Instructor Tools for Virtual Training Systems

Joris Field
National Aerospace Laboratory, NLR
joris.field@nlr.nl

Amy Rankin
Linköping University
amy.rankin@liu.se

Arjan Lemmers
National Aerospace Laboratory, NLR
arjan.lemmers@nlr.nl

Magnus Morin
VSL Systems
magnus.morin@vsl.se

ABSTRACT

Crisis management exercises require a lot of preparation and planning to ensure that the training objectives are met. This is often a time consuming and expensive process and can be a major barrier to setting up frequent crisis management training sessions. The introduction of virtual training environments to supplement the live exercises enables the development of tools to support the instructors in their planning, management, observation and analysis of training exercises. This can simplify the planning process, and give instructors control over the configuration of the exercises to tailor them to the needs of individual trainees. In this paper we present a tool that supports instructors in the planning of virtual exercises, and can be used to provide templates for live exercises. This tool has been developed with ongoing feedback from instructors and crisis management personnel and forms part of a crisis management virtual training system.

Keywords

Crisis Management, Virtual Training Systems, Instructor Tools, Planning.

INTRODUCTION

Today crisis management training makes use of live exercises for a major part of the multi-organisation team training. Preparing and executing exercises is costly both in terms of time and funding, making virtual environment and game technology an important new source (Raybourn, 2007; Walker, Giddings, & Armstrong, 2011). Instructors have indicated that it can take up to six months to plan a live exercise for crisis management training in order to ensure that all of the elements are planned and in place to meet the objectives of the different organisations that are taking part. The training objectives for each organisation need to be included, and the different abilities of the trainees must be taken into account. The exercise must also be planned to include sufficient variation to ensure that the events are not predictable to the trainees. By simplifying the planning, a major hurdle to conducting frequent training exercises is removed.

The introduction of virtual environments also brings with it the possibility of new functionality for the instructors to support them in the exercise planning (Beroggi, 1995).This level of planning support, integrating the events in the scenario with training objectives, competencies, and variability for individual trainees is not a common feature today. This is currently being explored in the CRISIS project, where a virtual environment for training crisis management is being developed.

The project is developing tools to enable the configuration of adaptive and flexible training environments (Field et al., 2011). Different types of scenarios can be built from the same building blocks by including the ability to increase the complexity by configuring details in the scenario, changing the order in which events appear and the unpredictability with which they occur. This enables the instructors to configure events around particular training objectives and competencies and helps them to tailor each exercise to the needs of the trainees. It also enables an event in an exercise to be configured to meet the training needs of trainees on different skill levels, the novices as well as the experienced crisis manager. The research that is being carried out is investigating the level of support that instructors require (Rankin et al., 2012), and addressing the question of how this support can be provided for crisis management exercise planning in a virtual environment. Can additional planning and support tools be included in a virtual training system to ease the set-up of training exercises? Is the planning tool reducing the exercise preparation time for the instructors?

This paper describes the design criteria for the planning element of the instructor tools. While the initial version of the planning tool has been completed, it is still under development and will be evaluated by instructors and crisis management personnel in the coming months.

METHOD

The design phase for the virtual training system consisted of workshops with experienced instructors and representatives from 12 crisis management organisations from airports, police and rescue services across three different EU countries. These organisations are responsible for training their personnel to respond to crises such as aircraft accidents, railway accidents and security incidents such as bomb threats. The workshops combined structured discussions and group interviews to determine the requirements of the instructors for a crisis management training system. In total six workshops were held over a six month period. Between the workshops the information was used to develop mock-ups and basic prototypes that were used as the basis of the discussion for the next workshop. These mock-ups were also developed to describe functionalities that would be available in a virtual training system that are currently not available in live exercises for example. This method was used to ensure that the eventual users of the system were closely involved in the identification and definition of the system requirements and could provide feedback throughout the process (Rankin et al., 2011). The workshops identified that the key planning aspects for the instructors were: simpler, faster planning of exercises, ability to re-use exercise plans, access to training objectives and competencies during the planning, ability to use exercise plans for either virtual or live exercises, and the ability to plan and store exercises offline from the virtual training system.

