his position and line of sight to the system. Whereas the visual presentation of MUSTER in the first demos will be based on still-pictures and possible brief video sequences, this presentation will be the object of improvement in the nearest future by implementing the use of virtual reality in order to improve the realism felt by the trainees in performing the situation assessment.

MUSTER Achievements

Whereas most computerised training systems today have a sequential succession of events regardless of the counter actions of the trainees, the most important result of MUSTER is the development of an interactive training system in which the trainees will see the influence of the scenario as a consequence of their actions; and thereby have the feeling of a more realistic and, hopefully, a more efficient training session.

As mentioned above, the first presentation of MUSTER will be related to two site and national dependent demonstrations inside the domains of railway and maritime port areas in Denmark and Italy, respectively. Moreover, it is planned to use the MUSTER concepts in the training module of MEMbrain, a decision support system for emergency management being developed inside the framework of the EUREKA programme.

REFERENCE

Balducelli, C., S. Bologna, G. Di Costanzo, G. Vicoli, ENEA, M. Boero, AUTOMA: "A Computerized Support System to Cooperative Training in Emergency Scenarios Management". In Proc. *TIEMEC'95*.

The MUSTER consortium consists of the following participants:

Risø, Risø National Laboratory, (DK) (Coordinator)
DSB, Danish Railways, (DK)
DTI, Danish Technological Institute, (DK)
CRI, Computer Resources International A/S, (DK)
ENEA, Ente per le Nuove technologie l'Energia e l'Ambiente,(I)
AUTOMA, Automa Sistemi di Automazione Endustriale S.C.R.L, (I)
Polo, Polo Technologico Maritino - Marittimo, (I)
UCL, University College London, (UK)
Studsvik AB, EcoSafe (S)