DEFINING TOOLS TO SUPPORT THE INSTRUCTOR

The tools that have been designed include functionality in all areas of the instructor tools including planning, exercise control, monitoring and the after action review. The focus of this paper is, however, the exercise planning functionality. It outlines the areas of the development of virtual environment support that are novel compared to the existing situation for the planning of live crisis management exercises. Our analysis is based on the current situation at the organisations that were involved in the research workshops.

Exercise Planning

The planning of an exercise can currently take a significant amount of time – up to six months for a single exercise. By using a virtual training environment the intention is to simplify and reduce the amount of planning that is required for a team exercise. This is achieved through the definition of basic scenarios that can be re-used, and varied to meet the training objectives for different exercises and trainees.

A basic scenario might define the type of crisis – e.g. an aircraft accident – and the essential parameters of the exercise, such as the number of casualties, the nature of the accident, the location, and the organisations involved. However, there are a large number of variables that affect the complexity of the exercise and that need to be tailored to the trainees for each virtual exercise. The scenario consists of several events that can be varied and scheduled within the exercise. The database outlines each event, the aspects of the event that can be controlled, and how the events are included in the basic scenario timeline (Figure 1).

Figure 1 Mock-ups illustrating the basic scenarios.

This scenario can then be re-configured by the instructor to meet the requirements of the new exercise. This requires advanced planning facilities to ensure sufficient definition of the objectives, the exercise events, control and measurement parameters.

Defining the exercise

The planning tool is available offline from the main training system to enable instructors to put together exercises without the full system, or while the system is being used for other training exercises. Through the use of a library of exercises the intention is that the process of defining a new exercise is simplified. A new exercise can then be assembled from the basic outline of a previous exercise, or through combining elements of previous exercises. The library of exercises also includes references to the competencies that are, or can be, trained by each element of the exercise, based on the experience of the instructors' and analysis of past exercises. This enables the instructor to see which competencies have been covered as the exercise is put together. It also allows the instructor to decide to train a specific competency, and therefore select from a sub-set of exercise elements that would train that competency. This interrelation between the events and actions in an exercise, the training objectives and competencies enables instructors to quickly identify which areas of an exercise need to be tailored to meet the requirements of a new trainee.

For example, a weather event that could be included in the exercise is the change of wind strength and/or direction. This event affects the way in which the fire will develop, and the smoke will spread. It impacts not only the fire & rescue team, but also the medical team and potentially other personnel at the accident site. The event can therefore be tagged as having an impact on several team roles, and with relevant competencies for each role. For the fire officer this would exercise their observation, assessment and decision making competencies.

This database of exercise elements, or building blocks, with references to the competencies and training objectives is built over time as more exercises are carried out. The advantage of the planning system is therefore realised as the system is used. It enables an exercise to be planned based on the training objectives, the competencies to be trained, or on events. In all cases a complete overview of the exercise can be produced by the system. The output of the planning tool can be defined as a plan that can be used by the instructor during the exercise. If required, a script can be produced based on the particular events for the role-playing participants that are part of the exercise team.

As the exercise is put together from these different building blocks, the planning tool also identifies the parameters of this event that can be varied in the exercise, and the information that is required to monitor the performance of the trainees.

Defining control parameters

While an exercise plan is intended to define the exercise and how it will develop, there is a requirement for instructors to be able to control and vary the exercise once it is under way. The exercises need to be flexible to be able to achieve the optimal effectiveness (Rankin et al., 2012). In a virtual environment this can be simpler to control than in a live environment, since an instructor can be given control over a large number of the variables in the exercise. The variation in an exercise is intended not only to ensure that trainees do not experience the same exercise during multiple training sessions, but also to be able to adjust and tailor the exercise to the trainees' actions as required. In order to enable this variation in the exercise, the parameters that can be varied need to be defined at the planning stage. The planning tool therefore needs to indicate which parameters could be varied, for each exercise element.

Figure 2 is an illustration from the tool that is being developed which shows the scenario timeline, and the attributes that are available for the instructor to configure. On the left side of the screen there is an overview of the scenario parameters. This panel includes the execution control parameters for the events that the instructor defines in the planning to be available when the exercise is running. This screenshot also illustrates the translation of the mock-ups from the workshops, to the initial design that is being implemented.

During the exercise the instructor can control events and aspects of the exercise to ensure that the exercise maintains its training objectives. Returning to the wind example to illustrate this, the wind direction and strength can be defined in the planning to vary during the exercise so that to the trainees it is unpredictable and presents challenges to their skills. However, if, once the exercise is under way, it becomes clear to the instructor that the wind strength is severely affecting the ability of the trainees to carry out their task such that the key training objectives are not achieved, the instructor can intervene and adjust the wind strength accordingly.

Another example is the "activation" time for events in the exercise. The exercise timeline enables instructors to plan specific events taking place at allocated times in the exercise, though some flexibility in the timing may be desirable. Many current exercises are relatively rigidly scripted and instructors have indicated that some flexibility in when the events take place would be desirable. Therefore in the planning stage a range of time where an event would take place is defined, and this can be adjusted once the exercise is under way.

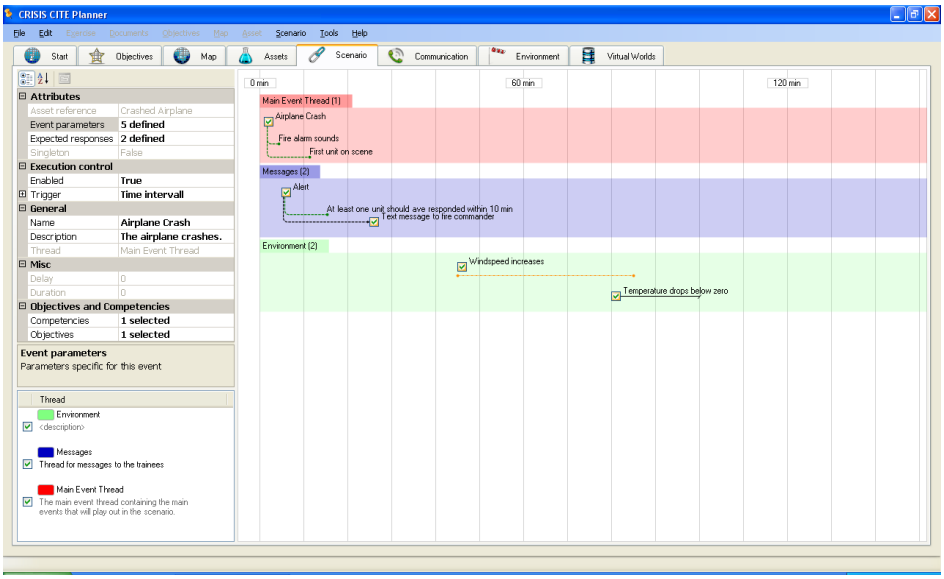

Figure 2 Illustration of scenario planning interface

Defining performance measurement parameters

The final stage of the planning for each exercise element is to define the performance measures that can be used to determine whether or not an event has been handled appropriately by the trainees. The nature of crisis management is that it is often difficult to define precise performance measures, but instructors have indicated that often expected outcomes can be identified in advance. These parameters are used both during the exercise and after the exercise to assess the trainees' actions against the training objectives.

In the example of the wind during the exercise, the expectation of the instructor would be that as the wind direction changes, the fire and rescue crew move their fire-fighting equipment to be able to ensure that they are upwind. Similarly, the medical team would monitor the weather to ensure that where they are working is not affected by the smoke from the fire, and that the casualties are sufficiently sheltered. The instructor can therefore define what the response of each trainee would be expected to be. These expectations contribute towards a "target" timeline for the exercise, alongside the timeline of the exercise events. This could include the time that the fire should have been extinguished by, given the weather conditions, and the time that the medical team would be expected to move to an alternate location.

The definition of performance measures is also used to define what is recorded by the system during the exercise. In live exercises a team of observers is required to record the activities of the crisis management team, and the effect of their activities on the development of the crisis. In a virtual training environment, many of the observations can be recorded automatically by the system. The application of a virtual environment based training system has the advantage that it is easy to collect data during the training, however, this data must be processed and analysed into useful information for the trainees. Indeed, it may be the case that too much data is available from the system. It is therefore important to ensure that the system provides tools to assist the instructor in identifying the data that is important to debrief each trainee, and the crisis management team as a whole (Kovordanyi et al., 2012). By defining the performance parameters during the planning, these can be prioritised in the data collection and filtered during the analysis by enabling instructors to identify the particular areas of interest in the exercise data.

Monitoring the trainee's performance during the exercise allows the development of additional support for the instructors, comparing the "target timeline" to the trainee performance in real-time. If the exercise is running off track, the system can alert the instructor that there is a significant deviation. This gives the instructor the option to intervene and correct the exercise, or to let events run their course as part of the training. It has also been noted by the experts that additional events from the planning database, may be required to be inserted in an exercise while it is running to ensure that the exercise meets its objectives. Therefore the planning phase needs to include those events which are available to an instructor to insert.

As part of the development, it is envisaged that a basic automatic analysis would be possible to enable the training of a crisis management team remotely from the instructor. The system can produce a simple report for each trainee that includes their individual training objectives, the timeline of their actions and the exercise

events and the performance measures recorded by the system. Dependent on the amount of information entered in the planning stage by the instructor, a comparison between the trainee's actions and the target actions could also be included. This gives the trainee direct feedback on their performance, and forms a useful basis for debriefing, particularly when the instructor is remote from the trainee. In the future it would be possible to include the analysis facility to an organisation's Learning Management System and future training exercises, to further improve the training cycle.

FINAL REMARKS

The preliminary response of the end-users to the designs that were developed from the workshops was very positive. The need for simplicity of being able to set-up, and adjust, an exercise using the tool was emphasised. It was felt that this would enable the desired saving in planning time. The planning tool would also give the instructors the ability to tailor exercises to trainees of different abilities, as was identified in the design requirements. The instructors welcomed the facilities that are being developed as part of the instructor support toolset for the virtual environment. The evaluation of the initial designs will be carried out in the coming months, which will provide feedback for improvements as the development is completed. The introduction of a virtual training system is seen as an opportunity to evaluate the potential enhancements that this could bring to the instructor feedback and training effectiveness as a whole. This development work is still ongoing, and usability reviews of the system will be held to refine the tools. The final stage of the development is training and evaluation sessions with crisis management teams.

ACKNOWLEDGEMENTS

The authors and project team would like to thank the representatives of the end-user organizations that contributed to the definition of the requirements: ISAVIA and the Icelandic emergency services, British Transport Police and ANA and the Portuguese emergency services.

The research for this study was carried out under the CRISIS project, funded by the European Commission's FP7 Framework Programme for Security Research, Grant Agreement Number FP7-24247.

REFERENCES

1. Beroggi, G. (1995). Employing virtual reality to support decision making in emergency management. *Safety Science*, *20*(1), 79-88.
2. Field, J., Rankin, A., Pal, J. V. D., Eriksson, H., Wong, W., & Science, I. (2011). Variable Uncertainty: Scenario Design For Training Adaptive and Flexible Skills. *Proceedings of European Conference on Cognitive Ergonomics*. Rostock, Germany.
3. Kovordanyi, R., Pelfrene, J., Rankin, A., Schreiner, R., Jenvald, J., Morin, M., & Eriksson, H. (2012). Real-time Support of Exercise Managers' Situation Assessment and Decision Making. *Proceedings of ISCRAM2012*. Vancouver, Canada.
4. Rankin, A., Field, J., Kovordanyi, R., & Eriksson, H. (2012). Instructor's Tasks in Crisis Management Training. *Proceedings of ISCRAM2012*. Vancouver, Canada.
5. Rankin, A., Field, J., Kovordanyi, R., Morin, M., Jenvald, J., Eriksson, H., & Science, I. (2011). Training Systems Design: Bridging The Gap Between User and Developers Using Storyboards. *Proceedings of European Conference on Cognitive Ergonomics*. Rostock, Germany.
6. Raybourn, E. (2007). Applying simulation experience design methods to creating serious game-based adaptive training systems. *Interacting with Computers*, *19*(2), 206-214. doi:10.1016/j.intcom.2006.08.001
7. Walker, W. E., Giddings, J., & Armstrong, S. (2011). Training and learning for crisis management using a virtual simulation/gaming environment. *Cognition, Technology & Work*. doi:10.1007/s10111-011-0176-5